PROCEEDINGS OF THE INTERNATIONAL FISHING INDUSTRY SAFETY AND HEALTH CONFERENCE

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2000

Foreword

Few jobs are as dangerous as that of commercial fishing. Commercial fishermen work in harsh weather, often at great distances from emergency medical care or rescue services. They must often combat external risk factors- extreme temperatures, the constant movement of their vessels- while at the same time, they face the challenges of fatigue and physical stress.

Preparation, and use of proper equipment, can go a long way to help commercial fishermen withstand the rigors of their work. NIOSH research indicates that fishermen who wear Personal Floatation Devices are far more likely to survive vessel sinkings or capsizings. Vessels that maintain emergency equipment such as life rafts, electronic beacons, and immersion suits in good working order help to ensure the survival of their crew. While many of the safety measures that have been implemented in the past decade for commercial fishermen in the U.S. are due to requirements from the Commercial Fishing Vessel Industry Safety Act, other safety measures have been implemented as a result of innovation from commercial fishermen and vessel and equipment manufacturers throughout the U.S., and around the world.

The findings in this document represent health and safety recommendations for commercial fishermen, from some of the most knowledgeable researchers in the world. This proceedings volume contains articles from commercial fishing safety experts from the Nordic Nations, United Kingdom, Argentina, Canada, Israel, and other areas, as well as articles from researchers throughout the United States. It is our hope that the common interests that were identified at the International Fishing Industry Safety and Health (**IFISH**) Conference in Woods Hole, Massachusetts in 2000 continue to help forge collaborative networks and joint research, as we work together to improve safety for commercial fishermen around the world.

John Howard, M.D.
Director
National Institute for Occupational Safety and Health

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We are grateful for the editorial comments made by Ann Backus, Harvard University School of Public Health, and the photographs and captions that were graciously provided by Earl Dotter. We think that his work sheds light on the dangerous work settings that commercial fishermen face every day.

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Public Health Summary

What are the hazards?

Fishing is one of the most dangerous jobs in the world. The International Labor Organization (ILO) and Food and Agriculture Organization (FAO) estimate that seven percent of all worker fatalities occur in the fishing industry, despite the industry accounting for less than one percent of the worldwide workforce. The occupational fatality rate for Alaskan and U.S. commercial fishers was 140/100,000 per year (1991-1997) and 168/100,000 per year (1994-1998), 32 and 38 times the overall U.S. occupational fatality rate (4.4/100,000 per year, NTOF, 1990-1994), respectively. In countries as distant as Australia, Denmark, Finland, Korea, and Sweden, occupational fishing fatality rates range from 16 to as much as 79 times higher than the respective countries' overall occupational fatality rate. The ILO has estimated that the fishing industry experiences 24,000 deaths and as many as 24 million non-fatal injuries each year worldwide. The fatality rate for the world's fishermen is estimated to be 80/100,000 workers/year (ILO estimate).

How can a worker be exposed or put at risk?

Commercial fishermen are exposed to environmental risk from the elements, including ocean water, inclement weather, and extreme temperatures. They are also vulnerable to injuries from equipment, and from unstable work platforms on the fishing vessels.

What recommendations has the federal government made to protect workers' health?

In the United States, the Commercial Fishing Industry Vessel Safety Act of 1988 was enacted to protect the health and safety of commercial fishermen in the US. The act requires, among other provisions, that fishing vessels carry various types of survival equipment. The Coast Guard is charged with enforcing those requirements. NIOSH has worked closely with the Coast Guard and other agencies and organizations to identify and address risk factors for death and injury in the commercial fishing industry. The proceedings here reflect extensive safety recommendations, projects and programs that have been presented and disussed at workshops like the Second National Fishing Industry Safety and Health Workshop in 1997, and the International Fishing Industry Safety and Health Conference, where these papers were first presented.

Where can more information be found?

The references cited by articles in this document will provide a useful inventory of published reports and literature. Additional information from NIOSH can be obtained by calling the following number or visiting the NIOSH website www.cdc.gov/niosh.

1-800-35-NIOSH
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Executive Summary

In October 2000 more than 100 fishermen and safety professionals from 13 countries gathered to discuss fishing vessel safety. Papers were presented and discussed, experiences shared, and contacts made or renewed. We hope that attendees were inspired by others' work and returned invigorated, to their projects or programs.

One major accomplishment of any conference is to publish the papers presented so that findings can be shared with other colleagues. The papers in this volume establish a foundation upon which to build new projects and programs. Forty-eight papers were presented at the conference, 43 of which are published here. (Five presenters were unable to submit their papers for publication.) We thank all of the presenters and authors for their contributions at the conference and to this proceedings volume.

Few occupations are as challenging to the worker's safety as is that of commercial fishing. Fishing vessel safety is a complex interaction involving human (skipper, crewmember, owner), machine (vessels, equipment), and environment (weather, management scheme). Safety problems can occur when even a single element- human, machine, or environment- malfunctions. Human factors include fatigue, inexperience or non-use of safety equipment. Machine factors include older vessels and inadequate safety guards for heavy machinery used in many fishing operations. Environmental factors include harsh weather and slippery and unstable work surfaces. While reviewing the papers in this volume, it became very clear that there is no universal solution for fishing vessel safety. There is a real need to explore strategies to prevent fishermen from being injured or killed on the job through efforts such as improving vessel stability and hull integrity, making safety equipment such as survival suits and life rafts more widely available, further education and training, implementing safer management regimes, understanding and heeding weather information, averting falls overboard and addressing industrial safety problems that exist on board many fishing vessels.

One of the challenges of improving safety on commercial fishing vessels is identifying plausible solutions to safety that neither hamper the ability of workers to fish nor diminish the quality of the catch. Within this volume there are interventions presented that meet these criteria. Readers will learn about efficient design of vessels, and how individual fisheries can accommodate a variety of vessel designs while safely pursuing their work. We note that many of the programs described in this volume strive to work in partnership with local fishermen to provide safety inspections and crew survival training. Technology has been able to help many fishermen in European and North American areas to obtain more accurate weather forecasts and to avoid hazardous fishing areas. Ultimately, most successful interventions rely on prevention; training, retrofitting, equipping with new technology are all things that a fisherman does before he leaves port. In many cases, these workers are much too far from help, when trouble occurs- the best interventions are those that prevent, or at least plan for worst-case scenarios well in advance.

IFISH attendees returned home filled with new ideas and a new sense of purpose about what can or should be done to improve the safety of fishermen in their communities. We hope this document continues to motivate people to make a difference. Even though fisheries and fishing boats vary around the world, all fishermen have one thing in common— they put their lives at risk every time they go to sea.

Jennifer Lincoln
Diana Hudson
George Conway

Monday, October 23, 2000

PROGRESS IN PREVENTION
OPENING SESSION

Photograph by Earl Dotter

Throughout the world, fishermen work long hours, in dangerous conditions. Progress has been made in the prevention of injuries to fishermen, but much remains to be accomplished.

PROGRESS IN PREVENTION AND RESPONSE IN FISHING VESSEL SAFETY

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Jim Herbert has fished commercially in Alaska for twenty-five years. During that time he has fished for nearly all species of finfish and shellfish with a broad variety of gear and aboard many types of vessels. He holds a Master's license from the U.S. Coast Guard and a Merchant Mariner's Document. Over the years he has served as member and chairman of the Homer Fish and Game Advisory Committee. He currently serves on the Alaska Fishermens Fund and the Alaska Marine Safety Education Association's Board of Directors. Jim is an original member of the U.S. Coast Guard's Commercial Fishing Industry Vessel Safety Advisory Committee and current Chairperson. During the school year he teaches marine and fisheries classes at Alaska Vocational and Technical Center in Seward, Alaska.

Fishing is a global industry and in coastal waters has a history as long as mankind. According to estimates by the Food and Agriculture Organization of the United Nations (FAO), more than 15 million persons are employed aboard vessels that target marine fisheries. As might be expected, most fishermen work on vessels less than 24 meters. The vast majority of the world's fishing vessels weigh under 25 gross tons (GT) and better than half of the fleet is more than 20 years old. The FAO estimates that half of the world's seafood is caught or otherwise collected by small-scale fishermen operating millions of small fishing craft. For example, in the United States there are an estimated 80,000 fishing boats of less than 10 meters in length, and among the Pacific Islands there are over 40,000 small-scale fishermen at work [ILO 2000].

These are the harvesters of the seas, the people who provide food to consumers. For many people in both the developed and developing countries of the world, fishing is not simply a job, but a way of life with its own traditions and values. It is a culture of its own. To be most effective in dealing with the fishing industry, we must understand the culture that surrounds commercial fishing in each country and region.

You have a sense of what is important to an individual by seeing how they devote their time and energy. When you talk to people in the industry and look through trade journals at the issues that matter most to commercial fishermen around the world, safety will not be at the top of their list. The big issues are gear conflicts, allocation issues, and the health of fish stocks. Contentious management schemes and endangered species are issues that generate a lot of attention. In short, outside of catching fish, what matters most in the professional sense are the politics and economics of the industry. Does this mean that these people don't care about safety? Some may be scofflaws who don't care about a better, safer way to do business. I would venture to say that the vast majority of individuals, if they are not convinced personally of the usefulness and economic merits of running a safe operation, at least feel the threat of enforcement if they do not comply with the minimums set out by laws. I believe that even though safety is not the burning issue that gets fishermen riled up and excited, it is very much there in the background and has increasingly become part of the way most fishermen conduct their operations. Here in the United States, since the Commercial Fishing Industry Vessel Safety Act of 1988, the statistics show a sizeable decrease in fatalities and a reduction in the loss of vessels [USCG 1999]. More importantly there has been progress in the industry's attitude toward safety in general. Does this mean we have arrived? Certainly not. We all know the statistics and incidents that point out that there is room for improvement. Each one of us has her or his idea of the best way to get further improvements.

Those in the fishing industry make their living harvesting marine resources to supply consumers, but it is far from a homogenous group. Here in the United States, as in many parts of the world, fisheries have a very regional nature. The lobsterman in Maine deals with different problems and situations compared with a shrimper off of Texas compared with a tuna seiner in the Western Pacific. This makes the 'one shoe fits all' approach so commonly seen in legislation so difficult to effectively bring into practice. The diverse and regional nature of the commercial fisheries will always make enforcement of laws and policies difficult. This suggests that to be most effective we must tailor our efforts at the regional level.

A frustrating matter for safety advocates all over the world is the limited amount of resources dedicated to fishing vessel safety. For example, in the United States the USCG is the primary agency officially tasked with enforcement of vessel and fishery laws. They are also the people called upon to perform search and rescue missions. They seemingly have responsibility for "everything wet" and like a sheet of rubber are constantly stretching finite resources ever thinner to cover federal mandates. Of necessity, they must carefully analyze how best to deploy their limited resources such as manpower, money and machinery. This is where careful data gathering and analysis will determine by region, fishery, and vessel type what are the high-risk targets, and aim the limited resources appropriately. Again this puts the focus on regional matters.

There are several areas where positive changes have occurred in the fishing industry in recent years that have had a favorable effect on safety. Similarly, trends indicate what might need continued attention in the future.

Communications: Getting and sharing information is vital to any professional. We know that fishermen are very keen on radios. Nowadays small waterproof VHFs are cheap and effective. What seems to have gained great importance in the fleet are cell phones. The USCG has been able to rescue several crews after receiving a cell phone call from folks in a life raft. The most recent innovation that is showing up even in smaller coastal vessels is satellite phones. While not being able to get the MAYDAY message out to anyone within radio range like a VHF and HF, these phones give very reliable long distance communications to other vessels and land stations. I have little doubt that in the years ahead we will see cheaper and more effective use of this technology. In addition, ADM Loy recently promoted the National Distress Response System Modernization Project before a Senate committee. This system could certainly take much of the search out of search and rescue. The British Columbia coast has seen the benefits of this type of radio network.

EPIRBS and now GPIRBS have done much to facilitate rescue of people in distress. Currently there are over a million units in use worldwide with over 220,000 using the 406 MHz frequency [Tewel 2000l]. With a properly donned immersion suit and properly activated EPIRB, the odds of rescue in coastal waters are remarkably good. Yes, there are still false alarms, but in the larger picture this is a remarkable technology to alert others of a crisis and allow rescuers to find those in distress. As this technology becomes more common in the recreational and charter fleets, the potential for increased false alarms may lead to different response mechanisms by rescue services or other vessels.

As the 121.5 MHz frequency is phased out in a few years, we may see new frequencies adjacent to 406 MHz dedicated to this type of radio alerting.

Weather forecasting: The science of meteorology has improved through the years. Geo-stationary satellites and weather buoy information combined with science provide better forecasts than ever before. That is not to say that Mother Nature doesn't reserve the right to change her mind and confound the experts. The program utilized by the National Weather Service to have at-sea vessels report actual conditions to meteorologists further increases the accuracy of 12 and 24 hour forecasts.

It is wonderful that real time imagery and updates are available at sea through the Internet, on some vessels. A few large vessels subscribe to private weather services. People who have spent any time at sea know that tuning in the high frequency or VHF weather forecasts is a very important ritual on nearly every vessel. Knowing what the weather is likely to do gives a person information to make better decisions about fishing or heaving to or heading to safer waters. Information is power and this is a perfect example.

Management: We can continue to focus attention on fishery management decisions that effect safety. The National Standard 10 of the Magnuson-Stevens Fisheries Act requires the American Regional Fishery Councils to consider the impact on safety of any plan before them. It should be pointed out that this is only one of many standards that must be taken into account. Often the issues before these councils are extremely contentious and individuals, communities, and companies have much at stake. The situation that currently exists in New England waters illustrates the great difficulty in making decisions that move toward consensus among stakeholders and still meet the mandates of regulations and laws.

The Mid Atlantic Fishery Management Council (MAFMC) took an aggressive stance in 1999 by unanimously passing a resolution that stated: "The MAFMC hereby resolves to ensure proposed fishery management plans do not negatively impact the safety of commercial fishing vessel operations." Moreover, the MAFMC recognizes that all fishery management plans should be developed so as not to place fishermen in an environment where they must unduly hazard themselves in order to remain economically viable. A council member who is a commercial fisherman initiated this resolution and it received unanimous support from his colleagues [Ruhle 2000].

Each Council has a U.S. Coast Guard (USCG) officer as a non-voting advisor. They can provide advice and insight on the safety implications of council actions.

The Individual Fishing Quota (IFQ) program was put in place in 1995 in the North Pacific to address the problems created by the overcapitalization of the sablefish and halibut fisheries. Problems included short "derby" openings (in most areas, openings lasted less than a week, sometimes for only two 24-hour periods a year). Safety concerns were also cited as one of the many problems that needed attention.

Halibut safety statistics demonstrate that the new system has been successful in this arena. Since the system was implemented in 1995 there has been an average of 10 SAR missions per year compared to an average of 28 per year in the last three years of derby fishing. The past five years have averaged 1.2 sinkings per year compared to 2 per year during the derby fishery. Since the IFQ program, 1.2 lives have been lost per year compared to 2 per year during the last three years, although each season is characterized by short intense openings [IPHC 2000].

Simply stated, fishery management is a very complicated matter, but it is foolish to make decisions that invite or encourage risk-taking on the part of fishermen.

Training: Enforcement and punishment stops bad behavior but does not necessarily change a person's attitude. It is very difficult to change the way someone thinks about something, especially if they have been doing things a particular way for a long time.

This is the area where training can have the greatest impact. It is one thing to have someone sit in a classroom, tell them what is wrong, and tell them how to do it better. Unless they are convinced that you are right, the odds are slim that they will do anything different once they get back on their boats. Training must be credible. If the instructor doesn't understand the industry or fisherman's problems, the students may not only reject the instructor and this class, but also be soured on training altogether. The most successful training organizations try to use experienced and knowledgeable instructors to gain the most positive effect.

While many nations have legal mandates and incentives for training, there can still be resistance. Training takes time and money. This can interfere with actual fishing time, boat chores, and may keep fishermen from spending time with family and friends. Accessibility to training courses and their cost is a common concern of working fishermen.

The good news is that most industry members who go through a high-quality training program leave with new ideas and skills that they begin to integrate into their operations. This training may give them the ability to respond to emergencies aboard their vessels and builds a body of knowledge and skills to prevent those emergencies from happening in the first place. This is the emphasis on prevention and response that is so important.

Advocacy Groups: Fisherman's Wives organizations like those in Gloucester, Massachusetts, Newport, Oregon, and Kodiak, Alaska have helped emphasize the importance of training and safety in general to parts of the fleet. If a captain is not concerned enough about safety, who has a greater investment in safety than the woman and children he may leave behind if he perishes at sea? If he loses his vessel and their business is lost, we know who will suffer the most – certainly not the banker or the cannery. If a crew person is injured or disabled at sea, this person not only pays a price with lost income, but also with readjustments and rehabilitation down the road. So it is a strong force for change to have the families of fishermen aware and committed to the matter of safety. Those who have the greatest investment or would suffer the greatest loss should have the greatest involvement. This helps further a change in attitude.

Friends and members of the fishing industry should seek to help solve its problems. We can start with the fact that fishing takes place in an environment that is often hostile. When you are at sea, even in relatively calm weather, the motion of the ocean is a constant factor. In severe weather work or even basic movements become difficult and fatiguing. We know it is a profession associated with higher than average risk. We must be careful not to over-simplify commercial fishing. This can lead to resentment by fishermen, not to mention ill-advised legislation and regulation. We know fishermen rely on their vessels for their livelihood and their survival, and that risks vary by region, fishery, and vessel.

We have made progress in making the fishing industry safer. There has been analysis of vessel related factors including stability and watertight integrity, material condition of vessels, or lack of safety equipment. People have examined behavioral factors such as fatigue, unsafe practices, and judgmental errors. The solutions that have been suggested will provide strategies that can prevent fishermen from being injured or killed. Other ideas will help reduce vessel casualties.

Still, finding the right balance of action and responsibility by individual fishermen, vessel owners, and regulators is a question to be worked out by each country and region. Ultimately, what we are trying to do is promote a change in the attitude of fishermen that makes the prevention of injuries, accidents, and losses the goal. If prevention fails, what we strive for is the ability of the individual and the system to provide an effective response. We can work toward solutions. I hope we can change people's minds about prevention and response. What we can do, we must try and do.

REFERENCES

International Labor Organization [2000]. Report on the safety and health in the fishing industry. http://www.ilo.org/public/english/dialog/sector/techmeet/tmfir1.htm

International Pacific Halibut Commission [2000]. Annual Report of the International Pacific Halibut Commission, 1999. IPHC Staff and Krys Holmes, Winterholm Press.

Ruhle J [2000]. Personal communication with Member Mid-Atlantic Fishery Management Council.

Tewel L [2000]. Boating: Don't find yourself with outdated emergency radio location device. Seattle Post Intelligencer Oct 11 2000. http://seattlep-i.nwsource.com/sports/boat11.shtml

United States Coast Guard [1999]. The Fishing Vessel Casualty Task Force Report.

Monday, October 23, 2000

WORLDWIDE PROBLEMS AND CHALLENGES IN THE INDUSTRY

Photograph and caption by Earl Dotter

"The wave made such a roar that the first mate shouted out to the rest of the crew, 'I'm going over,' meaning that he thought he was going overboard. Crouching down to reduce the force, another man was tossed four times toward the port side, but managed to stay in the boat. Another man threw his sharp knife in the corner to avoid being tossed with the lethal tool in his hand. Yet another crew member surfed with the wave, managing to grab hold of the netting in his path."

SAFETY AND HEALTH IN THE FISHING INDUSTRY: AN ILO PERSPECTIVE

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Brandt Wagner graduated from the United States Merchant Marine Academy in 1981, after majoring in Marine Transportation and Marine Engineering and obtaining Merchant marine deck and Engineering officer licenses. At sea, he sailed on research and commercial merchant ships, the latter as a member of the International Organization of Masters, Mates and Pilots. He left the sea to work for a major shipping line and then left the shipping line to work for shipping and private port interests in Washington, DC. This was followed by work with a marine and environmental consulting firm, including a period in Valdez, Alaska during the Exxon Valdez spill response. In 1990, Mr. Wagner became an official with the International Labour Office in Geneva, Switzerland. He has since been occupied with international efforts to improve the living conditions of seafarers and, more recently, fishermen. He was involved in the revision of the FAO/ILO/IMO Document for Guidance on the Training and Certification of Fishing Vessel Personnel. In 1999 he served as the Executive-Secretary of the ILO's Tripartite Meeting on Safety and Health in the Fishing Industry, and was responsible for the report used as the basis for discussion at the meeting. Prior to IFISH he represented the ILO at the Joint FAO/IMO Ad Hoc Working Group on Illegal, Unreported and Unregulated Fishing and Related Matters.

SUMMARY

The International Labor Organization (ILO) held a Tripartite Meeting on Safety and Health in the Fishing Industry in December 1999. This paper describes the Meeting in the context of the ILO's principles and objectives, reviews the report prepared by the ILO secretariat for use as the discussion document, reports in detail on the conclusions reached by the international participants, and discusses how the ILO secretariat, in cooperation with others, can continue to contribute improving safety and health in the fishing sector. The paper deliberately seeks to draw the most attention to the negotiated text of conclusions reached by representatives of governments, employers and workers (fishermen) who attended the ILO Meeting.

THE CONTEXT OF THE ILO MEETING : WHAT IS THE ILO AND WHAT ARE ITS MAIN OBJECTIVES?

The ILO was founded in 1919 to bring governments, employers and workers' organizations together for united action in the cause of social justice and better working conditions everywhere. In 1946 it became the first specialized agency of the United Nations system. It is unique among other agencies in that it has a "tripartite" structure (its meetings, committees and conferences are attended not only by government delegates but also by delegates representing employers and workers). The ILO has 175 Member States. It has three main organs: the International Labor Conference, comprised of all Member States, which meets yearly; the Governing Body, which determines the agenda of the Conference and directs the work of the International Labor Office; and the International Labor Office, the permanent secretariat of the ILO. The ILO has forty field offices around the world.

The primary goal of the ILO today is to promote opportunities for men and women to obtain decent and productive work, in conditions of freedom, equity, security and human dignity. Decent work means productive work in which rights are protected, which generates an adequate income, with adequate social protection. The ILO has articulated four strategic objectives in order to pursue and achieve this goal. They concern promotion of rights at work, employment, social protection and social dialogue.

Each of these objectives may be considered relevant to the issue of safety and health of fishermen.[1] Rights at work are relevant to all fishermen who fear losing their jobs for raising safety concerns. Increased employment opportunities may not be directly relevant but may indirectly contribute to alleviate poverty and related health problems in remote coastal communities. The two latter objectives, concerning "social protection" and "social dialogue" are most directly concerned with issues to be discussed at the IFISH Conference. "Social protection" includes protecting the health and safety [2] of fishermen and providing medical, survivor and other benefits to fishermen and their families following an accidents or illnesses. The promotion of "social dialogue" means promoting and facilitating the sharing of information among government officials, representative organizations of fishermen and fishing vessel owners' organizations and developing consensus on policy approaches and practical measures to address safety and health issues.

A BRIEF HISTORY OF ILO'S WORK IN THE FISHING SECTOR

The conditions of work of fishermen were addressed by the ILO as early as 1920, with the adoption of a (non-binding) Recommendation[3] concerning the limitation of hours of work of all workers employed in the fishing industry (a subject which, eighty years later, remains controversial). This was followed by the 1959 adoption of Conventions on minimum age, medical examination and articles of agreement, and in 1966, Conventions concerning fishermen's competency certificates (a forerunner of the STCW-F Convention) and fishing vessel crew accommodation, and a Recommendation concerning the vocational training of fishermen.

The Committee on Conditions of Work in the Fishing Industry met in 1954, 1962, 1978 and 1988 to advise the ILO on its work concerning fishermen. The last session discussed systems of remuneration and earnings, occupational adaptation to technical changes in the fishing industry, and the social and economic needs of small-scale fishermen and rural fishing communities. The ILO has facilitated many other smaller meetings at the national level (e.g., Philippines) and has provided technical advice and support to several countries (e.g., South Africa, Philippines, Argentina, Vietnam, Sri Lanka).

Together with the International Maritime Organization (IMO) and Food and Agriculture Organization of the United Nations (FAO), the ILO has assisted in the preparation of several publications that are aimed at improving fishing safety and health of fishermen. These include: the FAO/ILO/IMO Code of Safety for Fishermen and Fishing Vessels, Parts A and B; the FAO/ILO/IMO Voluntary Guidelines for the Design, Construction and Equipment of Small Fishing Vessels; and the FAO/ILO/IMO Document for Guidance on the Training and Certification of Fishing Vessel Personnel. Other publications, such as the ILO/IMO/WHO International Medical Guide for Ships, include chapters related to fishing.

THE ILO'S TRIPARTITE MEETING ON SAFETY AND HEALTH IN THE FISHING INDUSTRY

One of the ILO's means of promoting "social dialogue" at the international level is through sectorial meetings. The Tripartite Meeting on Safety and Health in the Fishing Industry was selected as one of the twelve meetings for the

1998-99 biennium. It was agreed that the purpose of the meeting would be to:

Exchange views on safety and health issues in the fishing industry;

Assess work done by an FAO/ILO/IMO Working Group concerned with the revision of the Document for Guidance on Fishermen's Training and Certification;[4]

Adopt conclusions which identify follow-up activities and review ILO standards adopted specifically for fishermen; and

Adopt a report of its discussion.

It was further agreed that the meeting would be composed of eighteen participants from governments, eighteen worker participants and eighteen employer participants, as well as observers from certain inter-governmental and non-governmental organizations.

The ILO secretariat was instructed to prepare a report on safety and health in the fishing industry, including a list of discussion points to focus the participants' attention on the major aspects of the agenda. The secretariat therefore produced a report entitled '*Safety and Health in the Fishing Industry,*' which was sent out to all participants before the Meeting.[5]

THE DISCUSSION DOCUMENT PREPARED BY THE ILO SECRETARIAT FOR THE TRIPARTITE MEETING

In preparing the 100-page Safety and Health in the Fishing Industry, the secretariat decided not to go into great detail on any one aspect, such as vessel construction, qualifications or fisheries management, but to touch upon many safety and health issues so that the tripartite constituents would have the basis for a wide-ranging debate.

The report drew upon available international literature on safety and health in fishing as well as the experiences of several countries. It also included excerpts from several papers prepared for the ILO.[6]

The first chapter of the report provided a brief overview of recent developments in the fishing sector, including employment, production (catch) trends and economic, environmental and legal changes that had, or would have, a major impact on fishing operations. It also drew attention to issues of particular interest to the ILO, such as the employer-worker relationship, the share system, living conditions at sea, child labor and fishing, cases of abuse and conflict relative to fishermen and "social dialogue" in the fishing industry.

In the second chapter, we touched upon the special characteristics of the working environment in the fishing industry, the various ways in which injuries, deaths, and adverse events are measured and recorded, the fatality rate in various countries,[7] diseases and health problems, causes of accidents, training and risk awareness, culture and attitude, the influence of the share system and lack of a minimum wage, the right (or lack of the right) to refuse unsafe work, fatigue, economic and fisheries management factors, and insurance.

When gathering information on these issues, we were particularly struck by the variety of ways adverse safety events and injuries were reported. As we noted in the report:

> "There is not only a great variety in fishing operations but also a great variety in the way fishing safety and health problems are qualified and quantified. For example, deaths and injuries can be related to vessel casualties or to personnel accidents not involving loss or damage to the vessel; they may be attributed directly to one cause (drowning) or indirectly to other causes (capsizing of vessel, falling over the side). Accidents may be attributed to a primary event or an underlying or primary cause; they may be associated with certain types of fishing (trawling, long-lining) or to certain types of equipment (winches, fishing gear). The external environment may be seen as the cause (bad weather) or an accident may be attributed to the human element (inattention, fatigue, lack of training). Causes may be described in very general terms used for all professions (falling from height, slipping) or be specific to fishing (caught in trawl winch). They can be categorized under various headings, including by vessel size."

We had also surveyed certain medical practitioners and others working with fishermen's health and safety issues to obtain their views on work-related morbidity and accidents among fishermen, and the replies received were summarized and included.

In the third chapter, we discussed national measures to improve safety and health in the fishing industry, addressing such issues as regulation and alternatives to regulation, the roles of ministries and agencies, consultation and "social dialogue," research, training, raising awareness, inspection and risk assessment, the cost of regulation, small-scale and artisanal fishermen, medical fitness examinations, treatment and insurance, reporting and investigating accidents, and search and rescue. The chapter highlighted what seemed to us to be good examples of not only government but also non-governmental (industry) initiatives. We drew attention to the relatively limited regulation of small-scale and artisanal fishing in most countries.

In the fourth and fifth chapters, we reviewed efforts to improve safety and health in the fishing industry carried out at the regional and international levels. East and South-East Asia Regional guidelines covering vessels between 24 and 45 meters and Council Directives applicable to European Union Member States were described. At the international level, the Torremolinos Convention and Protocol,[8] the STCW-F Convention,[9] and several joint FAO/ILO/IMO publications were reviewed. This chapter also provided information on ILO standards for fishermen, as well as other ILO standards concerning occupational safety and health that may also be relevant to the fishing industry. Problems related to the collection of international statistics on occupational injuries in the fishing industry were noted.

The sixth chapter reviewed ILO standards concerning fishermen, as well as maritime and other labor standards that could be applied to fishermen. This information was provided to enable the participants to advise the ILO as to whether these standards should be revised, promoted or considered obsolete. This was part of a more general ILO review of all Conventions and Recommendations adopted before 1985.

The last chapter of the report included a summary (see below) and points for discussions in the form of questions to the participants e.g., what steps should be taken to promote the enforcement or application of existing laws, regulations and recognized good practices designed to protect fishermen? How can more reliable data on the incidence and severity of accidents and disease in fishing be collected and appropriate action for prevention and treatment be developed?

An addendum provided more detailed information on efforts to improve safety and health in the fishing industry in selected countries (Canada, Chile, China, Japan, Republic of Korea, Morocco, Nigeria, Norway, Philippines, Russian Federation, South Africa, United Kingdom and the United States).

SUMMARY

Our report revealed or confirmed that:

Fishing is clearly a dangerous profession. In many countries it has the highest fatality rate of any occupation. While vessel casualties are an important cause of death, there are also other major causes of death or injury. Fishermen also suffer from a number of work-related injuries and diseases.

Several studies have indicated that fatigue is a serious safety and health issue. Fatigue appears to be linked to the nature of fishing operations and to employment arrangements that create an incentive to work long hours and to minimize the number of crew members.

We found limited information on efforts at the national level to reduce fatigue in the fishing industry.

Lack of awareness of certain risks may also be an important concern for some groups of fishermen.

Most fishermen are well aware that fishing is a hazardous profession, but they may not be receiving timely and clear information on the link between certain acts or omissions and resultant deaths, injuries and illnesses. For some, a tendency to deny or downplay risks may also serve to filter out important safety messages and reduce the impact of safety initiatives.

Under-reporting of fatalities, injuries and diseases appears to be a problem in the fishing industry. Even when these are reported, the many different approaches to collecting information on their types and causes may make it difficult to produce comparable data and statistics and thus make it difficult to identify and then address key issues. The nature of the employment arrangement in fishing, which may place many fishermen outside traditional occupational injury and disease reporting systems, also contributes to this lack of information.

Insurance should play an important role in improving safety and health in the fishing industry. However, it is not clear whether all forms of insurance adequately reward fishing vessel owners for having good safety and health records or for putting in place or improving accident prevention measures. The lack of insurance coverage for many fishermen is a serious problem.

The nature of fishing operations places fishermen far from immediate, professional medical care. Important issues include ensuring adequate and regular medical fitness examinations, first aid and other medical training for the crew; the carriage of adequate medical equipment and clear instructions on how to use it; access to shore-side advice by radio or satellite communications and means for the medical evacuation of seriously injured or ill fishermen. Despite improvements in medical care for many fishermen, there are some who do not receive sufficient care.

While most fisheries and fishing operations have common features, there are also many differences. These differences apply to safety and health issues, which may vary depending on the type of fishing, the size of the vessels and their equipment, the geographical area of operation and other factors.

While the information included in the report was not based on data from all ILO Member States, it appears that there are great differences in the scope and content of national laws and regulations concerning safety and health in the fishing industry. There are generally fewer safety and health requirements covering fishermen working on smaller vessels.

The informal nature of many parts of the fishing industry, and the co-adventurer status of fishermen related to their pay arrangements, may also affect the degree to which they are protected by laws and regulations concerning other workers. In some countries the industry, or at least portions of it, has developed a self-regulatory approach, partly out of concern over possible government regulation. It appears that there may be a slowly growing trend toward placing some larger fishing vessels in "open" registers, some of which have had historically high casualty and port state control detention rates for merchant ships. This may in part be done to avoid safety and other regulations.

The safety and health of fishermen can involve a wide range of national and regional ministries and agencies. In some countries fishing safety, especially as it relates to vessel safety, is primarily the responsibility of the ministry or agency responsible for marine safety; in others it is the ministry or agency responsible for agriculture and/or fisheries that has the lead role.

Occupational safety and health agencies have an important part to play. While in some cases there appears to be regular coordination among these ministries and agencies, this does not always happen.

The degree to which fishing vessel owners, representatives of fishermen and other interested and relevant parties are consulted on fishermen's safety and health issues, and the method of consultation, may vary. Some national and regional bodies involve not just the social partners, but also non-governmental organizations, insurers, designers, builders, equipment manufacturers, fishermen's wives and families, training and research institutions and others. However, it does not appear that such broad consultation is universal.

Research and training institutions in several countries are carrying out substantial research on safety and health in the fishing industry. It is unclear whether and how this information is being regularly and efficiently exchanged among these institutions. There appears to be a substantial amount of high-quality training and awareness material (pamphlets, books, videos, etc.) produced in some countries that might be easily modified for use in other countries.

Some countries have extensive training and certification schemes for fishermen, often reflecting the provisions of the ILO's Fishermen's Competency Certificates Convention, 1966 (No. 125), and Vocational Training (Fishermen) Recommendation,1966 (No. 126), and more recently those of the IMO's International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, 1995 (STCW-F), as well as the 1985 FAO/ILO/IMO Document for Guidance on Fishermen's Training and Certification. However, the focus of many training programs appears to be on skippers and senior officers. Training programs for crew members and for small-scale or artisanal fishermen seem to be limited, though some countries have established impressive apprenticeship programs.

It appears that a good portion of the world's fishing vessels may not be regularly inspected, particularly not for occupational safety and health aspects. This may be related to limitations on resources and, in certain cases, to resistance from some fishermen due to cost and other concerns. Some innovative schemes have been developed both to reduce the cost and subsidize the purchase of safety equipment.

Artisanal and small-scale fishermen have, as groups, received comparatively little attention with regard to safety and health. This may be due to the remoteness of their communities, their lack of political and economic power to improve their situation, a lack of government resources and other reasons.

Some countries require some form of medical examination and medical certificate for certain groups of fishermen. Medical examinations and certificates appear not to be required for small-scale and artisanal vessels. The extent of the provision of medical care to this latter group of fishermen, as well as to their families, requires further consideration. This issue may be an economic as well as a "fishermen's health" issue, as the availability and cost of health care to the families of fishermen affects the viability of fishing employment and the viability of fishing communities.

In some regions efforts have been made to improve the safety and health of fishermen. In Europe, several Council directives have regulated, or are likely to regulate in the near future, such areas as vessel construction and equipment, minimum conditions for safety and health and medical treatment for European vessels. The work is obviously also affecting safety and health at the national level. There has been regional cooperation in the production, translation and distribution of training and other safety and health information. A recent initiative by a European trade union, in cooperation with fishing vessel owners, government officials, insurers and others, demonstrates the possibilities for regional social dialogue on safety and health issues.

While there are several international standards related to safety and health in fishing, it appears that the benefits of these standards may not be reaching the majority of the world's fishermen. This is because these standards have not been widely ratified and, even if ratified, may not have entered into force. These standards also may not fully address the needs of small-scale and artisanal fishermen. This is, however, partly due to the inability to reach international agreement on safety standards for small-scale and artisanal vessels.

Codes, guidelines and other publications produced by the FAO, ILO and IMO, often jointly, may be contributing to the improvement of safety and health in the fishing industry. In some countries, the content of these publications is reflected in national regulations and practices. However, most are nearly two decades old and may require updating. The IMO has initiated work to revise some of these publications, and this may present an opportunity to make substantial improvements. It may also permit the inclusion of additional information relevant to the safety and health of small-scale and artisanal fishermen.

Other ILO Conventions and Recommendations covering safety and health for all workers could be relevant to the fishing industry. However, the full benefits of these standards may not be reaching fishermen for some of the reasons described above. The ILO, together with the FAO and IMO, may also be able to provide, through its existing tools (the CIS system , hazard data sheets, publications, etc.), and with substantial input from research and training institutions, an efficient means of improving the international exchange of information on safety and health in the fishing industry. Given the FAO's strong contacts with agriculture and fisheries ministries and agencies, the IMO's strong contacts with maritime administrations and the ILO's strong contacts with labor ministries, occupational safety and health administrations and employers' and workers' organizations, a coordinated effort, replicated at the national level, might have a considerable impact on raising awareness of fishing safety and health issues and facilitating responses to those issues.

The collection of international data on accidents, injuries and diseases in the fishing industry has been hampered by different methods of collecting and reporting data, including the way in which these data are compiled at the national level and reported at the international level. If the production of useful international statistics on accidents, injuries and diseases, and fatalities is considered important, action may be required at the national level (e.g., by adopting a classification scheme which is convertible to ISIC Revision 3). Coordination between regional databases (e.g., the database under consideration in Europe) and international databases (e.g., ILO and IMO) seems an important issue.

While there are certain steps that might be taken by the ILO, FAO and IMO to address safety and health, and other issues, in the fishing industry, the greatest share of such work must be done by others. The real key to improving the safety and health of fishermen on a global basis will be to determine what should be done at the international, regional, national and local levels, and who should take that action. This requires achieving, at each level, an appropriate blend of harmonization and flexibility in laws and regulations in order to make real gains in safety and health without sacrificing innovation and the importance of developing, or facilitating the development of, the means for the continual exchange of information and, where appropriate, assistance, among all concerned parties. Careful consideration should be given not only to what the ILO can do but also to what others can do to build relationships, to enhance social dialogue, leading to improvements in safety and health in the fishing industry.

The issue of improving safety and health in the fishing industry cannot be separated from other aspects of fishermen's living and working conditions.

THE TRIPARTITE MEETING

More important than the report prepared by the secretariat was the outcome of the meeting, as it reflects the views of representatives of governments, employers (representative organizations of fishing vessel owners) and workers (representative organizations of fishermen) from around the world.[10]

As noted, the meeting's task was to adopt a record of the proceedings (entitled the Note on the Proceedings)[11] reflecting the views expressed by the participants, conclusions giving guidance to the Governing Body and, through the Governing Body, to ILO Member States on the matters covered by the agenda, or both, and to adopt resolutions on matters other than those specifically covered in the agenda item.

In addition to the discussion of the agenda items, the meeting held three panel discussions concerning "tools for the improvement of safety and health in the fishing industry," "the social implications of responsible fisheries," and "promoting social dialogue and fundamental principles and rights in the fishing industry." Summaries of these are included in the Note on the Proceedings. The summary of the first discussion may be of particular interest to IFISH participants.

The meeting adopted twenty-seven conclusions and one resolution.[12] These were the result of long, hard negotiations by representatives of the three groups. When reading these, IFISH Conference participants may wish to consider: 1) how they might take into account these conclusions in their own work (or use the conclusions to support their work); and 2) how they might assist others, including the ILO, to carry out specific tasks called for in some of the conclusions.

CONCLUSIONS ON SAFETY AND HEALTH IN THE FISHING INDUSTRY AS ADOPTED BY THE TRIPARTITE MEETING

GENERAL

1. Fishing is a hazardous occupation when compared to other occupations. Sustained efforts are needed at all levels and by all parties to improve the safety and health of fishermen. The issue of safety and health must be considered broadly in order to identify and mitigate – if not eliminate – the underlying causes of accidents and diseases in this sector. Consideration also needs to be given to the great diversity within the industry based on the size of the vessel, type of fishing and gear, area of operation, etc.

PRIORITY AREAS FOR IMPROVING OCCUPATIONAL SAFETY AND HEALTH

2. The areas of priority for improving occupational safety and health in the fishing industry are:

   Implementing and improving safety and health training;

   Enhancing social dialogue at all levels in the sector;

   Extending social protection to cover fishermen where it does not exist;

   Collecting and disseminating statistics, data and safety information;

   Promoting appropriate international standards;

   Providing international guidance for the safety and health of fishermen, particularly on vessels under 24 m in length;

   Addressing the human element aspect, such as fatigue and manning; and

   The implications for fishing vessels of the entry into force of GMDSS and the planned phasing out of radio watch-keeping on VHFCH16.

ROLES OF LEGAL, REGULATORY AND OTHER MEASURES

3. International standards concerning the safety of fishing vessels should be ratified and fully implemented, in particular, the STCW-F Convention.

4. Safety and health improvements cannot be achieved solely through legislation. A safety culture should be promoted in the fishing industry, including the use of safety management systems appropriate to the enterprise and the dissemination of safety information. Governments, employers and workers' organizations should be involved in the development and implementation of such systems.

PROMOTING ENFORCEMENT OR APPLICATION OF LAWS, REGULATIONS AND GOOD PRACTICES

5. Laws and regulations, essential for the promotion of safety and health in the fishing industry, are only of value if they are implemented. Government agencies responsible for enforcement must be given sufficient resources to monitor the implementation of safety and health requirements, ensuring, in particular, that vessel inspection services are adequate.

6. Governments should ratify the ILO's Occupational Safety and Health Convention, 1981 (No. 155),[13] and apply its provisions to the fishing industry.

7. Like workers in other sectors, fishermen should have access to social security protection; this should cover issues such as sickness, disability, occupational injuries, illness compensation, loss of life and pension schemes.

8. When Flag State legislation does not provide for insurance, fishing vessel owners, regardless of the size of the vessels, should carry insurance or other appropriate social security coverage for occupational injuries to fishermen. Insurance should cover medical treatment and compensation as well as survivor benefits.

9. Medical examinations are important to safety and health protection. All fishermen should undergo periodic medical examinations.

IMPROVING COORDINATION BY ALL MINISTRIES, AND THE ROLE OF LABOR MINISTRIES

10. Governments should ensure coordination of all ministries and agencies (national, regional and local) with an interest in the safety and health of fishermen and should avoid duplication of efforts. Officials responsible for fishing safety and health issues should have a thorough understanding of the fishing industry and its specific safety and health problems.

TRIPARTITE ACTION IN TRAINING AND MEASURES TO IMPROVE SAFETY AND HEALTH

11. Social dialogue is essential to improving the safety and health of fishermen, and it should be promoted at the enterprise, local, national, regional and international level and in all forums where fishing issues are discussed. This should include measures to build the capacity of employers' and workers' organizations, and facilitate their emergence where none exists.

12. Employers' and workers' organizations should be consulted during the development, monitoring and revising of laws and regulations relevant to the safety and health of fishermen. The social partners should also be consulted on other non-legislative efforts to address these issues. Standing consultative bodies, drawing on a wide range of interests in the fishing industry, should be established for the purpose of discussing safety and health issues.

13. Training is an essential means of addressing occupational safety and health issues, and occupational safety and health issues should be an integral part of all training programs for fishermen. Training, including refresher courses, should address different types of fishing gear, fishing operations and disaster preparedness, and should reflect the provisions of the STCW-F Convention, ILO's Vocational Training (Fishermen) Recommendation, 1966 (No. 126), and other relevant international codes and guidance.

14. Governments, employers, workers' organizations and research institutes should contribute to the development of hazardous occupation data sheets[14] for all types of fishing occupations and operations. They should submit studies, manuals and other material to the ILO for inclusion in the ILO's CIS database.[15] Such actions will assist in worldwide dissemination of

knowledge, experience and guidance on safety and health in the fishing industry.

SAFETY AND HEALTH FOR SMALL-SCALE AND ARTISANAL FISHERMEN

15. A pragmatic approach is needed to address the safety and health issues of many small-scale and artisanal fishermen. This approach should take into account their vessel types, equipment, education level and cultural background. Development assistance related to poverty alleviation may also be an appropriate means of aiding these fishermen. The costs of safety measures should be met by governments where appropriate, for example, through insurance and national welfare schemes, which should also compensate fishermen for lost income when fishing is prohibited by the competent authority due to extreme weather conditions.

ACTION ON SAFETY, HEALTH AND RELATED ISSUES FOR VULNERABLE GROUPS OF WORKERS

16. Governments should take urgent steps to ratify and implement the Worst Forms of Child Labor Convention, 1999 (No.182). Implementation should include removing children from all hazardous work in the fishing industry. National action programs to eradicate the worst forms of child labor should include schemes to assist fishing communities.

17. Better employment opportunities should be provided for women in the fishing industry. Furthermore, the involvement of fishermen's spouses and families in safety and health campaigns has been very effective in many countries. Spouses and families are also important sources of information on fishermen's safety, health and other problems. School curricula in fishing communities should include basic information on health and safety in fishing.

18. Action should be taken to improve the situation of abandoned fishermen and non-domiciled fishermen. Flag States should ensure compliance with national requirements and minimum international standards in respect of the social conditions, safety and health and environmental conditions on board fishing vessels flying their flag. Coastal States should make provision of decent living and working conditions on board fishing vessels a condition

that must be met in order to obtain and retain permission to fish in the Coastal State's exclusive economic zone.[16]

IMPROVING DATA ON THE INCIDENCE AND SEVERITY OF ACCIDENTS AND DISEASE

19. Reliable data and statistics are needed to identify fishermen's safety and health problems and focus response and resources effectively. Under-reporting of occupational accidents and diseases of fishermen is a very serious problem. Governments, employers' and workers' organizations should assist in developing or improving reporting systems. Governments should approach insurance providers to exchange information, where appropriate, on accidents, injuries and diseases.

20. Harmonization of data is important. The collection of data on occupational accidents and diseases in the fishing industry can be improved by the use of standardized forms. Statistics and lessons learned should be widely disseminated, especially to employers and fishermen. In order to prevent statistics on fishing from being lost in the general category of "agriculture, hunting, forestry and fishing," governments should adopt classification schemes which are convertible to the International Standard Industrial Classification of all Economic Activities (ISIC), Revision 3, as recommended by the ILO.

21. All maritime casualties involving fishing vessels should be investigated and subject to inquiries in accordance with international Conventions.

22. More information should be collected on occupational diseases and other health problems experienced by fishermen. This information should be collated and be made available to the ILO's constituents in the form of suitable guidelines addressed to fishermen.

ILO STANDARDS CONCERNING FISHERMEN

The conclusions concerning ILO's standards for fishermen are too lengthy to include in this paper. However, they may be found in the Note on the Proceedings. Among other things, the Meeting requested the ILO to undertake a study on working time arrangements in the fishing sector.

ILO ACTION TO PROMOTE SAFETY AND HEALTH IN THE FISHING INDUSTRY

23. The revised text of the FAO/ILO/IMO Document for Guidance on Fishermen's Training and Certification[17] requires no additional substantive changes prior to completion, and the IMO should be encouraged to finalize and publish this document as soon as possible.

24. The ILO should participate in the revision of the FAO/ILO/IMO Code of Safety for Fishermen and Fishing Vessels, Part B, Safety and Health Requirements for the Construction and Equipment of Fishing Vessels, and, following consultation with the IMO, should take a leading role in revising the Code of Safety for Fishermen and Fishing Vessels, Part A, Safety and Health Practice for Skippers and Crews.

25. The ILO, in consultation with its tripartite constituents, should develop a user-friendly manual on safety and health in the fishing industry specifically aimed at working fishermen and covering various types of fishing operations as well as both large and small vessels. This manual should reflect the reality of fishing operations.

26. The ILO, together with the IMO and WHO, should undertake to revise the ILO/IMO/WHO Medical Guide for Ships.

27. Moreover, the ILO should:

    Consider that fishing is a "hazardous occupation" when implementing the InFocus Program on SafeWork;[18]

    Continue to collect and disseminate information on "best practices" concerning safety and health in the fishing industry;

    Develop hazardous occupation data sheets for all aspects of all types of fishing operations;

    Promote the holding of tripartite national and regional seminars on safety and health in the fishing industry;

    Strengthen the framework and institutions for social dialogue through the InFocus Program on Strengthening Social Dialogue, and through the Bureau for Workers' and Employers' Activities, enhance the capabilities of the workers' and employers' organizations to engage in and contribute to social dialogue in the fishing sector, particularly as it concerns safety and health issues;

Through its International Program on the Elimination of Child Labor (IPEC), assist the endeavors of tripartite constituents to eradicate child labor, and, in particular, its worst forms in the fishing industry;

Take into account the problems of abandoned fishermen when considering the issue of abandoned seafarers;[19]

Address the problem of fatigue; and

Take appropriate measures to eliminate the ill-treatment of fishermen.

FOLLOW-UP BY THE ILO TO THE CONCLUSIONS ADOPTED BY THE TRIPARTITE MEETING

The ILO is taking into account all of the above conclusions (as resources permit), but will focus in particular on those listed in conclusion no. 27. In doing so, it plans to work closely with the other FAO and IMO secretariats and with other interested organizations. The IFISH Conference provides an opportunity for discussing how those concerned with safety and health can continue to exchange information after the Conference ends. For the ILO, it also provides an opportunity to identify those organizations and individuals having the knowledge and resources to: assist in the establishment and strengthening of representative organizations of fishing vessel owners and fishermen; contribute to the preparation of hazardous occupation data sheets; provide examples of "best practices" in fishing safety which can be made available to others; assist in efforts at addressing the very difficult issue of fatigue; and otherwise continue to share their information and experience.

FOOTNOTES

1. The term "fishermen" is used in this paper as it is the term currently used in ILO standards concerning workers in the fishing industry. The term is meant to apply to both men and women.

2. The goals, mandate and strategy of the ILO's major programme concerning occupational safety and health, the InFocus Programme on SafeWork, are set out at: www.ilo.org/public/english/protection/safework/decent.htm.

3. A Convention is subject to ratification. Once a State has ratified a Convention, and the Convention has entered into force, the State is obliged to bring its domestic law and practice in conformity with the Convention provisions. A Recommendation is not open to ratification. Instead, it provides guidelines, including suggestions of a technical nature, to assist States in developing their national policy and practice with regard to the particular labour matter. All ILO Conventions and Recommendations are available on the Internet at "www.ilo.org".

4. Recently revised and renamed the FAO/ILO/IMO Document for Guidance on the Training and Certification of Fishing Vessel Personnel. The revision aimed, among other things, to update the publication to make it consistent with the International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, 1995 (STCW-F Convention).

5. The full text of the ILO report, in English, French and Spanish, is available on the Internet at: www.ilo.org/public/english/dialogue/sector/techmeet/tmfi99/tmfir.htm.

6. One of the contributors was Menakhem Ben-Yami, who prepared a paper entitled, "Risks and Dangers in Small-Scale Fisheries: An Overview". As the ILO report, due to limits in space, could not do full justice to this paper, it has been published, in English and under the same title, as an ILO Working Paper, and is available from the ILO.

7. The ILO's Occupational Safety and Health Branch had estimated a worldwide fatality rate of 24,000 deaths in the fishing sector each year. This rough figure was based on a projection of a rate of 80/100,000 rate to a the FAO's estimation of 28.5 million people engaged in fishing, fish processing and fish farming.

8.Torremolinos International Convention for the Safety of Fishing Vessels, 1977, and the Torremolinos Protocol of 1993.

9. International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, 1995 (STCW-F Convention).

10.The Meeting was attended by government representatives from China, Cuba, Denmark, Iceland, India, Indonesia, Mexico, Nigeria, Norway, Russian Federation, Spain, Thailand and United Kingdom; employer representatives from Senegal, Ghana, Argentina, Norway, New Zealand, Peru, Indonesia, Spain, San Salvador, France, Pakistan, Malaysia, Iceland, Japan, Nicaragua and Suriname; worker members from Chile, Argentina, Nigeria, France, Belgium, Morocco, India, Faröe Islands/Denmark and Japan (with advisors from some of those countries as well as Ivory Coast, Paraguay, Canada, Denmark, Russian Federation, Brazil, Norway and Iceland). Observers came from the FAO, IMO, Organization for Co-operation and Development (OECD), World Health Organization

(WHO), International Christian Maritime Association (ICMA), International Collective in Support of Fishworkers (ICSF), International Confederation of Free Trade Unions (ICFTU), International Maritime Health Association (IMHA), International Organization of Employers (IOE), International Transport Workers' Federation (ITF) and World Confederation of Labour (WCL). Two panel members in the panel discussions, one from the United States and one from Iceland, also participated.

11. The Note on the Proceedings, which contains the report of the discussion (which follows the same general headings as the conclusions), conclusions on safety and health in the fishing industry, resolution concerning future ILO activities in the fisheries sector and social dialogue, summaries of panel discussions, list of participants and other information is available on the Internet at: http://www.ilo.org/public/english/dialogue/sector/techmeet/tmfi99/tmfin.htm.

12. The Resolution concerning future activities in the fisheries sector and social dialogue called upon the ILO to carry out a number of activities concerning fishing. As the resolution is not related directly to safety and health, and as space does not permit inclusion of its full text, it will not be described in this paper. It is available on the Internet in the Note on the Proceedings.

13. This Convention prescribes the adoption of a coherent national policy on occupational safety, occupational health and the working environment. It is one of the ILO's main Conventions covering occupational health for all workers. A brief description is found in the secretariat's report.

14. The data sheets provide information on the hazards, risks and notions of prevention related to specific occupations. The data sheets consist of four pages covering information on the most relevant hazards related to the occupation; a detailed and systematized presentation on the different hazards related to the job, with indicators for preventative measures; suggestions for preventative measures for selected hazards; and specialized information for occupational safety and health professionals, including a brief job description, note and references. The ILO is considering developing data sheets for the fishing sector. For more information, see http://www.ilo.org/public/englsih/90travai/sechyg/fhazard.htm or contact David Gold at "sechyg@ilo.org."

15. The CIS is a worldwide service dedicated to the collection and dissemination of information on the prevention of occupational accidents and diseases. A brief description is included in the secretariat's report.

16. The ILO is investigating the link between Illegal, Unregulated and Unreported (IUU) Fishing and conditions of fishermen. In this regard, it was invited to, and has participated in, the Joint FAO/IMO Ad Hoc Working Group on Illegal, Unreported and Unregulated Fishing and Related Matters held in Rome 9-11 October 2000.

17. This work has been completed. The revised Document for Guidance will be published by the IMO.

18. This is the ILO's main programme on occupational safety and health. See footnote 3 for website address of this programme.

19. This issue of abandoned seafarers is being considered by a Joint IMO/ILO Ad Hoc Expert Working Group, which will meet in its second session at IMO headquarters from 30 October — 3 November 2000. Certain aspects of the problem of abandoned fishermen are being considered during this discussion.

Photograph and caption by Earl Dotter

Near a rocky cliff in the bay, the skipper of this Nova Scotia-designed drag boat raises the dredge as the sternman waits underneath the headgear supporting the dredge cable.

SAFETY AT SEA FOR FISHERMEN AND THE ROLE OF FAO

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Fishing at sea is probably the most dangerous occupation in the world. Data from those countries that collect accurate accounts show that occupational fatalities in their fishing industries far exceed their national average. For example, in U.S. the fatality rate is an average of 160 per 100,000, which is 25 to 30 times the national average;[1] in Australia, the fatality rate for fishermen is 143 per 100,000 compared with 8.1 per 100,000 nationally;[2] following a recent spate of accidents in South Africa, the casualty rate has risen from 62 deaths per 100,000 fishermen in 1995 to 585 deaths per 100,000[3] in 1999; in 1995-96 in the United Kingdom, there were 77 fatal injuries per 100,000 fishermen as opposed to 23.2 per 100,000 employees in the mining and quarrying industry (the next highest category in that year) without evidence of the improvements that are apparent in most other industries over the past six years.[4] In Samoa, casualty rates have dropped dramatically from 850 per 100,000 fishermen in 1997 to 350 per 100,000 in 1998 to 150 per 100,000 in 1999 following the introduction of safety regulations for vessels, equipment and training. However, very few countries are able to supply injury data; although the members of International Maritime Organisation (IMO) decided that the collection and analysis of statistical information on casualties, including fishing vessels and fishermen, should be prepared on an annual basis,[5] they acknowledged in 1999 that there has been a very limited response.[6]

The Food and Agricultural Organisation (FAO) estimates that of the 36 million engaged in fishing and fish-farming, roughly 15 million fishers are employed aboard decked and undecked fishing vessels operating in marine capture fisheries, of whom more than 90 percent are working on vessels less than 24 m in length. It seems plausible that the fatality rate in countries for which information is not available might be higher than those mentioned above. Thus, the number of global fatalities might be considerably higher than the figure of 24 ,000 deaths world wide per year estimated by International Labour Organisation. The consequences of loss of life fall heavily on the dependents. In developing countries, these consequences can be devastating: widows have a low social standing, there is no welfare state to support the family and with lack of alternative sources of income, the widow and children may face destitution.

THE PROBLEM

The evolution of the fishing industry over the centuries has been accompanied by the development of skills and experience in vessel design, construction and equipment, as well as in fishing operations and safety at sea. Until the middle of the last century, these developments were almost invariably gradual and steady, largely unaffected by external influences. Technical developments from 1945 to 1970 drastically accelerated this evolutionary process; widespread use of outboard engines, the use of hydraulics for hauling gear and catches, synthetic nets and lines, fish-finding electronics and refrigeration equipment led to massive leaps forward in productivity and profitability. Under the free-for-all access to fisheries together with the market's insatiable demand for fish, the harvesting capacity of the fleets was bound sooner or later to reach or even exceed the maximum yield of the fishable stocks.

Over-exploitation of coastal resources and advances in vessel and fishing technologies are probably the major underlying factors that have negated the results of parallel efforts to improve safety at sea. Excessive fishing effort; increased competition; reduced profitability; economies in vessel maintenance, equipment and manpower; fatigue; recklessness; fisheries management measures (which do not take sufficient account of the human element or fishermen safety into consideration); diversified fishing operations unaccompanied by training, traditional experience and skills; these are some of the factors that have resulted in fishing being the most dangerous occupation in the world.

POSSIBLE SOLUTIONS

There are a number of areas where improvements can be made: provision and analysis of data identifying the causes of fatalities and injuries; education and training of trainers, extensionists, fishermen and inspectors; improved fisheries management, safety regulation and enforcement; increased collaboration between fishermen, fishermen's organizations and government.

DATA

Some would argue that the root and actual causes of accidents in the fishing industry are known intuitively. While this may often be the case, reliable quantified data would be likely to show differing trends in different regions, countries and fisheries, and should contribute to understanding the main causes of fatalities. In order to focus and prioritize the actions that should be taken to increase fishermen's safety, the most frequent causes of danger and vessel losses must be fully investigated. Thus, vastly improved accident reporting is seen as central to the quest for improved safety in the industry.

Even when injury reporting takes place, the many different approaches to collecting information on the types and causes make it difficult to produce comparable data and statistics and thus make it difficult to identify and address key issues. The nature of the employment arrangements in fishing, which may place many fishermen outside traditional occupational injury and disease reporting systems, also contributes to this lack of information.[7]

REGULATIONS

Regulations and technical standards at the national level must be formulated, reviewed and amended through dialogue between the builders, owners, fishermen and administrations to ensure that all parties share a sense of ownership and responsibility in the application of the new regulations.

Enforcement of safety regulations is essential. This requires collaboration within administrations, and particularly between Fisheries and the Marine Authorities.

But in reality, very few of the individual inspectors attached to Fisheries Divisions have a background in boat-building, marine engineering or naval architecture, nor have had any training in the conduct of condition surveys of vessels of any sort at the level normally required for classification or insurance purposes. Thus while part of the solution may lie in regulating the quality to which boats are constructed and equipped, attention must also be paid to the necessary skills of the enforcers. Ensuring adequate enforcement implies a significant commitment on the part of the administration, taking into account the cost and effort of establishing, staffing and training a new section.

However, a safe working environment cannot simply be imposed from above. Even if all relevant international conventions were extended to include fisheries, ratified by sufficient numbers of countries and implemented and enforced in laws and regulations at national levels, a safe working environment could not be assured without community participation. Even after the most rigorous decision-making and regulation-formulation processes inside the administration, regulation has yet to pass the most demanding test of all: the public must agree to comply with it.

TRAINING

Training for fishermen is clearly one of the means that can be used to channel the results of the lessons learned from analysis of improved data. Historically, the formal training of fishermen has been limited to skippers, mates and engineers in developed countries and undertaken to ensure compliance with certification requirements. The British Merchant Shipping Act (1894) provided the basis for regulations that covered most of the Commonwealth including India, Australia, Canada and many other countries. The IMO Protocol to the Standards of Training, Certification and Watchkeeping for Seafarers (1978) provided standards for countries to follow, but the Protocol was never ratified and was superseded by the Convention for the Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (1995) (STCW-F). These provisions only referred to vessels greater than 24 m in length or powered by more than 750 kW, but for smaller vessels, the FAO/ILO/IMO Document for Guidance on Fishermen's Training and Certification gave further information on courses and syllabi. This document has been recently revised in line with the STCW-F and retitled "Document for Guidance on the Training and Certification of Fishing Vessel Personnel" (Document for Guidance).

Any mandatory program is prone to resentment, resistance and probable failure, unless it has the support and involvement of fishermen. In Europe, there has been a change in emphasis from formal training to functional training where trainees have to demonstrate their competence to complete tasks, rather than prove their knowledge by providing oral or written answers to questions. This type of functional training requires more resources than theoretical training, particularly where trainees are exposed to dangerous situations and safety during the safety training process becomes an issue.

ATTITUDE

Ensuring positive attitudes towards improved safety at sea must be a task of every fisheries institution, regardless of its function or hierarchical position. This process is one that in fishing communities could start at elementary or primary school. Such a process has been attempted in United Kingdom to introduce children to the idea of safe fishing.[8]

Despite increased safety legislation, mandatory courses and improved safety equipment, some European countries are concerned that the accident and fatality rates remain very high and have considered the Integrated Safety Management (ISM) system adopted by IMO for trading vessels to see if this could provide an answer to the problem. The ISM system requires that the master and crew of a vessel provide a written report, which analyses and describes the hazardous areas and activities which take place during the operation of the vessel (termed a safety management system). They are also required to state the precautions they will take to reduce or eliminate such hazards. Hence the fishermen are guided into a process whereby they have to think about safety on their own vessel using their particular fishing method rather than rely on the provision of equipment and training which is neither specific to the vessel nor the fishing method. However, there are reports that the objective of this measure is being circumvented with owners hiring consultants to draw up the ISM reports for their vessels. There are also concerns about such a system causing excessive paper work and it not being appropriate for crew members with limited literacy.

FISHERIES MANAGEMENT

An additional approach through which safety might be improved would be fisheries management. The seas and oceans are now recognized as sensitive and limited resources that must be carefully nurtured by all who exploit them. This is such a revolutionary concept that it will take considerable time until its consequences are realized in full: that free access to fisheries will disappear, be it on the high seas or within national waters. Every nation will have to find ways to manage its fisheries, collect information on the size and composition of the fleet, and adjust it to the capacity of the fish-stocks within its jurisdiction. While this implies that even artisanal fisheries amongst the developing nations will have to be contained and controlled in some way, it is recognized that restricting access to fisheries may prove a politically and practically daunting task. Fisheries have been free-for-all, the fleet largely uncontrolled and often operated directly from the shore with few or no harbors that might act as control points. Nevertheless, fisheries will have to be managed sooner or later, whether by the state or by the international or local community, and experience bears out that the benefits of such a regime may in fact compensate for the costs.

The new legal regime of the oceans gives coastal states rights and responsibilities for the management and use of fishery resources within their Exclusive Economic Zones, (EEZ) which embrace some 90 percent of the world's marine fisheries. This coincides with clear indications of over-exploitation in many waters, which motivates national governments to bring fisheries under proper control. An obvious instrument is the issuing of authorizations to fish, which can be applied to both vessels and crew.

The aim of managing fisheries should not only be the responsible harvesting of living marine resources so as to secure their sustainability, but also to provide fishermen with acceptable working conditions.

This development opens up new possibilities for managing safety at sea. Throughout the twentieth century safety issues were promoted almost exclusively on a voluntary basis, with limited results. By treating safety as an integral part of fisheries management, and making safety requirements prerequisites to fisheries authorization, progress is certain to ensue. These measures will require a change of attitude within fisheries, and consequently a firm motivation on behalf of the legislators, but given that fisheries are the most dangerous occupation known on earth, these moves are justified and seem inevitable.

FAO

FAO is one of the three specialized agencies of the United Nations system playing a role in fishermen's safety at sea. The other two are the IMO and the ILO. IMO deals largely with international shipping and is the agency responsible for improving maritime safety and preventing pollution from ships; adoption of maritime legislation is still IMO's best-known responsibility. The ILO formulates international labor standards in the form of Conventions and Recommendations, setting minimum standards of basic labor rights, promotes the development of independent employers' and workers' organizations, and provides training and advisory services to those organizations. By virtue of the working methods of IMO and ILO, their results tend to have little impact on the safety of artisanal and small-scale fishermen who operate largely outside the regulated sector.

The FAO has the mandate to raise levels of nutrition and standards of living, to improve agricultural productivity, and to better the condition of rural populations. Over the last decade, much of the work of the Fisheries Department has been directed towards the formulation and implementation of the Code of Conduct for Responsible Fisheries[9] which recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of all those concerned with the fishery sector. It recognizes too the importance of the safety issue, and contains several references to the subject addressing working and living conditions, health and safety standards, safety of fishing vessels, training, certification and accident reporting.

Within the Fisheries Department of the FAO, the Fishing Technology Service promotes, develops and transfers appropriate fish capture technology and practices with due regard to protection of the environment and the well being of fishing communities. It develops, through consultation with governments, other international organizations, non-governmental organizations and those involved in fisheries, codes of conduct and standard specifications and guidelines in support of fisheries management, safety at sea and the protection of the environment.

The service has implemented a number of projects aimed at improved sea safety. These have particularly been directed at the developing countries and carried out in the field, in cooperation with the local people. The issue has been tackled from various perspectives including improved vessel design and construction, better preparedness for natural disasters, improved collaboration between government and fishermen representatives, providing assistance in the setting up of national sea safety programs, and institutional strengthening to fisheries training centers.

FAO AND SAFETY AT SEA

Many developing countries face the need to design and implement a system to manage their fisheries and may look for external advice and aid to further their goals. FAO is the obvious UN agency to promote a holistic approach to fisheries management; FAO will continue to advocate the inclusion of safety at sea as an integral part of the proposed management regime. This will be reflected in its active use of the Code of Conduct for Responsible Fisheries to promote and monitor issues pertaining to safety at sea.

One of FAO´s major strengths in fisheries lies in the identification, formulation and implementation of field projects, which involve local administrations, expertise and communities, under the guidance of experts from FAO. Up to 1800 such field projects have been operating at any one time (in all areas of FAO's expertise including agriculture and forestries), resulting in the build up of knowledge of local conditions as well as a network of contacts both at local, national and regional levels. Regarding fisheries in particular, FAO has implemented hundreds of projects in the field directly related to the establishment of fisheries training institutions, improving the quality of design, construction and equipment of fishing vessels, improving methods of harvesting, processing and distribution of the products, and above all, working directly with and building up competence in the fishing communities.

Since its creation in 1945, FAO has taken an active part in the formulation and implementation of international standards, instruments and guidelines to further its aims, often in close cooperation with other UN agencies concerned, primarily the IMO and ILO. FAO will continue to work closely with IMO and ILO on the issue of safety at sea for fishermen, and in particular with regard to design, construction and equipment of fishing vessels, as well as on matters related to health and working conditions, training and certification.

THE CODE OF CONDUCT FOR RESPONSIBLE FISHERIES

With the Code of Conduct for Responsible Fisheries and the accompanying Technical Guidelines, FAO has provided a framework on which different fisheries management systems can be built. The Code of Conduct is a unique instrument in its holistic approach, being based on and bringing together key elements from international conventions and guidelines concerning fisheries and related environmental issues. The fact that the Code is to a great extent non-mandatory has proven to be more of an asset than weakness, as it renders the Code attractive as a model on which to base the management of fisheries, without having to be ratified as a whole.

The Code of Conduct refers to safety, training and certification of competency in eight paragraphs in the Code (see appendix). This provides an opportunity for FAO to use the Code of Conduct as a vehicle to promote various issues relating to safety at sea. Specifically, this can be done when monitoring the implementation of the Code. A questionnaire, which is sent out biennially to all member states, serves not only to gather information, but also to highlight key issues and is therefore important as a tool to arouse awareness of safety as an integral part of fisheries management.

TECHNICAL GUIDELINES ON THE ADMINISTRATION OF SAFETY AT SEA.

The series of Technical Guidelines that expand on the principles of the Code of Conduct enjoy credibility as practical and reliable sources of information. In the Code of Conduct safety at sea is the subject of several paragraphs. Expanding on those and explaining how they could be applied, the implications they may have, what kind of legal framework they may require, etc. could be useful for administrators who intend to meet the challenge of improving safety at sea in their country. The formulation of such guidelines is now under consideration for inclusion within the Department's work program.

TECHNICAL ASSISTANCE AND CAPACITY BUILDING

The problems encountered in safety at sea by fishermen in the developing countries are quite different from those in the developed ones. In the former, the vessels and fishing gear are often simple and labor intensive and their fishing communities are frequently dispersed along the shore, where harbor facilities are limited and beach landings common. Furthermore, the basic perception of the value of human life is culturally determined. This affects the motivation of each society to invest resources in life-protecting measures. In many developing countries there is hardly any political pressure to invest in safety at sea. This is further confounded by the absence of organized representation, such as unions and pressure groups, which makes coordinated action difficult. There is generally a lack of commitment and financial resources to provide institutional support to the fisheries sector regarding data collection, vessel registration, technical training, regulation and enforcement, and search and rescue, and also a lack of cooperation between different governmental agencies.

Different approaches to improving sea safety are required, and FAO has the experience and expertise to provide the required guidance and advice as a result of its long tradition of cooperation with local people in developing countries from the community level to the highest authorities in civil service and government. These local networks and the knowledge of local conditions in different developing countries and regions are of supreme importance, and should be regarded as a valuable resource that has been built up through the efforts of FAO over more than half a century. FAO will therefore continue to provide assistance that may range from ad-hoc advice to full scale technical assistance projects.

USE OF THE INTERNET

The Internet is rapidly becoming the main source of information worldwide with a scope and flexibility that provide endless opportunities for adapting material to individual needs. Courses on all sorts of issues pertaining to fisheries, including safety, are already being offered on the Internet, but they are not composed for nor aimed at users in the developing countries. Going through the array of existing material in search of something useful is a daunting task for the individual users, such as trainers or inspectors in the developing countries. Suitable course material needs to be compiled and edited as ground material for these users to choose from. Outlines of courses could be provided with rich picture material and relatively simple texts, which could be translated into different languages. FAO has the necessary expertise and local knowledge to carry out such a task, and this would be a logical continuation of FAO´s long-standing role as provider of training and extension programs. FAO will take a leading action in developing an Internet site and developing web based material for trainers/inspectors, suitable for adaptation to specific needs in different countries.

CONCLUSION

Measures to improve safety can only be truly effective where the motivation to apply them exists. To establish and maintain such a culture of safety is a never-ending task that demands the participation of the fishermen themselves and their families, the boat-owners, the legislators and the community at large. There are many examples of individuals interested in safety at sea who formed fishermen self-help groups or other NGOs and established a fruitful cooperation with the authorities to promote safety in their communities.

In those countries where appropriate regulations, enforcement and training are in place, there has been a measurable (though not always significant) reduction in the annual number of fatalities over the last 15 years. Although these countries account for less than five per cent of the world's fishermen, they demonstrate that results are achievable. Recognition of the issue of safety at sea as a major and continuing problem is the first step towards its mitigation. It is considered that responsibility for safety at sea should be borne by both administrators and fishermen, and similarly that effort and assistance is shared between those two groups to ensure an effective partnership enabling a safer profession.

APPENDIX: THE CODE OF CONDUCT AND SAFETY AT SEA

6.17 States should ensure that fishing facilities and equipment as well as all fisheries activities allow for safe, healthy and fair working and living conditions and meet internationally agreed standards adopted by relevant international organizations.

8.1.5 States should ensure that health and safety standards are adopted for everyone employed in fishing operations. Such standards should be not less than the minimum requirements of relevant international agreements on conditions of work and service.

8.1.6 States should make arrangements individually, together with other States or with the appropriate international organization to integrate fishing operations into maritime search and rescue systems.

8.1.7 States should enhance through education and training programs the education and skills of fishers and, where appropriate, their professional qualifications. Such programs should take into account agreed international standards and guidelines.

8.1.8 States should, as appropriate, maintain records of fishers which should, whenever possible, contain information on their service and qualifications, including certificates of competency, in accordance with their national laws.

8.2.5 Flag States should ensure compliance with appropriate safety requirements for fishing vessels and fishers in accordance with international conventions, internationally agreed codes of practice and voluntary guidelines. States should adopt appropriate safety requirements for all small vessels not covered by such international conventions, codes of practice or voluntary guidelines.

8.3.2 Port States should provide such assistance to Flag States as is appropriate, in accordance with the national laws of the Port State and international law, when a fishing vessel is voluntarily in a port or at an offshore terminal of the Port State and the Flag State of the vessel requests the Port State for assistance in respect of non-compliance with sub-regional, regional or global conservation and management measures or with internationally agreed minimum standards for the prevention of pollution and for safety, health and conditions of work on board fishing vessels.

8.4.1 States should ensure that fishing is conducted with due regard to the safety of human life and the International Maritime Organization International Regulations for Preventing Collisions at Sea, as well as International Maritime Organization requirements relating to the organization of marine traffic, protection of the marine environment and the prevention of damage to or loss of fishing gear.

FOOTNOTES

1. U.S.A. Bureau of Labour Statistic [1998].

2. ILO Yearbook of Labour Statistics [1998].

3. Fish Safe Foundation, South Africa [2000].

4. UK Government http://www.shipping.detr.gov.uk/fvs/index.htm.

5. IMO MSC/Circ.539/Add.2 and FSI 6/6/1.

6. IMO FSI 7/6/2.

7. ILO Report on the safety and health in the fishing industry, [1999].

8. MCA http://www.mcagency.org.uk/safefishing/ftintro.htm.

9. The Code is voluntary. However certain parts of it are based on relevant rules of international law, as reflected in the United Nations Convention on Law of the Sea of 10 December 1982. The Code also contains provisions that may be, or have already been given binding effect by means of other obligatory legal instruments amongst the Parties, such as the Agreement to Promote Compliance with Conservation and Management measures by Fishing Vessels on the High Seas, 1993.

SPECIAL HAZARDS OF IMMERSION IN NEAR FREEZING WATER

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Bill Keatinge was directed into research on survival in cold water during military service as a doctor in the British Navy, and published from this a series of papers on the factors that determined body cooling rates of volunteers in cold water. Other studies included the freezing of human skin in near-freezing seawater. His research since then has ranged over fields that include the causes of raised mortality in both cold and hot weather, but has always returned to cold water problems. It has recently focused on individuals with exceptional ability to swim and survive in extreme low water temperatures.

INTRODUCTION

Survival in near freezing water involves not only an intensified form of the problems encountered in less severe cold immersions, but also special hazards that are only presented by water temperatures below 12°C. The evidence about the nature and prevention of these problems of extreme cold immersion has come to light at intervals over the last 60 years. I would like to illustrate them from my and my colleagues' results, and to put them into a scientifically logical order rather than in the order in which the pieces of information came to light.

SUMMARY

Hypothermia is the main threat to the life of people immersed in cold water after shipwrecks, who usually have life jackets or other buoyancy aids. In cold water at temperatures down to 12°C a thick layer of subcutaneous fat can provide enough insulation to enable people to maintain safe core temperatures for many hours, though thin people without external protection cool rapidly. High surface area to mass ratio associated with small overall body size also accelerates body cooling.

At water temperatures below 12°C cold, vasodilatation, due mainly to cold paralysis of blood vessels in the skin, can lead to rapid heat loss even in obese people. In water colder than 5°C there are additional hazards from anesthesia of the skin, and progressive weakness due to impairment of nerve and muscle function from local cooling of the limbs. Severe nerve and muscle damage in the limbs can be produced by immersions in water below 12°C lasting for several hours. In seawater which freezes at -1.9°C, there is an additional risk of freezing of unprotected skin immersed in near freezing water for many minutes.

People who fall overboard clothed and without a life jacket are at risk of sudden drowning even if they are good swimmers, since the high viscosity of very cold water causes viscous drag and rapid exhaustion, and reflex respiratory distress in very cold water can incapacitate unadapted people.

Wearing of life jackets, and external protection against cold, with survival suits providing the most effective protection, are the most important preventive measures against immersion deaths after accidents at sea. Recent evidence shows that with cold adaptation people with thick subcutaneous fat can swim safely for several hours in water down to 5°C, without external protection, but based on current evidence, immersion suits with hand and foot cover are needed for anyone to do so in water colder than this.

EVIDENCE

The main fact underlying the hazards of cold immersion is that water is a much better conductor of heat than air. It also has a much higher specific heat, making it a better carrier of heat by convection. As a result, people without external protection in cold water have little external insulation, and lose heat at a rate that is determined largely by their own internal body insulation and heat production. The main facts about these heat exchanges were established by different research groups in experiments on volunteers, and from studies on long-distance swimmers, during the fifteen years after the Second World War.

The most important of the studies' findings is that adults without external protection cool in water at around 15°C at a rate that is closely dependent on the thickness of their subcutaneous fat. Body core temperatures of people with mean skinfold thickness less than 5 mm at subcostal, subscapular, abdominal, and biceps sites cooled by more than 2°C during 30 minutes in water at that temperature. People with skinfolds at these sites averaging more than 10-20 mm cooled little if at all in water at 15°C. Although exercise greatly increases body heat production, people immersed in water that is cold enough to cause progressive body cooling usually cool faster if they swim, than if they float still in life jackets. Blood flow to the limbs is greatly increased by the exercise, carrying heat to them from the body core. With relatively thin layers of fat that are present on the limbs, the heat transferred to the limbs from the body core is rapidly lost to the water.

Surface area/mass ratio is greater in small individuals than large ones. Small people therefore have a larger area of body surface to lose heat from, in relation to body mass where heat can be produced and stored. As a result, other things being equal, small individuals cool faster than larger ones in cold water. This is particularly important in children, who cool rapidly for this reason as well as because they usually have thinner subcutaneous fat than adults.

All of these factors remain important in water temperatures below about 12°C, but cold vasodilatation becomes an important risk factor in colder water. This vasodilatation results mainly from cold paralysis of blood vessels in the skin and so cannot be overcome by increasing the intensity of vasoconstrictor nerve activity. As a result even obese individuals generally start to cool progressively after around 30 minutes of immersion in water at 5°C.

In recent years it became clear that some individuals were nevertheless able to survive and maintain body temperature during many hours in such frigid water. The most striking was Gudlaugur Freidthorsson, an Icelander who swam for five hours in water at 5.2°C after his fishing boat sank off the south coast of Iceland. Subsequent experimental immersion in a laboratory showed that he could indeed stabilize body temperature in such water, lightly clothed as he was during his swim, and without undergoing marked cold vasodilatation. Another swimmer, Lynne Cox, wearing only a bathing suit and hat, swam for two hours five minutes in water at 7.2-7.3°C in the Bering Straits without core temperature falling below the normal range.

Both of these people were cold-adapted from repeated exposure to cold water at the time of their swims. A possible explanation of their ability to avoid rapid heat loss was that the blood vessels in their skin had adapted to the cold so that they did not suffer cold paralysis in their swims. Experimental evidence of such adaptation by blood vessels was later obtained from experiments in which one hand of volunteers was repeatedly exposed to cold. Subsequent immersion of a finger of that hand in ice water when the subject was generally chilled, and so had high vasoconstrictor tone, caused more vasoconstriction after, rather than before, cold adaptation. The likely explanation was that cold paralysis of the blood vessels was less after cold adaptation and so enabled the vasoconstrictor nerves to shut down blood flow to the skin more effectively.

The general conclusion is that some individuals with unusually thick and well distributed subcutaneous fat can survive and stabilize body core temperature for very long periods in water around 5°C, but probably only if they are cold adapted. The great majority of people immersed in water at that temperature following shipping accidents are not cold adapted, and even in cases where they have substantial subcutaneous fat, cannot be expected to survive for long without effective immersion suits. In the absence of immersion suits, any other external protection can have a dramatic effect in these extreme conditions. The rate of body cooling can be more than halved by ordinary, thick, non-waterproof clothing.

Immersion for around three hours in water below 12°C can cause non-freezing cold injury, with severe degeneration of nerve and muscle in the limbs, leading to lifelong disability in many cases. It is not known whether previous cold adaptation can reduce this injury, or can reduce the reversible cold anesthesia of the skin that develops in water below 5°C. However, with present knowledge, it is not clear that anyone can safely remain in water below 5°C for many minutes without external insulation.

It has often been supposed that human tissues cannot freeze in liquid seawater, but seawater in the oceans freezes at -1.9°C, and human skin freezes at -0.53°C. In practice, human fingers cooled below -0.53°C often supercool for many minutes rather than freezing, but in many cases they do freeze. This could be dangerous under any circumstances at sea, and highly dangerous to survivors in cold water. Seawater near coasts, and in gulfs with input of river water, often contain less salt than ocean water, but immersion of human tissue in ocean water at its freezing point for many minutes carries some risk of freezing for humans. This can be avoided by providing some insulation in the form of gloves or mitts, and by keeping the immersion brief.

The main conclusions from this with regard to survivors, as opposed to sports swimmers, are first that although thin people can die of hypothermia in water warmer than 12°C, obese people commonly survive many hours in water at 15°C without protection, and occasionally do so in water as cold as 5°C. Hope should not be abandoned too quickly in searches for survivors. Otherwise, the emphasis has to be on providing protection, preferably by inflatable life rafts with canopies, or less effectively by immersion suits or other protective clothing plus flotation for survivors immersed in the water. Heat loss can be reduced in the absence of effective protection by adopting huddle positions in which the legs are drawn up against the trunk, or by survivors holding together in groups. To ensure long survival of unadapted adults of any body build, protective clothing or rafts should aim to keep skin temperatures above 28°C. In briefer immersions, survivors should not allow skin temperatures to drop below 12°C for several hours, or below 5°C for many minutes, or below 0°C for a few minutes.

It was recognized in the 1960s that many accidental deaths in inshore waters, and some in the open sea, were taking place much too rapidly for hypothermia to be responsible for them. These deaths involved people without life jackets, but it was not clear why people who were often good swimmers should have drowned within a few minutes of entering or falling into cold water. Experimental swims showed that volunteers who were not cold adapted had no difficulty in swimming clothed for twelve minutes in water at 25°C, swimming pool temperature, but none were able to swim for that time in water at 4.7°C The reason was partly that intense reflex respiratory distress induced by cooling of the skin incapacitated them, and partly that the high viscosity of very cold water increased the work of swimming and so caused rapid exhaustion. Surprisingly, the middle-aged volunteers could swim further than younger and fitter people. The reason was that they had more fat, and the buoyancy of the fat enabled them to keep their heads above water even when fatigue had slowed swimming movements. The younger people, with less fat, sank immediately after their swimming slowed, and would have drowned if safety ropes had not been in place to pull them out. The practical solution is for all people liable to sudden immersion in cold water to have some form of buoyancy aid. A campaign on these lines in Britain, directed at children, was followed by a 20 percent fall in immersion deaths among children over the next four years. The most important way to prevent deaths from people falling overboard from fishing vessels is to have working practices that prevent them going overboard at all, but wearing a life jacket or other flotation aid is an option for reducing the risk to people doing tasks on deck in circumstances where, for example, emergency action is needed and a safety line is not practical.

FURTHER READING

Keatinge WR [1969]. Survival in Cold Water: The physiology and treatment of immersion hypothermia and of drowning. United Kingdom: Oxford Blackwell Scientific Publications.

Sloan REG, Keatinge WR [1973]. Cooling rates of young people swimming in cold water. J Appl Physiol *35:* 371-375.

Keatinge WR, Coleshaw SRK, Millard CE, Axelsson J [1986]. Exceptional case of survival in cold water. BMJ *292*: 171- 172.

Keatinge WR [1996]. Sections on: Heat Cold, Drowning and Seasonal Mortality. In: Weatherall D, Ledingham JG.G., Warrell DA, eds. Oxford University Press, Oxford: Oxford Textbook of Medicine. Third Edition. pp. 1180-1181, pp.1182-1185.

Protheroe RE, Rhodes B, Yagci AG, Donaldson G, Keatinge WR [1996]. The effects of local and general cold adaptation on cold-induced vasodilatation in cold conditions in humans. J Physiol. *491:* 56P.

COMMERCIAL FISHING VESSEL SAFETY

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LCDR Roberts is a 1983 Graduate of the United States Coast Guard Academy with a BS Degree in Electrical Engineering. He served two years as an engineering officer aboard the Coast Guard Cutter Monroe before entering the Marine Safety field. LCDR Roberts completed marine safety field tours at Port Safety Station Houston, Texas and Marine Safety Office Morgan City, Louisiana between 1987 and 1994, then was assigned to Marine Safety Office Wilmington, North Carolina as Chief of Vessel Inspections. He supervised implementation of the Commercial Fishing Vessel Voluntary Dockside Program in Wilmington through 1998. From 1998 to present, he has served as Chief of the Commercial Fishing Vessel Safety Division in the Coast Guard Headquarters Office of Compliance, which is responsible for national commercial fishing vessel safety policy development and program management.

One of the United States Coast Guard's (U.S.C.G.) overall goals is to increase the level of safety in the fishing industry so that it is no more dangerous than any other segment of the maritime community. The commercial fishing fleet in the United States is estimated to be between 100,000 – 120,000 vessels with approximately 1,500 vessels over 79 feet. The industry is reported to be one of the most hazardous in the nation; on average 78 crewmember deaths per year have been recorded between 1992 and 1999. Although the most serious deficiency in casualty statistics is the lack of firm population data to serve as the denominator for fishermen death rates, available data estimates between 160 – 180 fatalities/100,000 workers occur annually – well above 32 fatalities/100,000 workers goal set for the maritime industry as a whole.

The USCG's Commercial Fishing Vessel Safety (CFVS) Program for the past ten years has been aimed at gaining compliance with safety regulations through *voluntary* dockside vessel exams, public education and awareness campaigns.

Regulatory enforcement through the at-sea boarding of fishing vessels serves as a deterrent to safety violators and complements the voluntary program.

Damage control trainers and stability trainers, which allow fishermen to practice damage control skill on a vessel mockup and witness the affects of various vessel configurations on stability, have been deployed to address the professional knowledge gap in these areas. In addition we have deployed EPIRB test kits in all USCG districts to ensure EPIRBS are functioning properly and registered in the national SAR database to facilitate rapid search and rescue responses.

Over the years, our efforts in support of the Commercial Fishing Industry Vessel Safety Act have met with success in reducing fishing related casualties. To show the impact of the CFVS Program, two five-year periods of time should be examined – one before and one after implementation of the CFVS Program.

Before the Act, from 1984-88, 519 lives and 1,177 vessels were lost while commercial fishing, compared to 349 lives and 707 vessels lost during 1994-98 after the Act and the commercial fishing safety program were fully implemented. This represents about a 33 percent decrease in the number of fishing related deaths and a 37 percent decrease in the number of fishing vessels lost. Although this decrease is certainly a success, the number of deaths and vessel losses annually remains relatively high.

Despite our efforts, commercial fishing persists as our nation's most hazardous industry. In January 1999, the safety record the fishing industry and the USCG received widespread media attention after 4 clam vessels and 1 conch vessel sank off the Eastern Coast of the United States with 11 lives lost. In December 1998, just a few weeks prior to these casualties, five other fishing vessels were lost in just eight days with eight lives lost.

On January 29, 1999, in light of the increasing number of fishing vessel casualties and the impetus provided by the East Coast clam vessel tragedies, Admiral North chartered a Commercial Fishing Industry Vessel Casualty Task Force. The Task Force was comprised of USCG members, from both marine safety and operations, and from both headquarters and the field. Also included were commercial fishermen, representatives from the insurance industry, NTSB, NOAA, NMFS, OSHA and the Fishing Vessel Advisory Committee.

In March 1999, the Task Force issued a report containing 59 safety recommendations in 7 different categories.

In direct response to the Task Force report and evaluation reports, the USCG implemented *immediate action measure,* designed to improve CFVS under existing authority and focused attention on three improvement areas: at-sea boardings; voluntary dockside exams and education/outreach efforts; and CFVS training of USCG personnel.

DATA

The following is a brief description of the casualty statistics that influenced the strategies we intend to employ to address the unacceptable casualty rate for commercial fishing vessels. Figure 1 shows geographical USCG operational and jurisdictional districts. The sum of the following casualty data will be displayed in relation to these areas. The 17th District has the most fatalities over the time period displayed.

Figure 1: U.S.C.G. District areas

Figure 2 depicts the number of fishermen who died *or* were declared missing from operational causes from 1994 through 1998. During this period, the 17th (73), 8th (63), and 11th (56) districts top the list in total personnel losses.

This data, *though not normalized by denominator data,* such as number of fishermen or days underway, indicate that commercial fishing casualties occur on all coasts, and in all USCG districts.

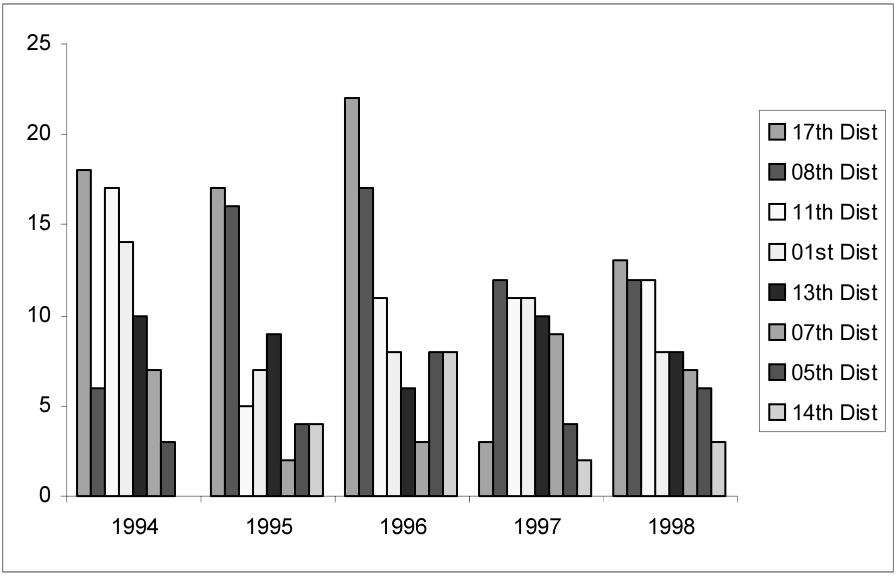

Figure 2: Dead and missing by Coast Guard District

Figure 3 shows the number of fishermen who were killed or lost by vessel type. Here you see that *trawl vessels* with a total of 116 lives lost are followed by vessels fishing with *traps and pots* with 81 fishermen lost.

The *unknown* category represents the loss of 33 fishermen over the 5-year period – our review of casualty data did not reveal *vessel type* for these 33 incidents. Improvement in data collection is necessary to further refine our analysis of casualty trends and better target prevention efforts.

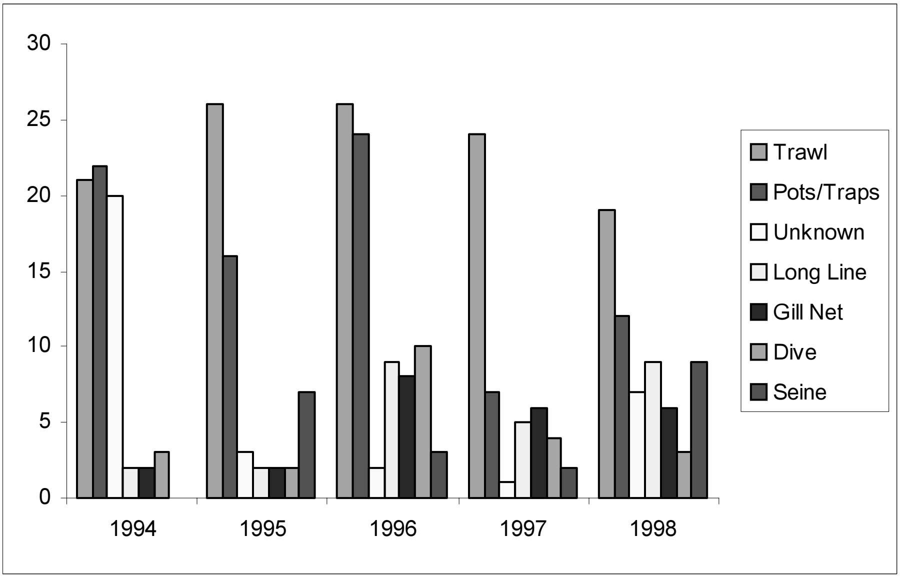

Figure 3: Dead and missing by vessel type. Note: includes types with over 20 total Deaths

Shrimp and *crab* were the two most hazardous fisheries during this period, with the shrimp fishery accounting for 64 losses while the crab fishery accounted for 62 losses. The *unknown* category also accounted for 62 losses. *Drowning* (49 percent) and *missing* (37 percent) lead the way as the primary causes of death among fishermen, accounting for 86 percent of all losses. The remaining 14 percent of deaths were brought about by exposure (7 percent), asphyxiation (4 percent) and being crushed (3 percent).

The primary cause of death among fishermen is drowning (49 percent). Commercial fishermen find themselves in the water, unexpectedly, by 2 major causes: 1.) flooding, sinking, and capsizing, which are interrelated to some degree, and 2.) falls overboard.

Fifty six percent of deaths result after vessels have flooded, sank, and/or capsized while 29 percent occur because of falls overboard. Arguably the *pulled overboard by gear* (5 percent) category could be added to the *falls overboard* category boosting its total to 34 percent of all losses.

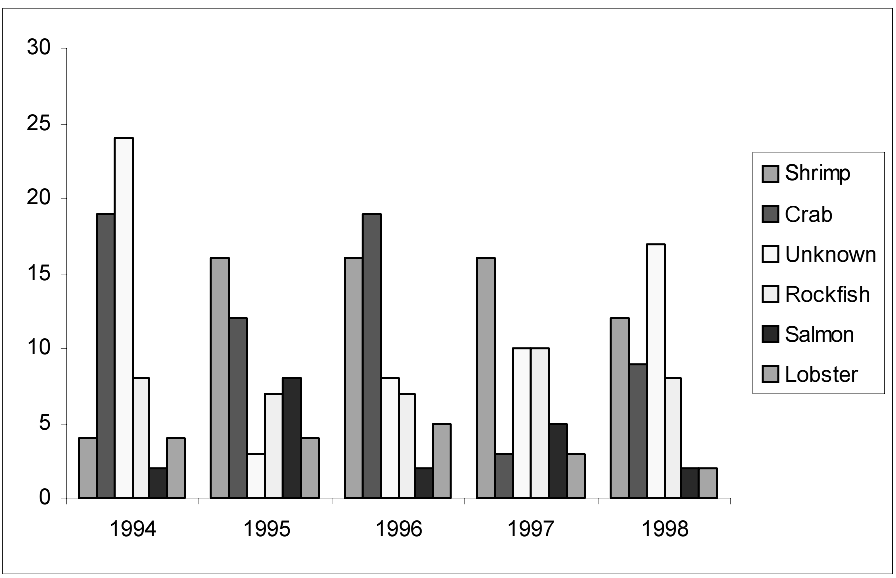

Figure 4: Dead and missing by fishery

The majority of fishing vessel losses (86 percent) occurs on vessels that are less than 80 feet in length. Please bear in mind that over 98 percent of all U.S. commercial fishing vessels falls into this size range; therefore, this distribution is to be expected.

The USCG Action Plan we are implementing on the nation level represents a consolidation of the top safety recommendations contained in the Task Force report and district evaluation reports as prioritized by USCG fishing vessel safety personnel and the Commercial Fishing Industry Vessel Advisory Committee, a citizen group charted to assist the USCG in developing fishing industry safety policy, as well as the data previously discussed in this paper. The Plan consists of three short-term and eight long-term action areas.

SHORT TERM ACTION AREAS

1. A Fishing Vessel Safety Division at USCG headquarters. The creation of this division will provide needed support *and* continuity to the CFVS Program. This division will also provide a stronger emphasis on commercial fishing vessel safety at the USCG headquarters level.

2. Field level enforcement operations on high-risk vessels were supported and encouraged to increase compliance with the minimum safety regulations. These activities hopefully will promote greater participation in fishing vessel exams nationwide in the long term.

3. Those involved with the CFVS program plan to improve upon the sharing of *best practices* and *lessons learned* with the fishing industry and USCG personnel. In theory education of the fishermen regarding the risks associated with their profession and risk reduction measures will help reduce casualties.

LONG TERM ACTION AREAS

1. Improve emergency preparedness drill enforcement. Commercial fishermen too often die because they *are not* well versed in emergency preparedness procedures, despite existing safety regulations. This action item will give law enforcement officers better tools to determine the degree of compliance with existing regulations, which require monthly drills for crewmembers.

2. Complete an existing regulatory project on fishing vessel stability and watertight integrity. From 1994-1998, 343 (or 49 percent) of all fishing vessels lost, were lost due to stability and/or watertight integrity casual factors. Also, 119 (or 33 percent) of all commercial fishing related deaths resulted from fishing vessel losses involving stability and/or watertight integrity as causal factors. Since stability and watertight integrity regulations already exist for *new* vessels of at least 79 feet – this action area will be applicable *only* to *new* fishing vessels *less* than 79 feet. The majority of U.S. fishing vessels are less than 79 feet, and the majority of marine casualties affecting fishing vessels and their crews involve these smaller vessels. So it makes good sense to address the larger pool of vessels at risk.

3. Improve casualty investigations and analysis. This action area is well underway. Currently a detailed review and analysis of about 1,100 fishing vessel casualty cases is being conducted in an attempt to identify casual factors and, in so doing, prevent similar casualties from happening in the future. Preliminary measures have been taken in the design of a new information database which will allow us to readily collect and query important casualty information, without a detailed review of individual casualty cases as is necessary when using the current database. The capabilities of this new database, along with analysis of SAR data, will help us better identify risks associated with certain variables, such as *fishery*, *operational design*, and *hull material*. We're also considering ways to better normalize casualty data to allow us to improve both our ability to identify relative risk and our focus on regional safety issues.

4. Improve communications. Measures have been taken to better communicate *lessons learned* and *best practices* to the fishing industry and USCG personnel in each of the following areas:
   National CFVS Week
   National CFVS Newsletter
   National CFVS Web Page
   National Media Campaign

5. Coordinate fishery management with safety. Fishery management decisions greatly affect the safety of fishermen. For instance, a decision to permit

fishing, *only* within a short time window, influences fishermen to fish during that time period in order to make a living. This practice, although quite effective in managing fisheries, sometimes leads to marine casualties and the loss of life when the short time window coincides with poor weather conditions. This action area is now in-progress and will be continued over the long-term. District CFVS Coordinators now attend Fishery Council meetings and provide advice on management decisions that might affect the safety of fishermen.

6. Seek authority and funding for mandatory vessel examinations and mandatory safety training. Fishing vessel exams help save lives, but our examiners spend too much time trying to convince fishermen to allow them on board and less time actually conducting exams.

   If fishing vessel exams were made mandatory, then examiners would be able to conduct a greater number of exams and evaluate the overall structural & watertight integrity of fishing vessels as well.

   We envision that the scope of mandatory exams would be similar to our existing *voluntary* exams and will concentrate on the existing safety equipment requirements.

7. A mandatory training based certificate program. Based on casualty investigations, it has been recognized that there is a safety training deficiency in the fishing industry. Moreover, the Fishing Vessel Advisory Committee, in their evaluation of Task Force recommendations, ranked *safety training* as one of their top ten initiatives to help save fishermen's lives. The certificate program will not be a traditional operator and crew licensing, and like mandatory examinations versus mandatory inspections, would likely be much more acceptable to most fishermen than *traditional* licensing. The training curriculum will reflect the existing emergency drill requirements and will address the basic safety knowledge needs of fishing vessel operators as well as their crews.

8. Request that Territorial Sea Baseline be substituted for Boundary Line in an amendment to the Fishing Vessel Safety Act. The location of the Boundary Line relative to the coast varies widely throughout the United

States and is not the best demarcation for safety equipment regulations. For instance, the Boundary Line swings out beyond 50 miles from shore in Southern California. Yet, in the Gulf of Mexico, the Boundary Line is 12 miles from shore, and in other areas of the United States the Boundary Line runs along the shoreline. For instance, the fishing vessel *Lindy Jane* sank about 50 miles off the Southern California Coast and the 3 fishermen on board died of hypothermia in about 4 hours. This vessel was not required to have a survival craft on board, since it was not beyond the Boundary Line. The Territorial Sea Baseline, however, is a much more consistent reference in relation to the coastline and will allow us to harmonize safety regulations with the risks associated with varying levels of environmental exposure.

Though the CFVS Program has been success in improving safety in the fishing industry through existing efforts, it has nevertheless reached a plateau – and while commercial fishing is safer than in the 1980s, it persists as one of our nation's most hazardous industries.

Through implementation of our Action Plan, we expect to have a significant and positive impact on the level of safety in the fishing industry.

FISHING VESSEL SAFETY — A MARINE ACCIDENT INVESTIGATOR'S PERSPECTIVE

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John Lang is a professional sailor who first went to sea in the British Merchant Navy in 1959. He transferred to the Royal Navy in 1962 and became a submariner and specialist navigator. During his naval career he commanded two submarines and a frigate and was, during the Gulf War, Director of Naval Operations in the Ministry of Defence in London. His last appointment before retiring from the Navy in 1995 was Deputy Chief of Defence Intelligence. He was appointed the United Kingdom's Chief Inspector of Marine Accidents in 1997. He lives in Winchester, is married and has two children.

INTRODUCTION

Fishing is among the most dangerous occupations in the world and has, in the UK today, one of the worst safety records of any industry. Although the number of fishing vessels being lost and fishermen being killed has reduced significantly in recent years as the size of the fishing fleet reduces, the number of deaths remains high and, on average, one UK registered boat founders every two weeks.

This paper focuses attention on the work of the UK's Marine Accident Investigation Branch (MAIB), explains what it is doing to prevent fishing vessel accidents, describes some of its findings from recent investigations and discusses the difficulties it has in trying to change attitudes within the industry. The problems it encounters are, it seems, identical to those experienced elsewhere in the world.

BACKGROUND

The UK's fishing industry is very diverse and embraces a wide range of activities from deep water pelagic fishing to scalloping, and from coastal netting to single handed potting. In June 2000 there were 7307 registered fishing vessels.

Although fishing's contribution to the UK's Gross Domestic Product is small, it tends to be a major employer in some coastal communities and is an established way of life for families who have been in the business for generations. The culture of the industry tends to be steeped in the past and those engaged in it are forever preoccupied with the traditional problems of battling with the elements, dwindling stocks, ever more regulations, rising costs, quotas and what they see as unsympathetic bureaucrats.

The majority of British fishermen are self-employed. Although many of them have an instinctive feel for safety and practice it in their own way, others virtually ignore it. Given a priority they will focus any new investment into ways of catching more fish.

Although many fishermen will maintain they are safety conscious, the evidence from accident investigation indicates otherwise. Costs weigh heavily on their minds and they will argue that meeting any new regulation to improve safety is prohibitively expensive. But as the MAIB frequently points out, nearly all the accidents investigated could have been prevented, not by investing in large sums of money, but by exercising greater care. Again and again it has been found that the enemy of safety is not so much a shortage of money, as the fisherman's failure to adopt a safety culture with everyone doing their best to prevent accidents happening in the first place.

THE MARINE ACCIDENT INVESTIGATION BRANCH

The MAIB was formed in 1989 and is responsible for investigating marine accidents to UK vessels and to any vessel involved in an accident in UK waters. It is entirely independent of the UK's maritime regulatory body and the Chief Inspector reports direct to the Secretary of State responsible for transport.

FISHING VESSEL ACCIDENTS — THE DETAILS

LOSS OF LIFE

Since 1992, 237 fishermen sailing in UK registered fishing vessels have lost their lives. A particularly tragic form of death that continues to feature regularly among the inshore fishermen, is the loss of lone fishermen who drown when they fall or are dragged overboard.

FOUNDERINGS

Two factors have emerged as the dominant features in vessel capsizings — a startling lack of knowledge about basic stability and adding top weight during conversions without recourse to professional naval architecture advice. Lack of stability knowledge is exemplified by conditions such as overloading, and an acceptance that water sloshing around in either the engine room or fish hold is no more than an inconvenience or occupational hazard. Fishermen may fail to realise that such a condition can lead to a rapid capsize and loss of life.

We have also been very struck by the near total indifference to the consequences of leaving weathertight hatches and doors open when not in use at sea. Few fishermen even know which doors fall into this category and the MAIB has argued strongly for them to be clearly marked so there can be no misunderstanding.

To aggravate the situation further, many fishermen fail to maintain bilge alarm systems in full working order. In many instances where undetected flooding has taken place, the alarm stopped working, but nothing had been done to repair it, or it had been landed for repair and was not on board when the flooding occurred.

NAVIGATIONAL ERRORS

Many accidents are caused by vessels running aground, usually at night, either en route to, or returning from, the fishing grounds. Analysis of the causes can be divided into two main categories, fatigue or an over reliance on automatic navigation aids.

Fatigue is endemic in the industry. Few fishermen get adequate sleep and, as they become increasingly tired, they make mistakes and there are numerous incidents of watchkeepers falling asleep in their wheelhouse chairs. The popular panacea for the problem is the fitting of a watch alarm but even this has its limitations. The alarm sometimes doesn’t work, is occasionally switched off and, perhaps most worrying of all, can be ineffective in keeping an extremely tired man awake. The reality is that even the most efficient system does nothing to alleviate the root cause of tiredness; excessively long working hours.

Trawls have been known to snag on pipelines and one particularly tragic accident in the North Sea recently led to the vessel capsizing with the loss of her entire crew when her trawl caught beneath one.

LOOKOUT AND COLLISIONS

The number of collisions involving fishing vessels shows no signs of reducing. They usually occur between fishing vessels or with a larger merchant vessel; sometimes with a yacht or other small craft.

Two explanations feature repeatedly: an unmanned wheelhouse with the watchkeeper going below to help stow fish or have a cup of tea, or the watchkeeper's lack of knowledge about what to do. There have been several instances where the person on watch was found to have only a rudimentary knowledge of the Regulations for the Prevention of Collision at sea. There is a naïve, and widespread, expectation among many that because the fishing vessel is a 'working vessel,' and shows lights or shapes to that effect, everyone else is obliged to keep clear.

Although the two reasons given are the most common causes of collisions, the failure to maintain an efficient lookout is frequently evident. At one end of the scale we have watchkeepers physically prevented from maintaining a good lookout by the structure of the vessel itself while at the other we have those who deliberately occupy their time doing something else. The MAIB has evidence of watchkeepers more engrossed in reading a magazine, or watching television or using the opportunity to catch up on lost sleep.

PERSONAL INJURIES

A fishing vessel is by its very nature, a hazardous place to work. No other industry involves its people having to function in a constantly moving environment by night and day in every type of weather. The risk of personal injury to individuals is extremely high and most especially to the inexperienced or the unwary. Although in many ways it is remarkable there aren't more injuries, investigations reveal that many of those that do occur could have been avoided had better protection been provided or greater care taken by individuals.

Some preventative measures are self-evident. A number of accidents have occurred because winch operators have not had a clear view of the working deck, winches or derricks and had failed to recognise the importance of watching colleagues as they worked in their vicinity. A hard hat can protect against some head injuries. Winch guards may stop people falling into them. Properly supervised repairs on equipment will avoid sub-standard work that could lead in turn to something parting when a load is applied. The provision of an effective, and well-placed, emergency stop button to cut power to machinery might prevent a person's hand being trapped or severed.

FIRE

The numbers of fires on board fishing vessels are similar to those found elsewhere in the shipping world. The causes are often the same, such as leaking oil coming into contact with a hot surface, or impregnating combustible material.

Some fires start in the galley, often through carelessness. The galley in a fishing vessel tends to be part of the communal living area and provides a greater number of opportunities for fires to start. Heat sources are often left on without people being aware of it while clothing left hanging close by sometimes catch fire.

The fisherman may also be less prepared than seafarers in other types of vessels in his ability to handle a fire. Although many fishermen receive a basic training in fire-fighting, investigations into fires at sea suggest that many of the lessons they should have learned are forgotten, usually because any form of onboard training is virtually unheard of. Even the routine securing of fire doors is extremely rare.

Until fishermen start to take the risk of fire more seriously and begin to practice even basic drills on board, the risk of a fire seriously damaging a vessel and affecting the livelihood of the crew will remain.

LIFESAVING APPARATUS

When the most serious events occur and it becomes necessary for the crew to abandon ship, there is an expectation that the lifesaving apparatus will function as designed. Too often it fails to do so, not so much because the design is at fault but because the equipment has either been installed incorrectly, or it has not been serviced or maintained properly. There are even instances of it not being on board at all.

The MAIB has uncovered examples of Electronic Position Indicating Radio Beacons (EPIRB) not being serviced correctly, registered to the wrong vessel, and even installed in such a way that they were unable to release automatically. The hydrostatic release mechanism in one EPIRB examined revealed it had been painted over and could not operate at all. There is also evidence that EPIRBs tend to get caught in the structure of a sinking fishing vessel and cannot reach the surface if the vessel inverts. Such a discovery has lead to studies being undertaken to resolve the problem.

Life raft installation is a perpetual problem. Although the life raft is very much the last resort for survival, many of the smaller boats do not carry them even though they can, and do, save lives. Many single-handed operators argue against the expense of providing them to the standards required by the regulatory body. The failure to connect the hydrostatic release unit correctly, and steps to ensure the painter is attached properly, are commonplace.

SURVIVAL

If everything goes wrong and the fisherman goes over the side, the last link in the safety chain is personal survival. The average fisherman is extraordinarily reluctant to wear a life jacket, usually because he will claim it is too bulky, is impractical for the work he does or is too expensive. To an extent the criticisms are justified; very few life jackets are suitable for use by fishermen but they do exist and are available. There are two other reasons for such reluctance to wear them; it doesn't fit the image and few will risk the derision of their peer group, and there are still many who adopt the fatalistic approach that if they fall into the sea, death is inevitable.

There are, however, signs of change. Families are beginning to realise that following an accident the chances of their loved one surviving could have been greatly increased had the victim worn a life jacket. The tragedy is that it takes a loss of life to persuade people to change the culture of a lifetime.

A number of fishermen are believed to have died from hypothermia rather than drowning and this is often overlooked as a cause of death. Survival suits for people who work at sea warrants further attention.

GETTING THE MESSAGE ACROSS AND SUMMARY

Informal discussions with similar marine accident investigation organizations across the world indicate that the causes of fishing vessel accidents tend to be very similar. Identifying the causes is not the problem; doing something about it is. There are three ways of reducing the number of accidents; more effective regulations, improving the design of vessels, and the equipment carried; and persuading the fisherman to change the habits of a lifetime and adopt a more safety conscious culture. Each of these solutions has a part to play.

One of the traditional traps that most people fall into when trying to change the culture of the industry is to impose measures from outside. The fisherman does not take kindly to non-fishermen telling him what to do. An official in a grey suit, or a seaman who has come ashore from the merchant navy, or the enthusiastic academic who tries to persuade fishermen to change is as likely to aggravate the situation as improve it.

The fishing community must change its attitudes and adopt a safety culture. Every individual fisherman must be concerned about safety so that it becomes second nature to carry out basic checks and to correct things that are wrong. They must be seamen as well as fishermen and they must resist the temptation to condemn anyone who suggests there are better ways of doing things.

There are, arguably, already far too many regulations in the industry. There is not so much a need for more of them, but a greater willingness to enforce those that already exist. But many of the regulations would be superfluous if fishermen would adopt a more safety conscious attitude; by not overloading their craft; by seeking professional advice when adding new top weight; by looking to see if their life rafts were correctly installed and by not watching TV when on watch during a passage back from the fishing grounds.

Ministers, civil servants, the police, coast guards, even accident investigators can make compelling cases for improvements but ultimately, it is the fishermen themselves who are best placed to change things. The fisherman will seek his own council and only listen to those he respects. There are four people who can influence him: his girlfriend or his wife, his mother and, most important of all, his grandmother. She is the one person who has seen it all before; who has experienced the agony of death or crippling injury, the loss of an income or the high cost of an accident.

Safety at sea in the fishing industry must be taken seriously but need not be expensive. To ignore it only adds to the costs. To think it doesn't matter will only mean the list of those who have lost their lives at sea will increase, and the number of people mourning the loss of fine vessels and people will grow. The trends must be reversed.

Nearly every accident at sea is preventable. It only requires a little more care, and more attention paid to learning the lessons from the misfortunes of others, to make fishing a safer and more profitable industry.

FACTORS GOVERNING THE DEVELOPMENT OF NATIONAL RULES AND REGULATIONS FOR THE CONSTRUCTION AND EQUIPMENT OF SMALL FISHING CRAFT

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Mr. Turner is a UK national, and studied naval architecture at Southampton University UK after spending four years as a yacht skipper in the Mediterranean and Caribbean. Following graduation in 1977, he worked as a commercial naval architect, shifting from yachts to small commercial and fishing craft, and carrying out consultancy work on behalf for governmental and non governmental organisations in developing countries around the world. Mr. Turner is Senior Fishery Industry Officer, Food and Agriculture Organisation of the United Nations, Rome, Italy.

This paper draws extensively on the 1995 Recommendation of the Council of the OECD on Improving the Quality of Government Regulation (OECD, Paris).

Given that there has been no significant reduction in fatality rates in the fishing industries of most countries of the world despite many initiatives to improve safety, it is clear that the processes of government and industry intervention addressing the design, construction and equipment of fishing vessels, together with those dealing with training and certification, require fundamental review.

Profound effort has been invested at an international level in attempting to improve safety at sea through the formulation of guidelines and conventions. This work has been meticulously done, taking into account the design and construction of vessels, stability, load lines, mechanical equipment and gear, safety equipment, communications, effects of weather and icing, working conditions and hours, training of licensed personnel, etc. The various international voluntary guidelines, developed primarily to serve as a guide to those concerned with framing national laws and regulations, have had little effect because they have not been put into practice. The Torremolinos Protocol, being the only international instrument adopted for fishing vessels (decked fishing vessels over 24 m [approximately 79 ft] in length) is unlikely ever to come into force because its provisions are seen as being either too stringent or too lenient by the countries whose signatures are required to bring it into force.

While many countries have regulations concerning the design, construction and equipment of their vessels, these regulations in developing countries are sometimes outdated, inappropriate and not enforced. In developed countries, regulations (ranging from stringent to lenient) have not always lead to a significant decrease in fatalities. The following failings have been suggested: they may not be in tune with the operation or requirements of the industry; they may be poorly enforced or unenforced; they may be unclear; there may be insufficient training within the industry to ensure full compliance, and insufficient training to enforcers to ensure their expertise and credibility. Furthermore it seems that on one hand, as vessels are made safer, the risk barrier taken by the operators is pushed further towards the limits in the ever increasing search for good catches; on the other hand, the continued upgrading of technical equipment is not always accompanied by sufficient training in its operation.

Poor relations between regulators and the industry do not foster compliance and have been seen as a contributory factor to lack of effect.

Before considering in detail the many issues to be addressed during the formulation of regulations concerning the safety of fishing vessels, it is pertinent to explore in some depth the broader role, objective and necessity of regulations within society, and to consider their formulation, effectiveness and implementation.

THE NEED TO IMPROVE REGULATION

Regulation refers to the diverse set of instruments by which governments set requirements on enterprises and citizens. Regulations include laws, formal and informal orders and subordinate rules issued by all levels of government, and rules issued by non-governmental or self-regulatory bodies to whom governments have delegated regulatory powers, and fall into three categories: economic, social and administrative.

Economic regulations intervene directly in market decisions such as pricing, competition, market entry, or exit. Reform aims to increase economic efficiency by reducing barriers to competition and innovation, often through deregulation and use of efficiency-promoting regulation, and by improving regulatory frameworks for market functioning and prudential oversight.

Social regulations protect public interests such as health, safety, the environment, and social cohesion. The economic effects of social regulations may be secondary concerns or even unexpected, but can be substantial. Reform aims to verify that regulation is needed, and to design regulatory and other instruments, such as market incentives and goal-based approaches, that are more flexible, simpler, and more effective at lower cost.

Administrative regulations are paperwork and administrative formalities — so-called "red tape" — through which governments collect information and intervene in individual economic decisions. They can have substantial impacts on private sector performance. Reform aims at eliminating those no longer needed, streamlining and simplifying those that are needed, and improving the transparency of application.

While numerous economic regulations have been reformed or repealed over the last two decades to make markets more competitive and encourage economic efficiency, few efforts have been made to reform or enlarge the vast majority of social regulations. This is largely due to the fact that powerful interest groups exist that support or oppose these rules, especially those on the environmental front. Critics of current social regulations argue that rules are inflexible, expensive and administered in a "command and control" fashion. Proponents of the current system reply that strict rules are needed to deter unfavorable behavior and outcomes.

Industry leaders argue that workplace laws and mandates are placing unfair and expensive burdens on their shoulders. Supporters of the regulatory system argue that strict rules and regulations are needed to protect worker safety and guarantee employee rights. Employers reply that such edicts actually end up hurting workers more in the end than helping them since they increase costs, lower wages and eliminate employment opportunities. All this makes it clear that the process of regulating effectively is fraught with difficulties. During the provision of assistance to its member governments regarding the formulation of regulations aimed at improving safety at sea in the fishing industry, FAO has found that use of the OECD Reference Checklist for Regulatory Decision-making is of interest and value as a methodology for improving the regulatory process.

The Checklist responds to the need to develop and implement better regulations and contains ten questions about regulatory decisions that can be applied at all levels of decision and policy-making. These questions reflect principles of good decision-making that may be used by administrations to improve the effectiveness and efficiency of government regulation by upgrading the legal and factual basis for regulations, clarifying options, assisting officials in reaching better decisions, establishing more orderly and predictable decision processes, identifying existing regulations that are outdated or unnecessary, and making government actions more transparent.

QUESTION 1: IS THE PROBLEM CORRECTLY DEFINED?

The first stage of defining the problem must include not only evidence of its nature and magnitude, but also explain why and how the problem has arisen. The process must include the views of all partners, taking account of their perceptions and perspectives.

Definition of the problem will suggest potential solutions, as well as eliminate those that are unsuitable or unworkable. Regulators must document the full scope of the issue in question, and examine supporting and opposing linkages between incentives of affected groups. When existing regulations are under review, the regulator must assess whether the nature or scope of the problem has changed since the adoption of the original regulations in such a way that a complete change in regulation is required.

In addressing fishing vessel safety, it would be expected that the regulator would be confronted with evidence of high rates of accidents and fatalities, as well as statistics revealing the primary causes of loss of life. But to formulate regulations which can be effectively implemented, the formulator must be aware of the state of the fisheries under consideration: how have they developed and diversified, how are they managed and by whom and with what effect, are they primarily artisanal or industrial, what are the levels of experience, skills, training and education, and so on.

Insufficient understanding by regulators with merchant marine backgrounds of the fishing industry, its evolution, nature and significance within many coastal communities, and particularly in regarding a fishing vessel as a place of work as opposed to a means of transport leads to basic flaws in regulation formulation leading to lack of their acceptance by those who should abide by them.

Not all problems can be resolved by government action. Problem definition must isolate those factors which government can influence through intervention, or alternatively, illustrate that government may not have the capacity to address the issue.

QUESTION 2: IS GOVERNMENT ACTION JUSTIFIED?

Government intervention should be based on clear evidence that a problem exists, and that government action is justified, taking into account government policy, the likely benefits and cost of action (based on a realistic assessment of government effectiveness) and alternative mechanisms for addressing and solving the problem. In the fisheries sector, such alternatives for consideration might include the provision of voluntary guidelines, delegation of responsibilities to fishermen's associations and other non-governmental organisations (NGOs,) etc. Since these alternatives are non-mandatory, and given that fishing is probably the most dangerous occupation, government intervention is justified as an additional measure to safeguard the health and safety of fishermen.

QUESTION 3: IS REGULATION THE BEST FORM OF GOVERNMENT ACTION?

The decision about how to intervene is as important as the decision about whether to intervene. A number of regulatory and non-regulatory instruments are available, having very different implications for results, costs, and administrative requirements. Regulators prefer a "command and control" form of regulation for a number of reasons: ease of enforcement, clarity for regulated groups, and certainty of intent. The drawbacks might include rigidity, tendencies to be over-detailed, inflexibility, high costs, adversarial nature, and in some cases, ineffectiveness and unenforceability.

It is the view of FAO that quality regulation is one of the key tools to ensure safety at sea, but that it serves little purpose unless accompanied by high quality training and enforcement programs. Voluntary safety initiatives initiated by government administrations have in general not been effective in improving safety due to inadequate participation by those concerned.

QUESTION 4: IS THERE A LEGAL BASIS FOR REGULATION?

Where parliaments delegate broad regulatory powers to ministries, sub-ministries and independent arms of departments of ministries, there may exist the difficulty of ensuring legality because the nature and limit of the delegated authority may become more open to interpretation.

Furthermore, it is pertinent to ask whether the regulation is compatible with existing legislation, including internal agreements, convention or internationally agreed (though voluntary) codes of practice. Where it is deemed that new regulations are required, they must co-exist comfortably with existing regulations, or the latter should be repealed or amended. Examination of international agreements will not only indicate whether the problem has been dealt with elsewhere, but will also support a longer-term process of regulatory coordination and harmonization.

In this respect, it is worth noting that Ministers responsible for fisheries from 126 countries [1] met in Rome on 10 and 11 March 1999 as a sign of their attachment to the implementation of the Code of Conduct for Responsible Fisheries adopted by the FAO Conference at its Twenty-eighth Session in October 1995 which contains several references to the responsibilities of governments concerning safety at sea, and in particular, the statement that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

QUESTION 5: WHAT IS THE APPROPRIATE LEVEL OF GOVERNMENT TO TAKE ACTION?

Governments can chose whom should act. Given the nature of the problem, what level, or system of cooperation among levels of government can regulate most efficiently? The answer to this question rests on several criteria: does the problem cross political boundaries, are the issues of a national, regional or local character, are there economies of scale in regulating at national level, what are the institutional capacities at national, regional or local levels? All these criteria are of particular relevance to fisheries.

It would be expected that various Ministries or departments, competencies as well as levels of government, be involved in the development and implementation of regulations. The regulator should consider how consultation and coordination could be effectively carried out during both formulation and implementation between levels and departments of governments, recognizing that ultimate responsibility for fishing vessel safety can lie with only one authority.

The selected authority must recognize the diversity of the industry that they are to regulate. Taking account of the evolution, ownership patterns and operating norms of the artisanal and industrial fisheries might result in differing regulatory approaches. In many countries, artisanal fisheries have existed outside the regulatory framework and opportunities may exist to develop good partnerships in the regulatory consultation process from the outset. Within larger countries, some fisheries are likely to be specific to a particular region of the country, operating with different loading patterns, for differing durations in different sea conditions, suggesting differing regulations for different regions.

QUESTION 6: DO THE BENEFITS OF REGULATION JUSTIFY THE COSTS?

Regulators rarely assess the cost of new regulations, nor do they assess the magnitude or value of expected benefits. While it is possible and desirable to assess the fiscal value of benefits derived from effective safety legislation and regulations (which would include putting fiscal value on human injury and life), it is harder to determine the standard or magnitude of acceptable risk. The cost of each regulatory proposal should be estimated and should include cost of compliance to all affected parties including consumers, owners, crews and various levels of government. Estimates should also include the administrative costs of regulation (and nonregulatory alternatives) including enforcement costs, although these costs are likely to be significantly lower than those costs borne directly by the private sector. It is reasonable that a pragmatic approach be taken to the issue of cost and benefit estimation, and the effort invested should be in proportion with the potential impact of regulation. Given that the fishing industry has the highest fatality rate amongst all occupations, a significant effort of estimating costs and benefits seems well justified, and will enable a prioritization among the alternative regulatory proposals by enabling the cost of each to be considered, together with its likely impact and ease of implementation.

QUESTION 7: IS THE DISTRIBUTION OF EFFECT ACROSS SOCIETY TRANSPARENT?

Regulators should consider the distribution of regulatory costs and benefits across those groups affected by the proposed regulations. Often, costs are not imposed on the same segment of society that benefits from the regulation. For example, labor regulations may benefit workers with jobs while making it harder for the unemployed to find jobs; vessel safety regulations are likely to impose costs on vessel owners while benefiting the crews. This means that policy officials should consider the issue explicitly to determine whether compensation or incentives are appropriate for adversely affected groups.

QUESTION 8: IS THE REGULATION CLEAR, CONSISTENT, COMPREHENSIBLE AND ACCESSIBLE?

Regulators should assess whether rules will be understood by all likely users, and to that end should take steps to ensure that the text and structure of rules are as clear as possible. This step in the decision process can improve not only the text of regulations, but can reveal unexpected ambiguities and inconsistencies. Clear and precise language also reduces the costs of learning about rules, minimizes disputes during implementation, and improves compliance. Regulators should also examine regulations for consistency of language and format with other regulations, the logical sequence of drafting, and the adequacy of definitions. Use of technical jargon should be minimized. Regulations incorporated by reference should be easily available. Finally, the strategy for disseminating the regulation to affected user groups should be considered.

QUESTION 9: HAVE ALL INTERESTED PARTIES HAD THE OPPORTUNITY TO PRESENT THEIR VIEWS?

Regulations should be developed in an open and transparent fashion, with appropriate procedures for effective and timely input from interested parties such as affected industry representatives, trade unions, wider interest groups such as consumer or environmental organizations, or other levels of government. Of particular value would be fishermen's safety councils or fishermen's organizations dedicated to safety. Consultation and public participation in regulatory decision-making have been found to contribute to regulatory quality by:

Bringing into the discussion the expertise, perspectives, and ideas for alternative actions of those directly affected;

Helping regulators to balance opposing interests;

Identifying unintended effects and practical problems;

Providing a quality check on the administration's assessment of costs and benefits; and

Identifying interactions between regulations from various parts of government.

Consultation processes should ensure that all parties share a sense of ownership and responsibility in the application of the new regulations and also enhance voluntary compliance, reducing reliance on enforcement and sanctions.

QUESTION 10: HOW WILL COMPLIANCE BE ACHIEVED?

Even after the most rigorous decision-making process inside the administration, regulation has yet to pass the most demanding test of all: the public must agree to comply with it. Yet implementation, consisting of strategies such as education, assistance, persuasion, promotion, economic incentives, monitoring, enforcement, and sanctions, is very often a weak phase in the regulatory process in countries that tend to rely too much on ineffective punitive threats and too little on other kinds of incentives. Implementation should be considered at all phases of decision-making, rather than left to the very end. One common source of noncompliance, for example, is failure of affected groups to understand the law, which may result from poorly drafted or overly complex regulations, or inconsistent interpretations by enforcement officials. Implementation considerations will also strongly affect decisions about alternative forms of action. Realistic assessment of expected compliance rates, based on available compliance and enforcement strategies, may suggest that one policy instrument is more attractive than another that appears more effective on paper, but is likely to be more difficult to implement.

CONCLUSION

The Checklist cannot stand alone: it must be applied within a broader regulatory management system that includes elements such as information collection and analysis, consultation processes, and systematic evaluation of existing regulations.

Government policy to regulate for safety at sea in the fishing industry must be accompanied by a total commitment to implement that regulatory regime, along with the necessary resources. Implementation encompasses a set of strategies that might include education, assistance, persuasion, promotion, economic incentives, monitoring, enforcement and sanctions, all of which are accompanied by the setting up or improvement of administration and associated costs. Implementation must be considered at every phase of the regulation formulation, and not considered as a final consequence of regulation.

While it may be true that "legislation is only as good as its enforcement," legislation cannot be improved by enforcement. The quality of the legislation remains the limiting factor. In many parts of the world, additional regulations for fisheries are not required. The overriding need is for regulations to be reviewed and amended to reflect the problems and their root causes; the process of regulatory review must be as dynamic as the industry being regulated. The regulators and regulated need the necessary training to ensure compliance and enforcement as well as a working relationship promoted by mutual respect and trust.

FOOTNOTES

1.The Rome Declaration on Responsible Fisheries was adopted unanimously by the Ministerial Meeting on the Implementation of the Code of Conduct for Responsible Fisheries, convened in Rome on 10 and 11 March 1999. The Meeting was attended by 126 Members of FAO: Albania, Algeria, Angola, Argentina, Australia, Austria, Bahamas, Bangladesh, Barbados, Belgium, Belize, Benin, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Chad, Chile, China, Colombia, Republic of Congo, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Democratic People's Republic of Korea, Denmark, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Estonia, Ethiopia, European Community, Fiji, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea Bissau, Guyana, Haiti, Hungary, Honduras, Iceland, India, Indonesia, Iraq, Ireland, Islamic Republic of Iran, Italy, Jamaica, Japan, Kenya, Republic of Korea, Liberia, Libyan Arab Jamahiriya, Lithuania, Madagascar, Malaysia, Malta, Mauritius, Mexico, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Samoa, Saudi Arabia, Senegal, Slovenia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Syria, Tanzania, Thailand, The Former Yugoslav Republic of Macedonia, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States of America, Uruguay, Vanuatu, Venezuela, Viet Nam, Yemen and Zambia.

FISHERMAN'S OVERVIEW OF THE MARINE PREDICTION CENTER

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Mr. Chesneau graduated from the University of Wisconsin, Madison,Wisconsin in January 1972 with a BS in Meteorology, and then received a Commission as Ensign in the U.S. Navy where he served for seven and half years. During his career with several agencies of the U.S. government and the private sector, Lee provided marine weather and oceanographic warnings, analyses, and forecasts on a global scale covering all ocean and seasons. As an experienced ship router, he developed a keen awareness of the issues that confront marine vessels of all type including the commercial fishing industry. In addition to his ongoing forecast experience,he is a certified instructor at the Maritime Institute of Technology and Graduate Studies (MITAGS), in Linthicum Heights, Maryland in support of the National Weather Service (NWS) outreach goals.He teaches Heavy Weather Avoidance (HWA) and NWS warning and forecast product interpretation to mariners enrolled in the course curriculum. This endeavor has helped shape today's Marine Prediction Center.

MARINE PREDICTION CENTER'S (MPC) MISSION

The U.S. National Weather Service (NWS) has the responsibility for issuing warnings and forecasts to protect life and property for the maritime community. Located in Camp Springs, Maryland, the Marine Prediction Center (MPC) is a component of the NWS's National Centers for Environmental Prediction (NCEP), of which there are eight centers. The MPC was first established in 1995, as the NWS modernized to meet the U.S. national interest. The International Maritime Organization (IMO) established The Safety of Life at Sea treaty, better known as SOLAS, so member nations as signatories can standardize and enhance opportunities for safer passage while at sea. The U.S. is a signatory to this treaty. Thus, the products and services provided by the MPC support the U.S. treaty obligations of SOLAS. These warnings and forecasts provided by the MPC are distributed by high-frequency (HF) radio-facsimile broadcast via the U.S. Coast Guard Communications Centers at

Boston, Massachusetts, and Pt. Reyes, California, for the North Atlantic and North Pacific Oceans, respectively. This paper will summarize both products and services produced by the MPC.

THE CUSTOMERS AND HIGH SEAS PRODUCTS

Marine vessels engaged in national and international trade routinely conduct transoceanic voyages with fast turn around times between ports of call. Large commercial ships require timely and accurate presentation of meteorological and oceanographic information in time and space over a large geographical area in order to plan for safe and economical operations. As illustrated by the tragic circumstances surrounding the *Andrea Gail* of "The Perfect Storm" fame, the commercial fishing community also requires the same timely and accurate information in perhaps a more regional geographic format. This information is most user friendly when presented in graphic form. The MPC, which includes an operational service unit, the Marine Forecast Branch (MFB), recognizes HF radio-facsimile as the most widely used medium by sea going vessels for receipt of graphically displayed environmental analyses and forecasts. It also meets its text product obligations as well.

RADIO-FACSIMILE PROGRAM

In the new millennium, mariners rely more and more on graphical presentation of weather and oceanographic information. The goal and mission of the MPC is to address the common needs and requirements of professional as well as recreational mariners engaged in transoceanic or regional crossings. Thus MPC offers the maritime community complete and timely graphic and text products to support navigation safety and operating efficiency. Three primary graphic types of products are issued: upper air 500-millibar (mb) charts, surface pressure, and sea state charts. Additional charts include sea surface temperatures (SST), tropical streamline and surface analyses, and meteorological satellite imagery. Text information is based on high seas and regional geographic boundaries consistent with a wide variety of maritime interests. Users whose specific or specialized requirements for high seas information are not met by these general safety-oriented products, are generally referred to the private meteorological and oceanographic sector for assistance.

UPPER AIR 500-mb PRODUCTS

The 500-mb charts are produced from a computer model of the atmosphere. The value of the 500-mb product to the mariner is of substantial significance that when understood and used properly can be the best tool for the mariner's safety decision making. These products are automated unmodified computer outputs that depict lines of equal height contours above the earth's surface (geo-potential heights) at 60 meter (m) intervals. Within the 60-m interval height contours, wind speeds of 30 knots (kn) and greater are shown with wind barb increments of 5 or 10 kn. Also embedded within the 500-mb height field are short wave troughs, generally 50 degrees or less in longitude. The trough axes are drawn on the charts as dashed lines. These short wave troughs will assist the mariner in locating surface low-pressure systems or developing lows on frontal waves, or can represent the bases for locating extended surface frontal boundaries or troughs. The 500-mb chart contains useful information for determining surface weather conditions and behavior of synoptic scale low and high-pressure systems. The 500-mb products are not intended to be used alone. The mariner is strongly advised to examine other radio-facsimile products described in the User's Guide located in the MPC Web Site (www.mpc.ncep.noaa.gov) in order to derive a complete picture of weather and sea state conditions.

SURFACE PRESSURE PRODUCTS

These products include four Surface Analyses per day transmitted in two parts, two full North Atlantic and Pacific Ocean 48-Hour Surface Forecasts, and one full 96-Hour Surface Pressure Forecast, once daily for the North Atlantic and Pacific Oceans. (See Figure One.) The MPC computer workstation aided surface analyses depict isobars, surface winds, frontal systems (occluded, stationary, cold, and warm), low- and high-pressure center positions, and central pressure. The Analyses include abbreviated ship reports participating in the NWS's Voluntary Observation Ship program. The 24-hour track history and 24-Hour Forecast position of each synoptic scale system's position and central pressure are displayed on 48/96-Hour Surface Forecasts. Wind feathers or barbs of winds 35 kn or greater, are depicted in increments of 5 kn. Synoptic scale systems having or expected to have "Gale", "Storm", or "Hurricane Force" conditions are labeled in bold capital letters. Similarly systems expected to develop "Gale" or "Storm", or "Hurricane Force" conditions within the next in 36 hours have labels of "Developing Gale" or "Developing Storm". Surface low pressure falls of 24-mb or greater during a 24-hour period are denoted in large capital letters as "RAPIDLY DEVELOPING" or RAPIDLY INTENSIFYING"

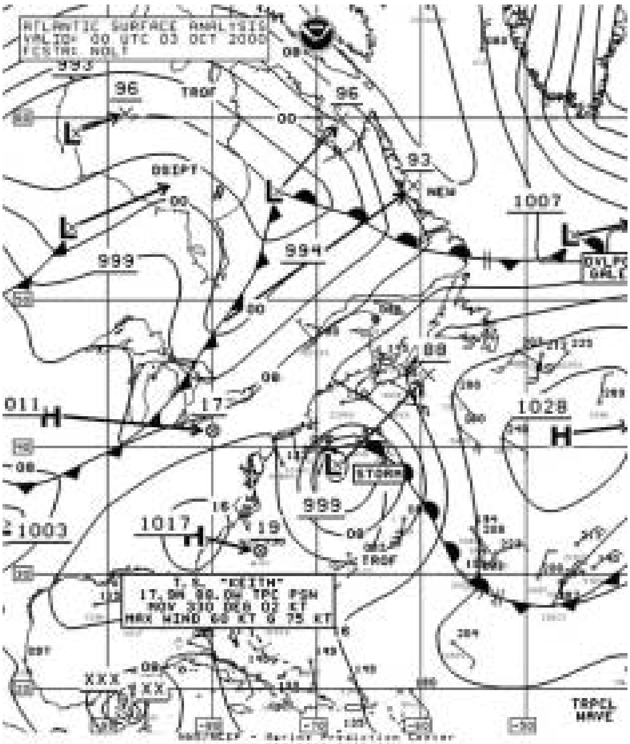

Figure 1: Sample Surface Analysis
(West half of North Atlantic Ocean)

SEA STATE AND WIND/WAVE PRODUCTS

One of the greatest hazards to a vessel's safety and sea keeping capability is the need to maneuver around and through changeable sea state conditions. Vessel Captains have the awesome responsibility to make transoceanic crossings with crew safety the highest of their priorities, while ensuring that the ship and its valuable cargo arrive at destination ports safely while meeting tight schedules. The duration of adverse or slowing seas must be minimized since turn around time in each port is usually less than 24 hours. The MPC issues one Sea State Analysis (1200 Coordinated Universal Time (UTC)), two 48-

Hour Wind/Wave Forecasts (from 1200 UTC/0000 UTC) and one 96-Hour Wind/Wave Forecast each day. During the winter cold season, the ice edge is depicted as a bold jagged line. The contours for these products are in 1-m intervals with a maximum combined sea height values centrally displayed and underlined. Forecast of primary swell direction arrows is also depicted. The Wind and Wave Forecasts, when viewed with the 48-Hour Surface Forecasts and Wave Period and Direction Forecasts, will help vessels make course and speed adjustments to avoid hazardous conditions and minimize exposure to slowing conditions.

REGIONAL PRODUCTS

Regional surface graphic products target both coastal and high-seas users. These products produced on polar stereographic map backgrounds encompass the western Atlantic Ocean west of 50° W. and north of 30° N., including the U.S. east coast and the Baja Peninsula, south to Cabo San Lucas, and north to the Gulf of Alaska, including Prince William Sound as far west as 150° W. The regional products consist of the 0000 UTC and 1200 UTC sea state analysis and 24-Hour Forecasts of the surface and wind/wave. The MPC's Marine Forecast Branch at NCEP in Camp Springs, Maryland, near Washington D.C., issues the sea state analysis and forecast products twice daily per ocean for 0000 UTC and 1200 UTC. The sea state analysis shows ship observations with observed winds (knot) and sea state in feet. The short range forecast products depict synoptic and mesoscale features of surface low and high pressure systems and isobars with frontal features, areas of reduced visibility, wind speeds, and significant wave height as generated by the synoptic and mesoscale weather systems within 1000 miles of the U.S. east and west coasts. The process of product preparation includes wind speeds derived from Special Sensor Microwave Imagery (SSM/I) or Scatterometer data received from a U.S. satellite from oceanic areas. This high state of the art technology of data input represents a significant enhancement in analyzing wind conditions in the marine environment. SSM/I and Scatterometer data is especially noteworthy in data sparse areas where there are no ship or buoy reports available. They also aid in short range prediction of the 24-Hour Forecast products by enabling marine meteorologists to compare initial data from forecast model output and making the necessary adjustments to the near term forecast solutions.

BASE MAPS

There are two types of base maps. The larger scale ocean base map is a Mercator projection and has latitude and longitude marked in 10-degree increments with 60° N. and the International Dateline highlighted in the larger Pacific Ocean basin. The Atlantic Ocean basin also in Mercator projection highlights 30° N. and 30° W. The second type of base map is the regional which encompasses the west and east coasts of the U.S. covering subsections of the Atlantic and Pacific high seas areas in polar stereographic projection. (See Figure Two.)

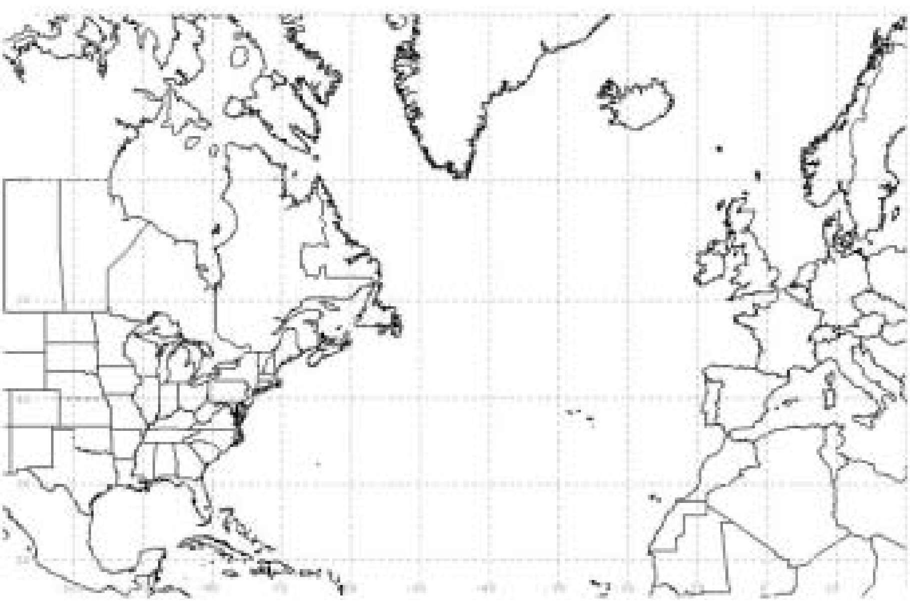

Figure 2: Sample Atlantic base map

500-mb ANALYSIS

These analyses are generated twice a day at 0000 UTC and 1200 UTC. They depict synoptic scale flow patterns, location, and amplitude of short waves. These synoptic scale features can be compared with previous analyses to determine the movement and trends of the upper air pattern. They can be used in conjunction with the surface analyses, sea state analyses, and meteorological satellite imagery, which are valid at the same synoptic time.

The surface analyses are generated four times per day (0000 UTC, 0600 UTC, 1200 UTC, and 1800 UTC) for each ocean. The analyses consist of isobaric pressure analyses at 4-mb contour interval spacing, labeled every 8-mb. The central pressure mb values of low and high pressure systems are depicted in bold three or four digits and underlined and placed adjacent to or under the “H” or “L”. The surface analyses also consist of abbreviated automated ship plots of wind direction (eight points on the compass rose), wind speed (in kn), present reported weather (using current standard symbols), and cloud cover amount. The product is issued in two parts, which overlap by some 10-degrees of longitude (between 165° W.-175° W. in the Pacific Ocean, and between 50° W. - 60° W. in the Atlantic Ocean). Both parts will project the low or high pressure system’s forecast position by drawing an arrow to the 24-hour position labeled as an “X” for lows and a circle with an “X” in the middle for highs with a bold two digit millibar central pressure value underlined under or adjacent to the 24-hour position label (e.g., 1050-mb high would be written as a 50 and a 960-mb low would have 60). Significant weather systems have labels depicting whether the system has “Gale” or “Storm” or “Hurricane Force” conditions, as observed by ship and buoy observations, Special Sensor Microwave Imagery (SSM/I), Scatterometer satellite data, or computer model guidance. If 36-Hour Forecast Gale, Storm, or Hurricane Force conditions are expected, the appropriate area has the label “Developing Gale” or “Developing Storm” or “Hurricane Force”.

The surface analyses have been doubled in size and issued as a two part product (0000 UTC Pacific Part 1, Part 2 ; 1200 UTC Atlantic Part 1, Part 2) to allow the mariner to use the surface analyses as a work chart. The mariner can also have the option to use the appropriate Parts 1 or 2 if operating only in that part of the ocean that will impact the vessel. The mariner can also compare the ship’s current barometric pressure reading and Beaufort Wind

Scale force conditions or anemometer readout of winds observed at the vessel to determine the product's validity. Mariners can then make their own inferences on how specific weather systems will impact their vessels. Used in conjunction with a 500-mb analysis, 1200 UTC Atlantic, the 24-Hour Forecast position of synoptic scale weather systems will aid in determining a weather system's motion and intensity trends, thus extending the usefulness of the product. The surface analyses will also be broadcast in a very timely manner, less than 3 1/2 hours from the valid synoptic time. This product is an important tool that can substantially aid in the independent decision making process for crew safety, protection of the vessel, prevention of goods or cargo damage, and maintaining schedules. These charts are produced every three hours (on the Internet) and twice daily (1200 UTC/0000 UTC) via HF Radio-facsimile broadcasts depict actual buoy and ship reports. Sea heights are analyzed every 3-feet increments.

SEA STATE ANALYSIS (1200 UTC ATLANTIC/0000 UTC PACIFIC)

This product is once a day per ocean at 0000 UTC for the North Pacific and 1200 UTC for the North Atlantic (example, 1200 UTC Atlantic and 0000 UTC Pacific Ocean with analysis of ship synoptic reports and automated weather stations such as CMANs for sea state in “meters”. The sea state analysis is prepared for each ocean at the time of day when the greatest number of observations are taken. The sea state analysis has solid 1-m contour intervals. Where appropriate, maximum and minimum combined wave height values (approximately 1/3 the height of the wind wave added to the height of the swell wave) are centrally depicted and underlined. To produce the final analysis ships and buoys reporting data along with the NCEP and Navy significant wave forecast models are used for guidance in areas of sparse data and are used to verify model guidance. The sea state analyses highlight where the most significant combined sea states prevail. When viewed together with the surface analyses, the user should have a complete picture of surface weather conditions in a very timely manner, thus substantially aiding the mariner in crew safety and the protection of property. (See Figure Three.)

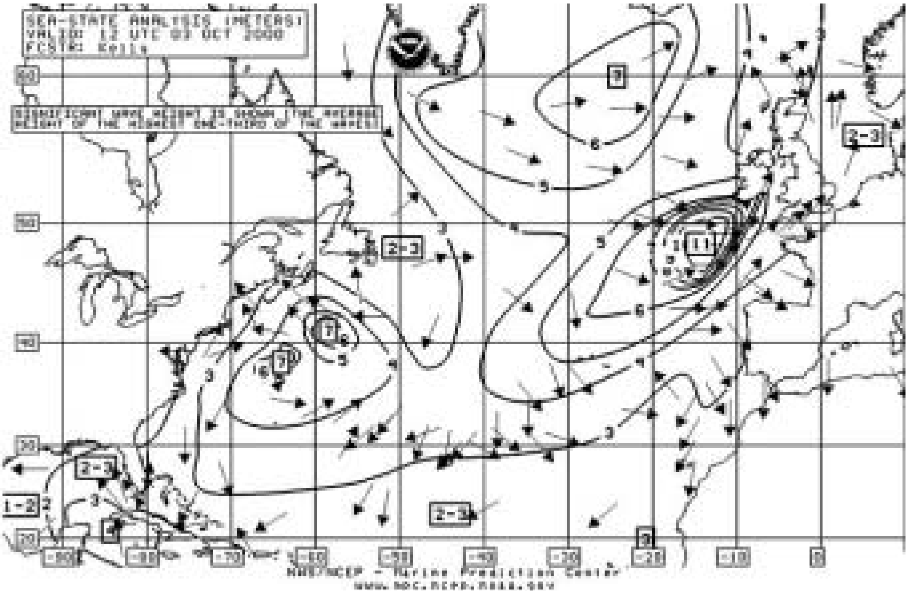

Figure 3: Sample Sea State Analysis

SUMMARY

In consultation with its customers, MPC has designed a timely product suite of graphics and high seas marine warnings and forecasts. When displayed together and organized the charts provide the mariner with a complete meteorological and oceanographic picture. Prudent decision-making dictates the mariner use all available information from as many sources as possible.

The MPC's Marine Radio facsimile Charts and High Seas Text Warning Forecasts program is designed to assist mariners in making decisions regarding the protection of the crew from injury, prevention of ship and cargo damage, fuel economy, and meeting fixed schedules, as well as serving the commercial fishing and recreational communities. The product suite is based on user feedback and input, and is always subject to review and revision. We strongly encourage input from the marine user community. For more information, please see MPC's Homepage website at www.mpc.ncep.noaa.gov.

Photograph and caption by Earl Dotter

College students repair nets after having signed on as crew on a commercial fishing vessel. Such inexperienced crews often face great danger in the Alaskan fishing grounds in hopes of short-term financial gain.

FISHING VESSEL SAFETY IN THE UNITED STATES: THE TRAGEDY OF MISSED OPPORTUNITIES

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This paper examines the history of fishing vessel safety legislation in the United States, and the missed opportunities that would have saved many lives. For most of the twentieth century, fishermen in the U.S. lived – and died – by the proposition that "as long as only the fisherman is hurt in an accident, it can remain his own business, accomplished at his own risk."[1] Many still believe that. In 1988, the United States finally adopted legislation[2] requiring that fishing vessels be provided equipment to increase lives saved, in the event the vessel is no longer habitable. The U.S. has yet to adopt legislation designed to prevent casualties, or minimize their effect, given that they have occurred.[3]

A COST-BENEFIT ANALYSIS OF ALTERNATIVE SAFETY PROGRAMS FOR U.S. COMMERCIAL FISHING VESSELS

For twenty years we have searched out and stumbled across bits and pieces of history that are the basis for this paper, portions of which have appeared before.[4]

On the eve of World War II, legislation requiring that fishing vessels be inspected was proposed. Recently we discovered legislative initiatives in the 1950s that would have required "inspection" of U.S. Commercial Fishing Vessels. Many lives were lost as a result of these missed opportunities, and commercial fishing is more hazardous today than it should be.

On the brink of the 21st Century it is important to understand our past failures in order to better judge what would succeed in the future. Not for the first time there is an opportunity "to…turn the corner from response to prevention."[5] Will this be just another missed opportunity?

INTRODUCTION

The level of safety on fishing vessels increased with the transition from sail to steam, but declined again with the introduction of diesel propulsion. In the days of sail – when cod was king – designers and builders sought speed to bring a perishable catch to market quicker, and seaworthy vessels to take the punishing gales on the Grand and Georges Bank. Vessels sailed from Gloucester and Boston and some years many did not return. There was no radio to call for help, nor were there aircraft, and few cutters to come to their aid.

By the 1930s diesel power was readily available, but diesel-propelled vessels were not "inspected," nor the officers "licensed." Sailing schooners were converted to diesel trawlers, and the "modern" American fishing fleet was born.

It is ironic to realize that were we to put steam plants into fishing vessels today, they would immediately become "inspected" and carry a complement of licensed officers. It is even more painful to contemplate what the state of our fishing fleet would be today had steam propulsion remained the standard.

PART I – THE DISTANT PAST

Early marine safety statutes established inspection and manning requirements for steam-propelled vessels, including fishing vessels. Subsequent legislation enacted by the Unites States Congress required the inspection of most passenger and commercial vessels regardless of the means of propulsion.[6] As a general rule, any vessel that required inspection was also required to have a licensed master or operator.[7]

There were no specific licensing requirements for masters, operators or other personnel for commercial fishing vessels.[8] A provision of the "Officers Competency Certificates Convention, 1936" did however require licensed masters, mates, and engineers on all documented vessels over 200 gross tons operating on the high seas.[9] Use of "creative" measurement permitted most fishing vessels to measure less than 200 tons thereby avoiding licensing requirements.

Unlike the statutes establishing the Federal Aviation Administration (FAA) that grant the agency broad authority to regulate all aircraft, Congress has never considered or adopted a statute granting the Coast Guard similar authority to make all vessels safe.[10] Unfortunately, legislation governing marine safety has been enacted only after terrible tragedies.

THE 1930s

The *Morro Castle* and the *Mohawk* disasters in the 1930s resulted in a thorough Congressional investigation of the marine safety statutes and organization. The years 1936 and 1937 were one of the most active periods in the history of marine safety legislation in the U.S., and established much of the legislation that we live with today.[11]

There were several proposals to regulate motor vessels – including fishing and towing vessels – as steam vessels. Steam vessels – including steam-propelled fishing vessels – were already subject to inspection, manning and equipment requirements.

Towing vessel interests, particularly those from the west coast, along with many fishing vessel interests objected to requiring inspection of diesel-propelled vessels. The major objections were to the increased manning requirements that "inspection" would bring,[12] an objection that is worth keeping in mind even today.

Congress did adopt legislation subjecting "seagoing motor vessel(s) of 300 gross tons and over, except "vessels engaged in fishing, oystering, clamming, crabbing, or any other branch of the fishery or kelp or sponge industry" to the regulations applicable to steam vessels.[13] But Congress failed to adopt legislation applicable to fishing vessels, and by the end of the 1930s, "uninspected vessels" were firmly ensconced in the legislative and regulatory framework established by the Congress.

FIRST FISHING VESSEL SAFETY BILL

In 1941, Representative Thomas A. Flaherty of Massachusetts introduced a bill specifically addressing fishing vessel safety. It proposed "to place fishing boats … under the supervision of the Bureau of Marine Inspection and Navigation (BMIN)."[14] Specific provisions of the bill would have required that fishing vessels be in "good and seaworthy condition" with "sufficient … watertight bulkheads … so that the vessel shall remain afloat with any one compartment open to the sea." The bill also required that vessels be equipped with: bilge pumps, ring buoys, life preserver for each person on board, lifeboats, a compass, distress signals, emergency rations, a radio telephone, first-aid kit, and a line throwing gun with projectiles. The bill proposed licensing of fishing vessel operators, with the license subject to "suspension and revocation."

Hearings were held on the bill in October 1941 at which time the bill was supported by the Atlantic Fishermen's Union of Boston representing Northeast fishermen. However, most other segments of the fishing industry opposed the measure, particularly the provisions for watertight bulkheads and the licensing of operators. Owing largely to the events of December 1941 (the bombing of Pearl Harbor, and the subsequent participation of the U.S. in World War II,) no further action was taken on this bill.

Despite a shrinking fleet, (the Navy acquired many large fishing vessels) the demand and prices for fish grew rapidly during World War II for several reasons. First, due to German U-boat blockades, European nations were unable to send vessels to sea; second, fish became a valuable source of protein for Allied troops, and as other sources of protein became scarce, civilians turned to fish.[15]

PART II – POST WORLD WAR II

In the post war era, the U.S. offshore fleet shrank again as domestic demand for fish declined and European nations got back to fishing. But, fishing vessel casualties in the early 1950s took many lives. Evidently, these losses did not go unnoticed. In several casualty reports of the early 1950s, the U.S. Coast

Guard Marine Boards of Investigation make reference to pending legislation that would have placed commercial fishing vessels under inspection.[16 17] Despite the terrible loss of life in the early 1950s, however, no bill requiring the establishment of construction, maintenance or operating standards for commercial fishing vessels was enacted. It is painful to think of the number of lives that might have been saved had such action been taken.

A RETURN TO "BOATING SAFETY"

But in the 1950s Congress did return to the issue of boating safety, for along with post war prosperity came a boom in recreational boating and a consequent increase in boating accidents and fatalities. In 1958 Congress enacted the "Federal Boating Act of 1958" amending Motor Boat Act of 1940 making it applicable to all "motor boats … on the navigable waters of the United States" and requiring the numbering of all vessels propelled by machinery of more than ten horsepower and established a system whereby individual states could adopt a uniform numbering and certificate system.[18] The Act further required that accidents involving numbered vessels be reported to the state in which the accident occurred and that the data collected by the states would be reported to the Coast Guard. During the next decade accident data compiled by the Coast Guard indicated the need for additional efforts to promote safety of recreational boats.

The provisions of the Motor Boat Act of 1940 for fire extinguishers, life preservers, flame arrestors, and ventilation of engine and fuel tank compartments remained the only requirements applicable to commercial fishing vessels. The limitations of these provisions became obvious when the U.S. Marine Safety Statutes were codified in 1983.[19] As the Motor Boat Act of 1940 – unlike the FBSA-71 – limits the Coast Guard's regulatory authority to those few items set forth in the act, the Coast Guard did not have the authority to adopt regulations requiring modern fire fighting, life saving or safety equipment on uninspected fishing vessels.

DOCUMENTATION VERSUS STATE NUMBERING

The numbering requirements of the 1958 Boating Safety Act created different ways to register vessels with the government. A vessel could be documented, which establishes its nationality, or it could be numbered by a state of principle use. Fishing vessels over five net tons are required by law to be documented and licensed for the fisheries.[20] But, many fishing vessels – those that measure less than five net tons – are numbered by the state. Unfortunately, the casualty reporting requirements applicable to documented and numbered uninspected commercial vessels are different. The resulting lack of uniform casualty reporting criteria limits the accuracy of casualty information on fishing vessels. Further the most important provisions of the 1988 Fishing Vessel safety legislation apply only to "documented vessels."

THE 1970s, STUDY BUT LITTLE PROGRESS

In 1968, the Coast Guard conducted – at the request of both the Congress and the Executive Branch – what is probably the most comprehensive and significant study ever carried out on fishing vessel safety in the U.S. The report, published in 1971, was entitled *A Cost Benefit Analysis of Alternative Safety Programs for U.S. Commercial Fishing Vessels,* and documented the fishing industry's poor safety record, concluding that one of the major contributing causes of this dismal safety record was that fishing vessels, with few exceptions, have traditionally been exempted from safety regulations. The study recommended licensing of masters, mandatory safety standards including full inspection and certification of new vessels and mandatory and voluntary standards combined with inspection and certification of existing vessels.[21]

In July of 1976, the Secretary forwarded copies of the 1971 study to the Senate Committee on Commerce and the House Committee on Merchant Marine and Fisheries. The Secretary did not recommend the Coast Guard's legislative program proposals, citing the inflationary impact and increased interest in a voluntary safety program by the U.S. fishing vessel industry. This action by the department stopped the initiative for fishing vessel safety legislation.

In 1978, the Coast Guard established a voluntary dock-side examination program for uninspected vessels. Forty five new billets for a Coast Guard-wide boarding and examination program were requested in the Coast Guard's FY 1979 budget, to improve safety throughout the U.S. uninspected commercial fleet including commercial fishing vessels.

In 1978, Rear Admiral (ret.) William J. Ecker, U.S. Coast Guard, (then a Commander) prepared *A Safety Analysis of Fishing Vessel Casualties* for the 66th National Safety Congress and Exposition.[22] He examined "some of the more frequent types of marine casualties involving fishing vessels and highlighted the salient aspects of these casualties as they relate to circumstances, location, fishing fleet type, and the subsequent result of these casualties, be it loss of vessel, loss of life, or other." He concluded, "there would appear to be ample evidence to warrant additional study and research into those incidents resulting in loss of life and loss of vessel for the purpose of ameliorating those circumstances and conditions that frequently precede tragic consequences."

THE 1980s

In June of 1980, J. E. DeCarteret, N. W. Lemley and D. F. Sheehan, Office of Marine Safety, Coast Guard Headquarters, presented a paper entitled *Life Safety Approach to Fishing Vessel Design and Operation* at a SNAME meeting,[23] and published a similar article *Proceedings of Marine Safety Council*.[24] The authors, drawing on the work of Admiral Ecker and the 1971 analysis of fishing Vessel safety, suggested that training combined with the recently initiated Coast Guard education and voluntary dock-side boarding program should have a positive effect on casualties. Their conclusions and recommendations echoed those of past investigations. Unfortunately, due to budget cuts, the USCG voluntary dock-side-boarding program was terminated, casualties continued and the pressure for action mounted.

In February 1983, the A-Boats – the F/V *Altair* and *Americus* – capsized and sank in the Bering Sea with the loss of fourteen fishermen. Captain DeCarteret, then chief of the Marine Safety Division in Seattle, led a joint Coast Guard/National Transportation Safety Board (NTSB) investigation that lasted more than two years. The final report recommended that the Coast Guard require stability analysis of new or modified vessels, adopt a modified load line system, and seek authority to promulgate minimum competency standards and require licensing of masters of fishing vessels. The Commandant of the Coast Guard did not concur, preferring to turn the matter over to the newly formed Fishing Vessel Safety Initiative Task Force that was pursuing voluntary approaches to fishing vessel safety. The Commandant said, "Being voluntary, it would require no legislation and would have no disruptive effect on industry."[25]

In August 1983, the House Merchant Marine and Fisheries Subcommittee on Coast Guard and Navigation held a series of hearings on Marine Safety. During one of the sessions the Committee heard testimony on fishing vessel safety from three individuals representing very different points of view.[26]

We testified on the need to establish a comprehensive program for fishing vessel safety in the Office of Marine Safety, to improve information on casualties, to coordinate ongoing safety projects, and update the Coast Guard's 1971 safety study, and suggested that Chapter 41 of Title 46 U.S.C. (Uninspected Vessels) be amended using the same flexible language set forth in Chapter 43 (Recreational Vessels) to permit the Coast Guard to develop comprehensive regulations for all uninspected vessels.

No action was taken on the suggestion for safety legislation, but the next year Congress did amend the statutes by defining fishing, fish tender, and fish processing vessels; exempting fishing tender vessels less then 500 gross tons and fish processing vessels less than 5,000 gross tons from inspection; and, adopting a new Chapter 45 setting forth requirements for "Fish Processing Vessels."

In 1984, the Coast Guard Office of Merchant Marine Safety established a fishing vessel safety program with the hope of reducing the number of uninspected commercial fishing vessel casualties by not less than ten percent by 1991 without a net increase of the level of commercial vessel safety resources, and established a full time task force to study how the fishing vessel safety initiative could best be implemented. Based on a paper by LCDR William Morani, a two pronged voluntary program was developed.[27]

One part of the initiative was intended to promote vessel safety through voluntary standards written by the Coast Guard in five Navigation and Vessel Inspection Circulars (NVIC). These voluntary standards, proposed in NVICs 5-85 through 9-85,[28] were revised and consolidated in NVIC 5-86.[29] The voluntary standards were written primarily for fishing vessel designers, builders, outfitters and marine surveyors. The second part of the safety initiative sought to promote crew safety through a safety manual that was developed jointly by the Coast Guard and North Pacific Fishing Vessel Owner's Association (NPFVOA).[30] Additional regional manuals – based on the NPFVOA manual – were developed and published for the Gulf[31] and Atlantic coasts.[32] The

Fishing Vessel Safety Initiative became part of the Coast Guard Marine Safety Program in January 1987, with the policy implementing the safety program published in a Commandant Instruction in November of that year.[33]

TRAGEDY STRIKES AGAIN

In August 1985, the F/V *Western Sea*, a seventy-year-old purse-seiner, departed Kodiak, Alaska to fish for salmon. There was no indication the vessel was in trouble until the body of crew member Peter Barry was recovered from the sea by the F/V *Dusk*. An intensive search by Coast Guard cutters and aircraft failed to locate any survivors. After the death of their son, Robert and Peggy Barry galvanized support from safety advocates, government officials, the legislature and the surviving families of other commercial fishermen lost at sea to renew the campaign for mandatory safety regulations.

In 1986, three bills were introduced in the House of Representatives specifically addressing fishing vessel insurance and liability issues. H.R. 4407 authorized the Coast Guard to write regulations for new fishing vessel (five net tons and over), and required load lines for fishing vessels over 79 feet. It would also have required crew training and licensing of skippers on new vessels. In exchange the bill would have limited liability on the newly regulated vessels.[34]

H.R. 4415 modified the liability statutes (Jones Act) and authorized the Coast Guard to require documented fishing vessels on the "high seas" to carry (in addition to the existing requirements) immersion suits, EPIRBs, lifeboats or life rafts, Visual Distress Signals, and communications equipment.[35] H.R. 4465 eliminated the existing exemption of inspection of fishing vessels, and required that some fishing vessel be inspected, and would have made additional requirements for inspected fishing vessels, but this bill did not address liability.[36]

In April 1986, three subcommittees of the House Merchant Marine and Fisheries Committee held hearings on these bills. Then Rear Admiral J. William Kime, Chief of the Office of Merchant Marine Safety, presented testimony supporting the Coast Guard's voluntary approach to fishing vessel safety. It was the position of the Coast Guard that, "A voluntary program would be as effective as regulations, with little difference in cost to the fishermen, and much less costly to the Government, and would achieve the desired results much more rapidly." Peggy Barry and several others who lost family on the *Western*

Sea testified passionately for enactment of legislation that would, at a minimum, require modern emergency rescue equipment on U.S. commercial fishing vessels.[37] After much deliberation by the Committee a compromise bill, *The Commercial Fishing Vessel Liability and Safety Act*, was sent to the full House. H.R. 5013 limited the liability of fishing vessel owners to a maximum of U.S. $500,000 in cases of permanent injury, except where there was gross negligence or willful misconduct, and required the carriage of additional lifesaving equipment on fishing industry vessels, including Visual Distress Signals, EPIRBs, life rafts, exposure (immersion) suits, radio equipment and other equipment to reduce the risk of injury.[38]

On August 13, 1986 after an intense lobbying effort by the American Trial Lawyers Association (ATLA), H.R. 5013 was defeated in the House. The defeat of this legislation placed added emphasis and urgency on the Coast Guard's voluntary initiative, and sparked the development of new bills for introduction in the next Congress.

SECOND TRY

In March 1987, two bills were introduced in the House dealing with fishing vessel safety and insurance liability. Congressman Lowry of Washington, on behalf of Robert and Peggy Barry, introduced H.R. 1836.[39] It would have required "new" documented "fishing vessels" to be "inspected" by the Coast Guard, but existing vessels "except when compliance with major structural or major equipment requirements is necessary to remove and especially hazardous condition" would not be subject to the inspection provision, and would have required all other vessels to be equipped with modern survival and rescue equipment, permitted the Secretary (Coast Guard) to prescribe additional requirements for fishing, fish processing and fish tender vessels including, and required the establishment of regulations for the operating stability of "new" or "substantially altered" fishing, fishing processing and fish tender vessels. It also "prohibited" the operation of the vessels "unless emergency assignments for individuals on board the vessel and periodic emergency drills" are conducted, and permitted "termination" of unsafe operations creating an "especially hazardous condition."

The bill called for licensing and training. All crewmembers would be required to be trained "in vessel safety and emergency procedures" using an approved manual, or by an approved training course. The operator of a documented "fishing industry vessel" would be required to hold a Coast Guard license.

The bill established uniform casualty reporting for all commercial vessels and established a Fishing Vessel Safety Advisory Committee of 17 members to make recommendations to the Secretary on matters relating to fishing, fish processing, and fish tender vessels, including navigational safety, safety equipment and procedures, marine insurance, vessel design, construction, maintenance and operation, and personnel qualifications; review proposed regulations. Finally, the bill proposed to add "safety" to Section 303(a)(2) of the Fishery Conservation and Management Act of 1976. H.R. 1841 was introduced by Congressman Studds of Massachusetts, Chairman of the subcommittee on Fisheries and Wildlife Conservation and the Environment and addressed liability and safety, but did not propose inspection or licensing.[40] The Studds bill had two sections, or "titles." Title I dealt with "compensation for temporary injuries on fishing industry vessels."

Title II of the Studds bill proposed to amend Chapter 45 of Title 46 U.S.C. by replacing the existing chapter applicable only to fish processing vessels with a new chapter applicable to all fishing, fish processing and fish tender vessels. There are many similarities between the safety proposal in the Studds bill and that of the Lowery bill (H.R. 1836) described above. But H.R. 1841 required additional regulations only for "new uninspected fish processing vessels … having more than sixteen individuals on board primarily employed in the preparation of fish or fish products." The requirement for "operational stability" was the same as H.R. 1836 as was the "equivalency" provision for fish processing vessel. But the section on "prohibited acts" did not include a paragraph on requirements for training, as did H.R. 1836. The sections on "termination" and "exemptions" were the same in both bills. The requirements for gathering casualty information from underwriters were the same in both bills, but H.R. 1841 did not call for uniform casualty reporting for all commercial vessels. H.R. 1841 also established an advisory committee, but the name did not mention "safety" as it was called the "Commercial Fishing Industry Vessel Advisory Committee."

Hearings were held in the House in June 1987 on H.R. 1836 and H.R. 1841.[41] During the hearings Captain Gordon Piche, Program Manager of the Coast Guard Fishing Vessel Safety Task Force, testifying on both bills stated, "the

Coast Guard can support consideration for safety management in H.R. 1841, the stability criteria that is recommended by both bills and the record keeping by the insurance companies." But, the Coast Guard did not "fully support or cannot support inspection, licensing, termination, and the proposed advisory committee." The Coast Guard "remains convinced that the voluntary approach is a viable program."

In March, Senator Chafee introduced a companion bill (identical to H.R. 1841) in the Senate,[42] S. B. 849, "To establish for timely compensation for temporary injury incurred by seamen on fishing industry vessels and to require additional safety regulations for fishing industry vessels."

The Senate Committee on Commerce, Science, and Transportation held hearings in September in Washington DC and in Wakefield, Rhode Island in December 1987.[43] Additional testimony on the bills at both the House and Senate hearings were held. The families of those lost on the *Western Sea* and in other fishing vessel tragedies supported the tough provisions of H.R. 1836. Those representing the fishing industry – including FAIR (Fishermen's Alliance for Insurance Reform representing eighteen fishing associations) – all testified in support of the liability provisions of H.R. 1841 and in general supported – sometimes reluctantly – the minimal safety provisions in the Studds bill. Most of the fishing industry representatives also recommended establishment of a notice requirement for crewmembers injured while in service of a commercial fishing vessel. All of fishing industry representatives expressed strong opposition to H.R. 1836, particularly to the proposed requirements for training and licensing. In addition, the committee also received written statements from a number of individuals and organizations.

In September 1987, the National Transportation Safety Board (NTSB) published a comprehensive study on *Uninspected Commercial Fishing Vessels* which recommended the establishment of minimum safety training standards requiring that captains and/or owners provide minimum safety training for all crewmembers; requirements for basic lifesaving equipment including imersion suits, flooding detection and dewatering systems, fire detection and fixed firefighting systems; approved lifeboat or life rafts; emergency radios; EPIRBs; safety certification and periodic inspection; prohibition of the use of alcohol or drugs when engaged in commercial fishing operations; education regarding the dangers of toxic gas exposure in unventilated spaces; and the need to examine and conduct research on stability issues. The NTSB testified at both Senate hearings in support of its recommendations.[44] In October, the House subcommittees met to consider H.R. 1841.[45] There was no consideration of 1836. Congressman Studds offered an amendment in the form of a substitute bill incorporating the major suggestions made by witnesses during the hearings. Many of the changes dealt with Title I. Congressman Studds' substitute also proposed some substantial changes to Title II, the safety portion of H.R. 1841. First, it proposed additional navigation and first aid equipment for documented vessels operating beyond the Boundary Line, and authorized the Secretary (Coast Guard) to adopt additional safety regulations for any new (entering into service after December 31, 1987) fishing industry vessel with more than 16 persons on board. It also required the Secretary, in consultation with the Commercial Fishing Industry Vessel Advisory Committee (CFIVAC), to prepare a plan for the licensing of operators of documented fishing industry vessels, and submit it within two years.

The Studds amendment was adopted and the following were then added :

> Require "buoyant apparatus" on fishing industry vessels as prescribed by the Secretary. (Rep. Bonker)
>
> Require the Secretary after consultation with the CFIVAC to adopt regulations for the inspection of fish processing vessels. (Rep. Lowery)
>
> Require that the members of the CFIVAC be appointed within 90 days of enactment of the bill. (Rep. Lowery)

Rep. Lowery also offered an amendment that would have required the training of crewmembers on board all commercial fishing industry vessels and the licensing of operators of documented vessels. The amendment was defeated on a voice vote.

The Studds amendment with changes was reported favorably to the House Committee on Merchant Marine and Fisheries. The committee met in April 1988 to consider both Titles of H.R. 1841. Chairman Studds offered a substitute for Title I making the compensation system for temporary injuries mandatory rather then voluntary, requiring an injured seaman, if requested, to undergo a medical examination in order to benefit from the compensation plan provided for in amendment, and removing the bar of civil action if a seaman failed to give notice of an injury. Studds also offered an amendment to Title II requiring the prominent display of the provisions of Title I and requiring all seamen to report all injuries within seven days.

Representative Lowry offered an amendment to Title II requiring, instead of Coast Guard inspection, that processing vessels be subject to classification by the American Bureau of Shipping (ABS) or a similar organization, and that the National Academy of Engineering carry out a study of the safety problems of fishing industry vessels and make recommendations on vessel inspections.

Efforts by the committee during the spring of 1988 to reach an agreement on the liability provisions of Title I were unsuccessful. The amended bill did not contain any provisions regarding liability. The bill did require that the Coast Guard develop a licensing plan and conduct studies on Fishing Industry Vessel Inspection and Unclassified Fish Processing Vessels. H.R. 1841 contained a new chapter, Title 46 U.S.C., regarding Fishing Voyages, which require fishing and wage agreements and prompt notification of illness, disability, and injury on fishing industry vessels. H.R. 1841, as amended, was favorably reported to the House by a unanimous vote of the committee. The House passed the Bill, as amended, on June 27, 1988. On August 11, 1988 the Senate passed the House version of the bill.

SUCCESS

On September 9, 1988, the President signed into law the "Commercial Fishing Industry Vessel Safety Act of 1988" (P.L.100 424); the first safety legislation enacted in the U.S. applying specifically to commercial fishing vessels. The implementation of the Act began in earnest almost immediately. The Commercial Fishing Industry Vessel Advisory Committee (CFIVAC) was appointed and drafting of regulations to implement the Act began by late 1988.[46] By September of 1991, the regulations were ready, and the Coast Guard developed a "voluntary dockside examination program" allowing a vessel owner to request that the Coast Guard or other recognized "third-parties" examine the vessel for compliance with the new regulations (and other federal requirements) and obtain a decal indicating compliance. In the event that deficiencies were found, recommended action would be suggested, but no penalty would be assessed. The Coast Guard established new positions – primarily civilian – to conduct the examinations.

Since adopting the Act and the implementing regulation, the fishermen who learn how to *use* the modern emergency rescue equipment required on the vessels they work on now have a better chance of surviving vessel casualties. But unfortunately far too many vessel casualties still occur and too many lives are lost. Many of these casualties could be prevented by the application of recognized design, construction, maintenance and operating standards. The Act provided opportunities to make progress in these areas, but again, opportunities have been missed.

PART III – MORE MISSED OPPORTUNITIES

The passage of "Commercial Fishing Industry Vessel Safety Act of 1988" was a great victory for all who had worked so hard to make commercial fishing safer for the American fisherman. But as the drafters intended when including requirements for additional study of licensing and inspection, this is a work in progress. Unfortunately opportunities to promote fishing safety continue to be missed.

The consideration of the licensing began soon after the Commercial Fishing Industry Vessel Advisory Committee (CFIVAC) was appointed. By early 1990, the Licensing Subcommittee of the CFIVAC made a detailed report regarding the licensing proposal, and specifically recommended a plan for the "certification" rather than licensing of commercial fishing vessel operators, and the plan adopted by the CFIVAC included "competency" requirements. The Committee laid out a number of specific recommendations to the Coast Guard for inclusion in its report to Congress on the licensing plan.

Two years later, in January 1992, the Coast Guard submitted "A plan for Licensing Operators of Uninspected Federally Documented Commercial Fishing Industry Vessels" to Congress. This "original" Coast Guard plan followed the traditional pattern for Coast Guard licensing, requiring an examination rather than "hands-on-training" as recommended by the CFIVAC.

The CFIVAC reluctantly endorsed the Coast Guard's licensing plan, but requested an opportunity to develop a response to a letter from Rep. Young of Alaska who asked for specific input from the Committee. A 'licensing working group' met in the fall of 1992 and drafted a proposal incorporating the "hands-on training requirements" preferred by the Committee into the "plan" as submitted to Congress. In December, the full Advisory Committee approved most of the revised plan, and recommended that it should apply to all vessels 36 feet or more in length, not just "documented vessels." In May of 1993 the Coast Guard submitted a revised executive summary, including the recommendations jointly agreed to by the CFIVAC and the Coast Guard. Despite this effort, no legislation to adopt the "licensing plan" was ever introduced in Congress.

As called for in the Act the National Research Council (NRC) of the National Academies of Sciences and Engineering carried out the inspection study. The project was assigned to the Marine Board of the NRC, and a Fishing Vessel Safety Committee was selected.[47] Its comprehensive report *Fishing Vessel Safety – A Blueprint for a National Program* was published 1991.[48] At its May meeting that year the CFIVAC reviewed the report and endorsed most of the recommendations including the establishment of an inspection program.

In November 1992 the Coast Guard sent to Congress its plan to require inspection of commercial fishing industry vessels, requesting authority (legislative changes) that would authorize the Coast Guard to:

> Establish a self-inspection program for vessels less than 50 feet in length;
>
> Require third-party inspection for vessels greater than 50 feet but less than 79 feet in length;
>
> Require Coast Guard inspection of vessels greater than 79 feet in length;
>
> Required load lines on new vessels 79 feet or more in length and on existing vessels 79 feet or more in length within ten years;
>
> Require that all new fishing industry vessels 79 feet or more length be designed and built to class standards; and
>
> Authorize the Coast Guard to impose additional hull and machinery standards for existing fishing industry vessels 79 feet or more in length.

Coast Guard noted, in its report to Congress, "that material condition of the vessel and equipment was a direct cause for over 85 percent of the known vessel-related casualties."[49] That neither the licensing nor the inspection plan ever received serious consideration by Congress is evident in that no bills were introduced or hearing held on the issues. Nonetheless, the tragedies continued, and at the end of the 1990s a series of casualties, this time involving fishing vessels on the East Coast of the U.S., prompted yet another look at fishing vessel safety.

Between December 1998 and January 1999 eleven fishermen died when their vessels were lost along the East Coast.[50] While these terrible losses were consistent with losses that occur all around the U.S. every year, the timing of the casualties garnered a lot of media attention. The Coast Guard responded by forming a "Fishing Vessel Casualty Task Force" made up of representatives of the federal agencies that interact with the fishing industry (Coast Guard, National Marine Fisheries Service, Occupational Safety and Health Administration, National Transportation Safety Board, and the National Oceanic Atmospheric Administration) and several industry advisors including managers, trainers, investigators, insurance, and fishermen.

The Task Force met in Washington DC in mid-February 1999, and released its report in April.[51] The Task Force posed the following question to policy makers, "Do the continued high loss rates in the commercial fishing industry represent an acceptable risk by today's standards?" The Task Force concluded, "… the risk is not acceptable, that pushing for breakthrough levels of reduced fishing industry losses is the right thing to do, and that the time is right to take on this challenge."

The Task Force recommended operator licensing, safety inspections, stability standards, better investigations, and improvements to the Coast Guard program. Out of these recommendations the Coast Guard developed an "Action Plan" including short term goals, program initiatives, and long-term proposals, including:

Improving drill enforcement;

Completing the regulatory project on stability and watertight integrity begun in 1992;

Improving casualty investigations and analysis;

Improving communication (with the industry);

Seeking authority and funding for mandatory vessel examinations;

Seeking authority and funding for mandatory safety training; and

Requesting that the geographic marker used for safety equipment be changed from the Boundary Line to the baseline from which the territorial Sea is measured.

This Action Plan is yet another opportunity to "work for a breakthrough to significantly lower casualty losses." It remains to be seen whether significant progress will be made, or whether this will be yet another lost opportunity.

POSTSCRIPT

In the recently published report on the loss of the F/V *ADRIATIC*, the "Action by the Commandant" seems to indicate a change in direction for the U.S. Coast Guard. The Commandant now supports seeking authority for 'mandatory examinations of inspections' and 'operator licensing.'[52] This is an encouraging development! We can only hope that the momentum is sustained. It would be a tragedy to miss yet another opportunity.

FOOTNOTES

1.Hand DE, Cleary Jr WA, Perrini F [1980]. Fishing vessel safety standards. Fish Boat pp 41 on.

2. P.L. 100-424, the "Commercial Fishing Industry Vessel Safety of 1988," 9 September 1988.

3. Planning Staff Office of Merchant Marine Safety. U.S. Coast Guard Headquarters.Washington, D.C.; [16 April 1971]. A Cost-Benefit Analysis of Alternative Safety Programs for U.S. Commercial Fishing Vessels. [footnote 2 on page V-3 of Vol. I]

4. (a) Hiscock RC [1982]. A Review of Fishing Vessel Safety – Past and Present. Proceedings of the Marine Safety Council. pp. 51-53.
(b) Hiscock RC [1982]. Industry or government will decide safety of fishermen. National Fisherman Yearbook, pp. 104-107.
(c) Hiscock RC [1983]. Testimony before Subcommittee on Coast Guard and Navigation, 2 August 1983. Serial No. 98-20.
(d) Cameron D B [April 1986]. Fishing vessel safety in New England. New England Section of SNAME. pp.18-26.
(e) Magno R G, Hiscock, R C [1991]. Commercial fishing vessel safety … a legislative history. Proceedings of the Marine Safety Council. *48:* 6 pp. 2-10.

5. Downey ML Chairman. U.S. Department of Transportation [1999]. A Coast Guard For the Twenty First Century, Report of the Interagency Task Force on U.S. Coast Guard Roles and Missions. Washington, D.C.

6. Shepheard HC [1945]. History of United States Navigation and Vessel Inspection Laws. Historical Transactions 1893-1943. Society of Naval Architects and Marine Engineers. pp. 517-524.

7. 46 U.S.C. Subtitle II, Part F.

8. 46 U.S.C. 3301 requires the "inspection" of "Fish Processing Vessels" (over 5,000 gross tons) and "Fish Tender Vessels" (over 500 gross) are exempt.

9. 46 U.S.C. 8304

10. P. L. 85-726, Federal Aviation Act of 1958.

11. Shepheard, p. 519

12. U.S. House of Representatives, 74th Congress, First Session, Committee on Merchant Marine and Fisheries. [1935]. Hearings on "Safety of Life and Property at Sea" [Part 1] Hearings on revision of inspection laws.

13. P. L. 722, 20 June 1936. [H.R. 12419]

14. H.R. 3254. "A bill to safeguard and protect further the lives of fishermen at sea and to place fishing boats under the supervision of the Department of Commerce, Bureau of Marine Inspection and Navigation." Introduced by Mr. Flaherty. February 11, 1941, 77th Congress, first session.

15. Dewar, ME [1983]. Industry In Trouble – The Federal Government and the New England Fisheries. Temple University Press, Philadelphia, PA. p. 14

16. F/V *Four Sisters*, April 1950, F/V *Gurdun*, January 1951, F/V *Mary M*, 26 November 1951,

F/V *Paolina*, 13 February 1952, and F/V *Anna C*, March 1952.

17. http://www.uscg.mil/hq/g-m/moa/casua.htm

18. P. L. 85-911, 2 September 1958

19. P.L. 98-89, August 26, 1983, 97 Stat. 500. See specifically: 46 U.S.C. 4101 for the statutes applicable to Uninspected vessels.

20. 46 U.S.C. 12108(b)

21. Planning Staff Office of Merchant Marine Safety [1971]. Cost-Benefit Analysis of Alternative Safety Programs for U.S. Commercial Fishing Vessels. U.S. Coast Guard Headquarters. Washington, D.C.

22. Ecker WJ [1978]. A Safety Analysis of Fishing Vessel Casualties. Prepared for the 66th National Safety Congress and Exposition. U.S. Coast Guard Headquarters. Washington, D.C.

23. De Carteret JE, Lemley NW, Sheehan DF [1988]. Life Safety Approach to Fishing Vessels Design and Operation. The Society of Naval Architects and Marine Engineers.Spring Meeting/STAR Symposium, Coronado, CA. U.S. Coast Guard, Washington, D.C. pp. 177 – 186.

24. De Carteret JE, Lemley NW, Sheehan DF [1981]. Safety from the Start: Designing and Operating Fishing Vessels with an Eye to Minimizing Risk. In: Proceedings of the Marine Safety Council (CG-129). U.S. Coast Guard, Washington, D.C. *38*:3. pp. 68-74.

25. Marine Board of Investigation Report and Commandant's Action Report No. USCG 16732/0002 HQS 83 [1983]. Marine Casualty Report Fishing Vessel *Americus*, O.N. 595758, Capsizing and Sinking. Fishing Vessel *Altair*, O.N. 618390, Disappearance on or about 14 February 1983 in the Bering Sea with presumed loss of life.U.S. Coast Guard. http://www.uscg.mil/hq/g-m/moa/boards/amerialtair.pdf For detailed description of the "A-Boat" casualties and the subsequent investigation see: Dillon, Patrick. [1988]. Lost At Sea – An American Tragedy. The Dial Press.

26. U.S. House of Representatives, 98th Congress, First Session [1983]. Serial No. 98-20: Hearings before the Subcommittee on Coast Guard and Navigation. Committee on Merchant Marine and Fisheries. July 19, 27, August 2, September 29 1983.

27. Morani JR WJ [1985]. An alternative to federal regulations – the voluntary approach. U.S. Coast Guard Fishing Vessel Safety Task Force. Washington, D.C.: Office of Merchant Marine Safety.

28. U.S. Department of Transportation.U.S. Coast Guard (G-MTH) [1985]. Navigation and Inspection Circular 5-85: Proposed Voluntary Stability Standards for Uninspected Commercial Fishing Vessels. Navigation and Inspection Circular 6-85: Radio and Shipboard Navigation Equipment; Proposed Voluntary Standards for Uninspected Commercial Fishing Vessels.Navigation and Inspection Circular 7-85.

U.S. Department of Transportation.U.S. Coast Guard [1985]. Fire Safety Measures; Proposed Voluntary Standards for Uninspected Commercial Fishing Vessels. Navigation and Inspection Circular 8-85. Lifesaving Equipment and Protection of the Crew; Proposed Voluntary Standards for Uninspected Commercial Fishing Vessels. Navigation and Inspection Circular 9-85. Hull, Machinery and Electrical Installations; Proposed Voluntary Standards for Uninspected Commercial Fishing Vessels.

29. U.S. Department of Transportation. U.S. Coast Guard (G-MTH) [1986]. Navigation and Inspection Circular 5-86. Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels.

30. Vessel Safety Manual [1986]. North Pacific Fishing Vessel Owner's Association. First Edition. Subsequent Editions 1990 and 1992.

31. Gulf Coast Fishing Vessel Safety Manual [1989]. Produced and funded in Cooperation with the National Marine Fisheries Service Saltonstall-Kennedy Program. Adapted from the Vessel Safety Manual produced by NPFVOA.

32. Rhode Island Sea Grant, in cooperation with United States Coast Guard [1991]. Atlantic Coast Fishing Vessel Safety Manual. Saltonstall-Kennedy Program, Rhode Island Sea Grant and the National Council of Fishing Vessel Safety and Insurance. Adapted from the Vessel Safety Manual produced by NPFVOA.

33. COMDTINST 16711.10, 6 NOV 1987.

34. H.R. 4407 "To limit the liability in the operation of fishing vessels that comply with improved safety requirements." Introduced by Mr. Jones.

35. H.R. 4415 [1986]. "To impose certain limitations on damage awards in actions for personal injury incurred by seamen on fishing vessels and to require additional safety regulations for fishing vessels." Introduced by Mr. Studds (for himself and Mr. Davis and Mrs. Schneider).

36. H.R. 4465 [1986]. "Amending title 46, United States Code, to require inspection by the Coast Guard of fishing vessels, to require certain safety equipment to be aboard such vessels, and for other purposes." Introduced by Mr. Lowery (for himself and Mr. Miller).

37. U.S. House of Representatives, 99th Congress, First and Second Session [April 17, 1986]. Hearings before the Subcommittee on Merchant Marine. Committee on Merchant Marine and Fisheries. Serial No. 99-36

38. U.S. House of Representatives, 99th Congress, Second Session [1986]. Report to accompany H.R. 5013. Commercial Fishing Industry Vessel Liability and Safety Act of 1986. Report 99-767.

39. H.R. 1836 [1987]. "To establish crew licensing, inspection and additional safety requirements for certain fishing vessels." Introduced by Mr. Lowry of Washington. The Barrys drafted this bill with the assistance of the author.

40. H.R. 1841 [1987]."To establish for timely compensation for temporary injury incurred by seamen on fishing industry vessels and to require additional safety regulations for fishing industry vessels."Introduced by Mr. Studds (for himself, Mr. Jones, Mr. Davis,

Mr. Young, Mr. Lowry, Miss Schneider, Mr. Hughes, Mr. Miller of Washington, Mr. Bennett, Mr. Lipinski and Mr. Bateman.

41. U.S. House of Representatives, 100th Congress, First Session [1987].The Subcommittee on Fisheries and Wildlife Conservation and the Environment The Subcommittee on Coast Guard and Navigation The Subcommittee on Merchant Marine. Committee on Merchant Marine and Fisheries. Hearing on H.R. 1836 and H.R. 1841. Serial No. 100-21

42. S. 849 "To establish for timely compensation for temporary injury incurred by seamen on fishing industry vessels and to require additional safety regulations for fishing industry vessels." Introduced by Mr. Chafee of Rhode Island (for himself and Mr. Kerry of Massachusetts) March 26 (legislative day, March 24), 1987.

43. U.S. Senate, 100th Congress, First Session [1987]. Hearing before the Committee on Commerce, Science, and Transportation. On S. 849 "To establish for timely compensation for temporary injury incurred by seamen on fishing industry vessels and to require additional safety egulations for fishing industry vessels." September 16, 1987 [Washington, D.C.] December 7, 1987. [Wakefield, RI]

44. National Transportation Safety Board [1987]. Safety Study Uninspected Commercial Fishing Vessel Safety. Washington, DC: NTSB/SS-87/02.

45. U.S. House of Representatives, 100th Congress, Second Session [1987]. Report to accompany H.R. 1841. Commercial Fishing Industry Vessel Safety and Compensations Act of 1987. Report 100-729.

46. Norman Lemley was the first Executive Director of the CFIVAC.

47. This committee included familiar names, such as, John DeCarteret and Bruce Adee of the A-Boat investigations, and Norman Lemley representing the U.S. Coast Guard.

48. Committee on Fishing Vessel Safety, Marine Board Commission on Engineering and Technical Systems [1991]. Fishing Vessel Safety – A Blueprint for a National Program. National Research Council. Washington, D.C.:National Academy Press.

49. U.S. Coast Guard Commercial Fishing Industry Vessel Safety Act of 1988 (P.L. 100-424). Report to Congress for the Inspection of Commercial Fishing Industry Vessels. Sent to the President of the Senate and Speaker of the House, 12 November 1992.

50. F/V *Predator*, Sinking, 28 December 1998; F/V Beth Dee Bob, sinking, 7 January 1999; F/V *Cape Fear*, sinking 8 January 1999; F/V *Adriatic*, sinking 19 January 1999.

51. Committee on Fishing Vessel Safety [1999]. Dying to Fish – Living to Fish. Washington, D.C.: U.S. Department of Transportation. See: http://www.uscg.mil/hq/g-m/moa/docs/fishing.htm

52. Investigation into the Circumstances Surrounding The Loss of the Commercial Fishing Vessel *Adriatic*, O.N. 579941, Eight NM East of Barnegat Light, New Jersey on January 18, 1999, with the loss of four lives. MC99000698, August 4 2000. See: http://www.uscg.mil/hq/g-m/moa/casualty.htm

FORECASTING EXTREME OCEAN WAVES

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INTRODUCTION

The recent best seller *The Perfect Storm* by Sebastian Junger and the subsequent Hollywood depiction brought extreme waves into the public focus. Fishermen and other mariners have long known the dangers of extreme waves. However, not until recently have marine forecasters possessed the understanding and tools to predict in advance the conditions that lead to the development of extreme waves.

In order to predict large ocean waves, the driving force or wind stress must be understood. In the case of extratropical cyclones, observational studies in the late 1980s greatly enhanced the knowledge of the evolution of the wind field associated with rapidly intensifying low-pressure systems [Shapiro and Keyser 1990]. Following the observational studies, the evolution of the wind field was simulated by high-resolution atmospheric models. Today, the cyclone wind field structure, described by Shapiro and Keyser, is routinely forecast by operational atmospheric numerical models.

A second advancement is that operational numerical wave models such as National Oceanographic and Atmospheric Administration (NOAA) WAVEWATCH III [Tolman1998b] more realistically demonstrate the creation and dispersion of swell energy than earlier wave models. The generation and dispersion of swell energy is critical in the development of extreme waves.

A third factor is the forecasters themselves and the skill that they bring to the forecast process. The NOAA Marine Prediction Center has a core of dedicated forecasters that analyze wave heights every three hours over the western North Atlantic and eastern North Pacific Oceans, 365 days a year. This routine task has helped make the forecasters quite familiar with the characteristics of both the atmospheric and wave model forecast systems. The forecasters are then able to confidently apply adjustments to the numerical forecast guidance fields before forecasts are distributed to mariners. Forecasters have come to recognize the potential for the development of extreme waves due to the phenomena dynamic or “trapped” fetch. In these instances, wave development is maximized due to a wind area moving in resonance with preexisting swell.

WAVE BASICS
FETCH, DURATION, WAVE DISPERSION

Wave growth is a function of the strength of the wind speed, the duration in time of wind stress acting upon the ocean surface, and the distance or fetch that the wind stress occurs. The limitation of any one of these factors will restrict wave growth. In nature, it is difficult to maximize all three at once due to turning winds and changes in wind speed.

A slow moving area of wind blowing across an area of open-ocean will create wind waves. The wind waves then move away from the wind area or generation area and begin to disperse by increasing their wavelength and decreasing the wave height. Wave period and wavelength are directly related, the longer the wave period, the longer the wavelength. Ocean waves move at approximately 1.5 times (m/s) the wave period (sec). Wave energy or group velocity moves at half the individual wave speed or 0.75 times (m/s) the wave period in seconds. Therefore longer period waves will migrate away from the generation area as swell. A swell with a 17 second period will have a group velocity of approximately 12.5 m/s or 25 knots.

Sailors have long recognized that longer period swell is a precursor to the inset of bad weather. This works well for swell generated by a slow moving or turning storm system. Unfortunately, under the right combination of storm movement and swell movement it is possible to have both the leading edge of swell and the high winds within a cyclone arrive at a given location at the same time. When this happens it is called dynamic fetch and extreme waves can occur.

DYNAMIC FETCH

A slow moving weather system generates swell, then swell migrates outward away from the source. Suppose that the weather system begins to accelerate and runs over or moves in resonance with its earlier produced swell. Wind stress would be acting on existing swell and building wind waves on top of that swell. Individual wave heights would be maximized due to constructive interference. This resonance of storm system with swell propagation is called dynamic or "trapped" fetch and produces extreme seas.

During a dynamic fetch event, since swell has no longer outrun the storm, there is no precursor to a rapid rise in wave heights, therefore, little or no warning is given. Wave heights can double, triple, or more in several hours. During Hurricane Danielle in 1998, significant wave heights increased from 2 to 16 meters in just 6 hours at Canadian buoy 44141. Significant wave height is defined as the average height of the one-third highest waves. It is no coincidence that Danielle had accelerated from 7 to 17 m/s over an 18-hour period. Buoy 44141 was to the east or right of the track of the storm.

Hurricane Luis in 1995 produced seas of 17 meters at the same buoy south of the Canadian Maritimes with peak individual waves in excess of 30 meters. Luis, over the previous 24 hours, had accelerated from 8 m/s to 19 m/s over a relatively straight track. This phenomena is not restricted to rapidly moving tropical cyclones but is also observed with extratropical or mid-latitude cyclones.

CASE STUDIES

Two examples of extreme waves are presented in this section. The first is from a mid fall 1999 extratropical cyclone that developed in the eastern Pacific and intensified west of the Oregon Coast. Significant wave heights of 16.5 meters were measured by buoy 46006. The second example is from an accelerating tropical cyclone, hurricane Gert, in the western Atlantic in 1999.

EXTRATROPICAL CYCLONE

Over the oceans, autumn is a time of transition when deep tropical moisture can be forced into higher latitudes and cold air can surge southward. The result is the potential for violent, explosive developing storms. Sanders and Gyakum [1980] described such storms as bombs.

The incipient cyclone developed southeast of Japan on 22 October 1999 in an area of tropical moisture and then moved slowly to the northeast. On the 24th the cyclone began to accelerate straight east along 42º N. latitude while gradually dropping in central pressure. Marine Prediction Center forecasters began to warn for possible storm force winds with the cyclone on the 25th. On the 26th , rapid intensification began as the cyclone made a very gradual turn to the east northeast. Maximum intensity was observed mid day on the 27th with the cyclone center near 46º N. 135º W., just off the Oregon Coast. Winds to 65 knots were observed to the south and southwest of the center at the time of peak intensity. In an eight-hour period, significant wave heights rose from 5 meters to 16.5 meters. Significant wave height is defined as the average of the 1/3 highest of the waves. Peak waves or highest waves observed are typically 1.9 times the significant wave height. In this example individual seas were likely in excess of 30 meters or 100 feet. Very large swells in excess of 25 feet were observed along the West Coast of the U.S. over the following two days.

TROPICAL CYCLONES

Hurricane Gert was one of several Category 4 hurricanes observed during the 1999 Atlantic Season. Gert developed south of the Cape Verde Islands on the 11th of September and tracked west-northwest through the 17th. The storm reached peak intensity on the 16th with winds to 130 knots. On the 17th, Gert changed to a more northwest track in response to a weakness in the subtropical ridge. On the 21st, Gert changed to a more north-northeast track and began to accelerate from 5 to 12 m/s. The storm brushed Bermuda later on the 21st. Although the hurricane itself posed no threat to the U.S. mainland, Gert produced swell that brought seas to 12 feet along much of the East Coast. The beaches of New England became a haven for surfers. Two people were washed off the shoreline at Schoodic Point in Maine and into the surf. Unfortunately, they did not survive.

As Gert passed across the Canadian array of ocean buoys it passed just west of buoy 44141. The maximum significant wave height observed by 44141 was 45 feet as shown in the MPC Wind/Wave analysis for 0300 UTC 23 September 1999.

DISCUSSION: WHAT TO LOOK FOR

The examples of Danielle, Luis, Gert, and the October 1999 Pacific all produced extreme waves. Buoys recorded significant wave heights from 45 to 56 feet with individual waves up to 100 feet. In the four events discussed, there are some common threads. All of these storms were moving very rapidly, between 12 and 19 m/s along straight tracks. The highest waves were observed to the right of the direction of motion with the exception of Luis. Luis passed just to the east of buoy 44141.

For tropical cyclones this rapid speed of motion typically occurs along a north-northeast or northeast direction as a cyclone passes out of the tropics into the mid-latitudes.

For extratropical cyclones, the track for optimized wave production appears to be from west to east or west-southwest to east-northeast track. The cyclone usually explosively deepens or bombs. It has become evident to forecasters that west to east movers are dangerous.

The rapid motion in excess of 12 m/s appears to allow the cyclone and area of wave generation to either move in resonance or catch up to swell generated earlier by the storm. Wave and swell generation are optimized to the right of the direction of motion (northern hemisphere) of a cyclone because winds are blowing parallel and in the same direction as the cyclone. (The cyclone winds act on an already disturbed ocean surface). Once the cyclone catches up with or moves in harmony with its swell then wind waves do indeed build upon the swell and extreme waves can be produced.

Of the two possibilities, the tropical cyclone case is probably the easier to understand and forecast. If the track is going to remain straight in excess of 12 m/s then an extreme wave event is likely.

A version of the WAVEWATCH III model is now run two times a day using the very high-resolution wind field from the NOAA GFDL Hurricane Model

[Kurihara et al 1998]. The GFDL-WAVEWATCH III model forecasts were in the process of being evaluated by MPC forecasters during the hurricane season of 2000-2001. So far the results have been encouraging.

FORECASTING LIMITATIONS

An understanding of dynamic fetch is just one necessary ingredient needed by Marine Prediction Center forecasters to produce accurate wave forecasts. Numerical forecasts of winds are not perfect and thus the resultant numerical wave forecasts are less than perfect. The forecaster must understand the limitations of all the ingredients that go into producing a numerical forecast and apply that knowledge in a variety of circumstances. A key ingredient is an understanding of how cyclones behave, their life cycles, and wind evolution. Numerical forecasts still have trouble with forecasting rapidly developing extratropical cyclones. The result is too weak a wind forecast and thus too low a wave forecast. Forecasters must compensate for this.

Producing three-hourly wave analyses has had its benefits for the forecaster. Wave model biases become obvious. A clear bias of the NOAA WAVEWATCH III is to produce waves too slowly and too low in strong cold air advection across warmer waters. There may be two explanations for this; either the wind is extremely efficient transferring energy to the ocean in the form of wind stress or wave growth is not fully understood and accounted for in fetch limited cases. Perhaps the best example of this is off the East Coast of the U.S. in winter in strong northwest flow with cold air flowing across the warm Gulf Stream. MPC forecasters often can compensate for this bias and increase both the seas and the winds. It is possible that this bias also occurs in cold air advection in rapidly intensifying cyclones and would cause an underestimate of seas.

Extreme waves also occur in areas of strong ocean currents such as in the Gulf Stream and the Kuroshio Currents. Unfortunately, there is very little observational data in these areas. Operational wave models are not at the stage yet that they contain the effects of ocean currents. Forecasters do warn for higher seas in the vicinity of ocean currents and define the current areas. Warm and cold eddies association with larger currents also have small current maximum associated with them. Even if the larger scale ocean current could be introduced into operational wave models, the effects of these eddies would not be resolved, therefore not forecast.

Extreme seas with the 1991 Halloween Storm occurred in a large area of strong winds. The cyclone itself was nearly stationary. It has been suggested that these extreme waves were the result of a rapidly moving wind maximum sweeping along the sea surface in resonance with developing swell. Unfortunately, diagnosing and forecasting the motion and intensity of a wind maximum embedded in a large-scale wind field is currently beyond the capabilities of the operational science due to the small scales involved.

Forecasters do not forecast wave shape or make any estimation as to whether waves are breaking or not. Although breaking waves and steepness are critical for mariners, forecasting these conditions is also beyond the current state of the operational science.

SUMMARY

Until recently, forecasters did not have the tools or understanding to confidently forecast extreme wave events. Three factors have made the forecasting of extreme wave events possible; advances in atmospheric wind forecasts, realistic treatment of swell generation and dispersion by ocean wave models, and better understanding of extreme wave events by NOAA Marine Prediction Center forecasters.

As presented here, many extreme wave events are produced by rapidly moving storms (extratropical and tropical) (speed of motion 12 m/s or more) that travel along a straight track. For extratropical cyclones, typically the cyclone is rapidly intensifying. As pointed out in section 4b, there are other factors that produce extreme seas such as ocean currents and current maximums associated with thermal oceanic eddies that are not able to accurately forecast for various reasons. Forecasters do not have the ability to forecast whether seas are breaking or even the steepness of seas.

What does this mean for the mariner? Although forecasters are not able to anticipate all extreme sea events, many can be predicted.

REFERENCES

Kurihara Y, Tuleya RE, Bender MA [1998]. The GFDL Hurricane Prediction System and its performance in the 1995 hurricane season. Mon Wea Rev *126*(5), 1306-1322.

Sanders F, Gyakum JR [1980]. Synoptic-dynamic climatology of the “bomb”. Mon Wea Rev. *108:* 1590-1606.

Shapiro MA, Keyser D [1990]. Fronts, jet streams and the tropopause. Extratropical Cyclones. In: Newton CW, Holopainen EO, eds. The Erik Palmen Memorial Volume, American Meteorological Society, pp.167-191.

Tolman HL [1998b].Validation of a new global wave forecast system at NCEP. In: Edge BL, Helmsley JM, eds. Ocean Wave Measurements and Analysis. ASCE, pp. 777-786.

SAFETY IN SMALL SCALE FISHERIES — WHAT IS TO BE DONE?

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INTRODUCTION

Marine fishing has always been the most dangerous of all civilian occupations [Ben-Yami 1998]. Fish workers frequently operate under hostile conditions, often using imperfect vessels and technology. Small-scale fisheries are particularly vulnerable to worker injuries [Ben-Yami 2000; Holliday 2000].

Casualties are high in countries and areas where small-scale fish workers operate under conditions where their vessels, safety and communication equipment, first-aid, search-and-rescue (SAR), and early warning services are less than adequate [Gallene 1995, 1997; Johnson and Tore 1994; Satia 1993]. These workers fish and collect aquatic organisms by swimming, diving, wading, or using small-scale fishing craft. Such craft are defined as mainly decked boats of less than 10-12 m length overall, and less than 12-15 MT displacement, powered by engines not exceeding 200-300 hp (150-225 kW), as well as rafts, canoes, pirogues, and open-deck dhows up to 16 m length overall, powered by engines not exceeding 200 hp (150 kW) [Ben-Yami 1988].

Safety problems of small-scale fishermen have so far received low priority even in many industrial nations, and have been all but neglected in most of the others [Ben-Yami 1998, 1999 & 1999a; Wagner 1999]. Reduction of casualties can be achieved through concerted action of fishing communities and organizations, national and sub-national authorities, international organizations, and voluntary bodies.

This paper provides, in outline form, a brief overview of recommendations for fishing safety that could be implemented by local, regional, and/or international bodies. Some sections contain more information than others: Later sections of this paper have been severely abridged. An unabridged version of these recommendations will be made available by FAO/FIIT in the future. The bibliography attached to this paper can provide further references for recommendations.

OVERVIEW OF INTERNATIONAL INITIATIVES AND A PROPOSED PLAN OF ACTION TO IMPROVE

FAO, ILO, IMO, and WHO are the main inter-governmental bodies institutionally qualified to deal with problems of safety and health of fish workers on the world scale. FAO, in particular, has decades of experience and involvement in the various aspects of development and management in fishing communities, including boat design and construction, and fishermen's safety. It appears, therefore, that FAO should assume the leading role in international and intergovernmental activities in small-scale and artisanal fisheries safety issues, particularly in developing countries. Institutional-administrative feasibility represents another reason for centralizing such program under the umbrella of a single international organization. Nonetheless, with respect to some aspects of seamanship, such as certification, and international and national safety codes, standards, insurance, and legislation, IMO and ILO ought to be consulted and should extend their assistance [IMO 1998; Wagner 1999].

Internationally supported programs, sponsored by intergovernmental regional and worldwide organizations, would carry the necessary weight to negotiate with governments and to deal with political "anti-regulation" pressures and official opposition based on implementation difficulties.

Such international endeavors may assume various forms. Here, one option is proposed.

A WORKING GROUP MODEL

FAO could formulate a world program for safety in small-scale fisheries. A full-time Chairman (or a Group Secretary) would be appointed to coordinate a specially established Working Group. Among its first tasks would be identification of financial sponsorships, and approach to all governments to carry out surveys of the state of safety in their small-scale fisheries. In Third World countries, nongovernmental organizations (NGO) and FAO field projects might assist. Since NGOs play important roles in many developing countries, especially where it comes to community-related work, the integrated joint program should allow for drawing in NGOs wherever they are willing and able to help, while those NGOs that provide substantial input into the program ought to be represented on the program's Working Group.

An important task of the program would be a worldwide convention on safety-at-sea for small-scale and artisanal fisheries that would provide guidance and legal background to member countries. This convention should contain fishing standards that promote safety for fishermen.

SURVEY OF WARNING SYSTEMS AND SAR

The Working Group would review the existing warning systems and SAR services throughout the world's small-scale fisheries. FAO has already accumulated some related information and experience [Gallene 1995, 1997; Houehou 1993; Johnson and Toure 1994]. With respect to reviewing warning systems, regional international cooperation should be encouraged and, if necessary, coordinated by the Working Group. Regional storm warning systems should be looked at from two points of view: forecasting and monitoring, and broadcasting. The next step should be to seek, promote, and support solutions.

TRAINING IN ACCIDENT PREVENTION, BEHAVIOR IN EMERGENCIES, AND SURVIVAL AT SEA

The Working Group would review the level of training and know-how in areas with high casualty records, and initiate and promote training activities as those described below. Again, where governments are unable or unwilling to take proper care of these aspects, the program should seek international and NGO support.

STRATEGIC PRIORITIES

Because the safety situation in small-scale fisheries worldwide is so bad, even modest improvements would result in substantial reduction of the casualty rate. Two basic strategies are possible: (1) injury prevention; and (2) reducing human and material casualties resulting of accidents. Depending on specific, local conditions, both strategies can be applied separately, consecutively, or simultaneously.

The first strategy encompasses improvements in boats' design and construction, particularly paying attention to stability, weather warning systems, storm shelters for vulnerable coastal populations, and compulsory training and licensing of skippers and crews in safety of both navigation and on-board procedures. Additional priorities consist in integrating safety issues in fishery management and eco-labeling schemes, and, where feasible, reduction and elimination of financial and fishery management-induced incentives to take risks, as well as in legislation and insurance that stipulate safety measures.

The second strategy involves attention to SAR, safety, first aid, and survival equipment on board, emergency communication and tele-location systems and skipper and crew expertise and performance in emergencies, and related training.

The rest of this paper will outline specific model standards that could be implemented by the aforementioned Working Group, that address the two strategic priorities.

MODEL STANDARDS FOR PREVENTION AND TRAINING

The Working Group should promote the following policies for managed fisheries:

> Set the days for short-opening fisheries to avoid days of particularly bad weather.
>
> Cut out periods of bad weather when applying seasonal or other short closures.
>
> Apply mandatory closures at times of bad weather for fisheries supported by boats of comparable seaworthiness.

Introduce mandatory insurance stipulating seaworthiness tests and equipment inspections as a condition for the allocation of fishing licenses, quotas, and other fishing rights.

Safety-at-sea laws and rules should allow mandatory equipment to be considered tax- and duty-free, and allow for economic means to allow for seaworthiness inspections of fishing craft, crew and skipper certifications, and inspections.

The Working Group should promote legislation and enforcement of rules preventing inhumane and unjust treatment of artisanal crews employed with their craft by "motherships". Proposed training and certification standards are described below.

CERTIFICATION

Fisherman in charge of fishing craft carrying at least one additional crewmember should be certified. Initially, experienced "old-hands" could be grand fathered. Syllabi for certificates should fit local conditions, type and size of boat, educational levels of fishermen, and include local navigational methods, rules of the road, basic first-aid knowledge, and behavior and management of emergencies.

PROPOSED TRAINING AND PUBLICATIONS STANDARDS

The Working Group should promote training courses, crash-courses, workshops, seminars, etc. in two main categories: training of trainers and educators; and training of fishermen. Educational efforts may be needed where local beliefs impact behavior, e.g., fishermen do not trust modern weather forecasting. Governments should be encouraged to organize courses and workshops, and where needed, itinerant training units, [Ben-Yami 1999; McCoy 1991].

PROPOSED TRAINING STANDARDS FOR TRAINERS

Trainers themselves should be experienced seamen or fishermen, especially for training in survival, emergency management, and use of safety equipment.

Other trainers needed include extension workers for voluntary SAR groups; first-aid paramedics; mechanics-instructors; boat building instructors; and instructors in emergency use of sails.

It is important to train staff of first-aid units to recognize symptoms of decompression sickness in diving fishermen, and realize the urgency of speedy transportation of the casualty to a recompression chamber [Berkow et al 1997].

Training programs should involve teaching prevention and management of marine accidents. This would involve teaching scenarios addressing stability, overloading, and "top-heavy" situations, including capsizings and handling of holes and leakages. Training, education, and examinations [Rayment and Fossi 1994] should cover survival at sea, handling boats in currents, rough weather, tall waves, surf, and management over shallows and water spouts. These curricula should cover "man overboard" and "abandon ship" routines, groundings, and ways to refloat vessels before major damage occurs. The curricula should also cover Rules of the Road and recognition and avoidance of collision courses, and precautionary behavior and procedures on board in worsening weather [Gulbrandsen 1998]. Training and certification of SCUBA divers is another critical issue.

PROPOSED TRAINING STANDARDS FISHING CREW MEMBERS

Curricula should be prepared and instructors selected according to specific, local needs. Curricula for crew members should include: "Abandon ship" practice; rapid donning of immersion suits; first aid, including recognizing symptoms of, and dealing with hypothermia; and survival in water in the presence of sharks.

Proposed Standards for Safety Publications for use on vessels should promote the following concepts or standards:

Encourage regulating bodies to produce easy-to-use, waterproof and small-size maps charting dangerous spots and areas, and safe routes.

Encourage regulating bodies to prepare popular, well-illustrated pocket guides/ manuals on accidents prevention and safety at sea for artisanal fisheries, translated into relevant languages and distributed to governments and programs dealing with safety at sea. [FAO/ILO/IMO 1988; Gulbrandsen and Pajot 1993; Marine Safety Agency et al 2000; Safety Committee 1972; Safety Liaison Working Group 1997]. Guidance on how to react to accidents and management of emergencies should be included in new or reprinted manuals.

Produce or reproduce and distribute a series of guides aimed at boatbuilders without formal training in the construction of seaworthy and reliable small-scale fishing craft. [Coackley 1991; Fyson 1980, 1985; Mutton 1982; Gulbrandsen 1992; Gulbrandsen and Pajot 1993; IMCO,1976 a, b; Reinhart 1975; Riley and Turner 1995; J.Turner; K.Codel priv.comm.].

PROPOSED INTERNATIONAL DESIGN AND CONSTRUCTION STANDARDS FOR SMALL-SCALE FISHING CRAFT

A team of experts should identify and formulate international and regional standards for small-scale fishing craft design and construction that can be used as a basis for regulation and enforcement. The standards must address fishing, environmental, socioeconomic and cultural conditions, as well as general technological level and infrastructure in different parts of the world, and recommend existing and new designs which would be safer, and contribute to better working and living conditions on board, more efficient fishing operation, including fuel economy.

PROPOSED SAFETY IMPROVEMENTS TO ARTISANAL BOATS

Improvements can be introduced to traditional craft while maintaining its character, such, as buoyancy after capsizing or flooding; improvements to increase the ability to right the boat up by swimming crew; plastic-foam buoyancy blocks fitted in appropriate spaces; material changes, such as the use of bolts, instead of nails, and use of better tools; improvements that contribute to watertight integrity, freeboard, stability, performance in waves and in surf, etc. [Ben-Yami 1999; Gulbrandsen 1992].

PROPOSED STABILITY STANDARDS FOR FISHING VESSELS

The special conditions of operation of fishing vessels, especially double-rigged trawling boats and small-scale purse seiners, require special consideration of stability, due to external pulls. [Coackley 1991; Fyson 1980, 1985; Gulbrandsen and Pajot 1993; Mutton 1982; Riley and Turner 1995]. Where necessary, vessel manufacturers should provide “weak-link” elements in the rigging or the fishing gear that could break off when pulls raise to dangerous levels [Ben-Yami 1999].

PROPOSED STANDARDS FOR PREVENTION AND TREATMENT OF STINGS, VENOMS, AND POISONS

Fishermen are prone to painful and even fatal injuries by venomous and poisonous marine animals. The Working Group should promote improving the availability of anti-venoms and related medicines to fishermen, especially in Third World fisheries; research and development of anti-venoms and immunization against venoms, and poisons such as ciguatera, and of simple ciguatera presence tests [Berkow et al 1997; Williamson et al 1996]. The Working Group should require mobile first-aid units, where wading, swimming, and diving fishing activities are frequent [Berkow et al 1997; Williamson et al 1996.]. It should promote regulations and recommendations related to minimum first-aid responses and list drugs against venoms and poisoning to be carried by such units and on board small fishing craft.

PROPOSED STANDARDS FOR WEATHER WARNINGS

The Working Group should promote reorientation of weather warning systems to serve small-scale fisheries.

DELIVERY OF WARNINGS: RADIO

The Working Group should promote policies obligating public and private radio stations, in areas prone to major storms and sudden weather changes, to transmit weather warnings as soon as received, without waiting for regular weather forecast times. Such procedures, where necessary, should be made compulsory by law. The Working Group should require all seagoing, fishermen, including artisanal fishermen, to carry radio receivers able to receive such weather broadcasts [Anon. 1996, Calvert 1998].

DELIVERY OF WARNINGS: MILITARY FORCES

The Working Group should promote the use of military aircraft to alert fishermen at sea, on land close to shore, and on the beaches, on approach of dangerous weather.

PROPOSED FIRE PREVENTION STANDARDS

The Working Group should promote relevant regulation to address fire prevention, including, regulations stating that:

> “Small craft powered by petrol-driven outboard motors should carry additional fuel in extra outboard fuel tanks that allow for easy on/off attachment to fuel lines, and do not allow fuel to spill in the vessel. Spilled fuel can lead to fires aboard vessels, which can result in vessel loss, and/or injuries or death to crew. Small open boats should carry a bucket, and some sand in a container.
>
> Larger, decked small-scale fishing vessels must be designed with special consideration to water pumping systems, galleys, engine room and casing, and exhaust pipes, to minimize the risk of fire.”

PROPOSED STANDARDS FOR PREVENTING COLLISIONS

The Working Group should require that all boats carry simple radar reflectors and exposed light during nighttime operations. Notwithstanding any electronics, a person must be on lookout whenever the boat is in motion. Crew members should demonstrate good knowledge of “Rules of the Road” and discernment of collision course prevention measures.

PREVENTING BEACHING ACCIDENTS

The Working Group should promote locally appropriate beaching installations and services; and promote land and sea anchoring of beacons, light and other beacons.

PROPOSED STANDARDS FOR OPERATIONS ON THE BEACH: DISASTER PREPAREDNESS; EVACUATION AND PROTECTION

The Working Group should promote policies addressing beach fishing activities including the introduction of visual warning means including flags hoisting, smoke signals, pyrotechnics, etc., warning techniques from the air, and the use of radio transistors. Where hurricane-force winds destroy dwellings and carry in their wake torrential rains and floods, the Working Group should promote the construction of safe storm refuges, such as, well constructed (e.g., reinforced concrete) houses, especially, schools, houses of worship, community centers, and, where necessary, raised flooring. One possibility is to construct low-cost community "survival platforms". These may consist of a concrete, well fenced floor set on a sufficient number of concrete pillars tall enough to keep the platform above any possible flood, with a minimum carrying strength of at least 300-400 kg/m^2, and wide gangways and stairs. Such structures can save large numbers of people and animals, while requiring minimum maintenance [Ben-Yami 1999; Turner J priv.comm.].

MODEL STANDARDS FOR MANAGEMENT OF INJURIES AND EMERGENCIES AT SEA

Existing guides and manuals do not adequately deal with many of the issues associated with fishing injuries and emergencies. The Working Group should promote activities that contribute to increased survivability.

PROPOSED STANDARDS TO PROMOTE SURVIVAL DURING AND AFTER VESSEL EVENTS

The Working Group should require that all fishing craft designed to remain buoyant upon capsizings should be fitted with hand ropes or other means by which people in water could hold onto the vessel, and right the craft up. The Working Group should require that every boat carry hooks and line for emergency fishing, some sort of signal pyrotechnics (desirably parachute flares), a transistor radio receiver, an electric torch with spare batteries, a cellular telephone (where feasible), a buoyant waterproof container for the above supplies, life jackets fitted with reflective tape or active lighting systems for all persons on board, a basic first-aid set, buoyant emergency water containers, anchor and anchor rope, and a bucket or two. All small boats should carry paddles or oars, a mast and sail, and a lamp.

Magnetic compasses should be carried in all boats fishing at a distance exceeding 1 to 2 nm offshore [Gulbrandsen 1992 & 1998; Gulbrandsen and Pajot 1993]. Decked small-scale vessels larger than 7 to 8-m length should be equipped with standard navigation lights, hand and mechanical bilge pumps, fire extinguishers, and carry additional equipment, such as a small life raft (if boat not buoyant), light and smoke signals, and a light-buoy with radar reflector. EPIRB buoys and personal survival suits should be required in cold-water areas.

PROPOSED STANDARDS TO PROMOTE SURVIVAL IN WATER

The Working Group should require that all survival equipment be well stowed and maintained and in case of sinking, easily or self-detachable and seaworthy. All boats should carry sufficient number of life jackets, and if necessary, should be assisted in their acquisition and distribution.

PROPOSED STANDARDS TO PROMOTE SURVIVAL DURING FISHING OPERATIONS

Fishermen should be informed that injuries are caused from contact with winches and line and net-haulers, running gear (cables, wires, nets, and longlines being set and hauled), fish hooks, and heavy weights overhead, as well as with thrashing and dead fish. The Working Group should require vessels to have first aid at hand at all times; discontinue fishing when external medical assistance is urgently needed; keep sharp knives, axes, and/or other cutting devices nearby, in the event that crew members get caught by running lines, ropes, or cables.

PROPOSED STANDARDS TO PROMOTE SURVIVAL WHILE DIVING AND OTHERWISE FISHING IN WATER

The Working Group should require local authorities to:

Provide emergency recompression chambers where large numbers of fishermen are employed in commercial SCUBA diving; and

Ban SCUBA fishing in deep water if safety oversight is not available.

PROPOSED STANDARDS TO PROMOTE SURVIVAL IN BAD WEATHER

Fishermen should be informed that sudden gales, major storms and heavy fog frequently cause small boat capsizings, grounding, losing way, and collisions, as well as casualties. Successful weathering of a storm requires thorough preparation of the boat in the harbor, or when the weather starts to deteriorate. The Working Group should enact policies that require fishermen to ensure that the deck is tight, all hatches shut and secured, and all weights, containers, and fishing and other equipment safely lashed down. The fishermen should stretch manropes where people must move, e.g., between forecastle, engine hatch, and the wheelhouse.

PROPOSED MODEL STANDARDS USEFUL ESPECIALLY FOR DECKED BOATS IN THE 8-12 M RANGE, ARE LISTED BELOW:

Follow stability rules;

Don't overload the vessel with excessive equipment or catch;

Mind stability when making changes to vessels or equipment;

Make sure all hatches, weather deck and watertight openings are in good condition with gaskets;

Keep bilges free of excess water;

Frequently check all void spaces for water; and

Ensure that the bilge-pumping system is operational.

To maintain boat's bow into the weather, fishermen should be required to keep on board a sea-anchor (that may be replaced by wise use of fishing gear, especially in trawls), and a small gaff sail (trysail) that can be set over the boat's stern.

PROPOSED STANDARDS RELATING TO SEARCH-AND-RESCUE (SAR) SERVICES AND SMALL-SCALE FISHERIES

Wherever necessary, the Working Group would promote strengthening or establishment of SAR services. Most, if not all coastal industrial countries have SAR services. In such countries, small-scale fisheries should reach the level of training and equipment comparable to that practiced in the larger-scale fishing fleets, for example, introduction of real time vessel monitoring system (VMS), automatic emergency and position calls from vessels in danger, and wider use of EPIRBs.

Three basic types of SAR services are relevant to small-scale fisheries: (1) voluntary civilian forces; (2) state-run: naval, air force, coast guard, and police; and (3) community self-help SAR groups. Fishermen in trouble are mostly found and rescued by other fishermen. Therefore, visual or other contact among small fishing boats is important.

Where governments are not effective, the Working Group should identify local, traditional and/or new institutions and leaders, and help them organize their own SAR and related activities. SAR groups may construct and install simple radar reflectors on canoes and sailing rafts, and/or equip them with radar-reflector buoys or beacons marking dangerous reefs and rocks, lights or fires on beaches and at shelter entries to mark night passage of fishing craft through surf or narrow passages, beacons. The Working Group should require the installation and operation of beaching installations, etc. Local groups can also handle simple weather-warning systems, such as using mosques' loud speakers, hoisting warning flags, generating smoke signals, etc., to alert the fishermen working inshore.

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REFERENCES

Anon. [1996]. Were they warned in time? World Fish *12*:3.

Bates Q [1999]. Anger at inshore code. World Fish *48*(2):20-21.

Ben-Yami M [1988]. The role of small-scale fishing gear and techniques in development: challenges towards the year 2000. In: Proc.World Symposium on Fishing Gear and Vessel Design. St.John's, Newfoundland, Canada: Marine Institute, pp.449-453.

Ben-Yami M [1998]. The dangerous profession. World Fish, *12*:6.

Ben-Yami M [1999]. Risk and Dangers in Small-Scale Fisheries – an overview. International Labour Office, Geneva: Working Paper of the Sectoral Activities Program.

Ben-Yami M [1999a]. Safety at sea: the tragedy of official default. Samudra *(9)*:24-28.

Ben-Yami M [2000]. There are no excuses for orphan's tears. World Fish *(3)*:10.

Berkow R et al. (Editors) [1997]. The Merck Manual of Medical Information. West Point, PA, U.S.A: Merck Research Laboratories, P.O.Box 4, p. 1510

Calvert P [1996]. Safety at sea: An attitude of mind not an externally enforced set of rules. Lecture at One-Day Workshop of the Kerala Fisheries Society on Safety at Sea. Mimeo. 11 pp.

Calvert P [1998]. Cyclone warning. Samudra *21*:10-12.

Coackley N [1991]. Fishing Boat Construction: 2. Building a fiberglass fishing boat. FAO, Rome :FAO Fish.Tech.Pap. 321.

FAO/ILO/IMO [1988]. Document for Guidance on Fishermen's Training and Certification: an international maritime training guide.I MO, London.

Fyson JF [1980]. Small Trawlers. Fishing Boat Designs: 3. FAO, Rome: FAO Fish.Tech.Pap.(229). 52 pp.

Fyson JF (Ed.) [1985]. Design of Small Fishing Vessels. Oxford, U.K.: Fishing News Books, pp. 320

Gallene J [1995]. Data Compendium on Safety at Sea for seven West African Countries; Mauritania, Senegal, The Gambia, Guinea-Bissau, Guinea, Sierra-Leone, and Cape Verde, 1991-1994. IDAF/WP/71Techn.Rep.(*71*):13 pp. (IDAF/FAO Cotonou, Benin).

Gallene J [1997]. Data Compendium on Safety at Sea for six Central African Countries; Cameroon, Gabon, Congo, Sao-Tome & Principe, Democratic Republic of Congo, Angola, 1991-1996. IDAF/FAO, Cotonou, Benin: IDAF/WP/.116 Techn.Rep.(*116*):16.

Gulbrandsen J [1998]. Training in sea safety development. FAO, Bangkok.: TCP/IND/6712 Field Doc, *(4)*:10 p.

Gulbrandsen O [1992]. Safety in small fishing boats. Infofish Interntl *(1)*:44-46.

Gulbrandsen O and Pajot G [1993]. A Safety Guide for Small Offshore Fishing Boats. Bay of Bengal Program, India: BOBP/MAG/16, 34 pp.

Holliday E [2000]. Act on my plan to cut death rates. Fish.News Internatl., 2000(*1*)16.

Houehou F [1993]. Strengthening safety at sea. IDAF Newsl. (FAO), (*19*):18-21.

International Maritime Organization [1998]. Revision of the Fishing Vessel Safety Code and Voluntary Guidelines. U.S.A. and Russian Federation submissions. Sub-Committee on Stability and Load Lines and on Fishing Vessel Safety

Inter-Governmental Maritime Consultative Organization [1976a]. Code of Safety for Fishermen and Fishing Vessels — Part A: Safety and health practice for skippers and crews. London/Rome: FAO/ILO/IMCO, 108 pp.

Inter-Governmental Maritime Consultative Organization [1976b]. Code of Safety for Fishermen and Fishing Vessels — Part B: Safety and health requirements for the construction and equipment of fishing vessels. London/Rome: FAO/ILO/IMCO,58 pp.

Johnson JP and Toure JA [1994]. Accidental death and destruction in artisanal canoes. IDAF Techn.Rep. (*59*):21 pp.

Marine Safety Agency et al. [2000]. Emergency Procedures for Fishing Vessels. Southampton, U.K: MSA, 3 p.

McCoy MA [1991]. Survey of Safety at Sea Issues in Pacific Island Artisanal Fisheries. Field Doc. 91/3 Suva, Fiji: FAO/UNDP Regional Fishery Support Programme, 84 pp.

Ministry of Fishery and Marine Transport [1994]. Draft Code of Conduct (Dakar, Senegal). (From Rayment and Fossi, 1994).

Ministry of Transport, Shipping and Ports Administration, Small Vessel Division [1999]. Small Vessels - Standard for Safety, Emergency, and Rescue Equipment. Haifa: Government of Israel.

Mutton B [1982]. Hauling Devices for Small Fishing Craft. Engineering Applications: 2. FAO, Rome: FAO Fish.Tech.Pap.229, 146 pp.

Rayment P and Fossi A [1994]. Report into the safety and security of the artisanal fishermen of Senegal. Sea Safety Group U.K./CCFD, France. Brea, Cornw. U.K. 62 pp.

Reinhart JM ,editor [1975]. Small Boat Design. Proc. ICLARM Conf. Small Boat Design, Noumea, Oct.27-28, 1975. Manila, Philippines: ICLARM, 77 pp.

Riley RON and Turner JMM [1995]. Fishing Boat Construction: 3. Building a ferrocement fishing boat. FAO Fish.Tech.Pap. (354):149 pp.

Safety Committee, Fisheries Association of British Columbia, Vancouver [1972]. Fishermen's Safety Manual. Government of Canada: 84 pp.

Safety Liaison Working Group [1997]. Emergency Procedures for Fishing Vessels. Hampshire, U.K.: Marine Safety Agency.

Satia BP [1993]. Safety at sea: top priority. IDAF Newsl. FAO, *(19)*:4.

Wagner B [1999]. Safety and Health in the Fishing Industry. International Labour organization – Sectoral Activities Program. Geneva, Switzerland: ILO, 100 p.

Williamson JA et al eds. [1996].Venomous and Poisonous Marine Animals. Sydney, Australia: Univ.New S.Wales Press, 503 pp.

Photograph and caption by Earl Dotter

The caption reads; "These lads have joined the silent majority and here lie in peace where no wind can disturb their rest. Charmed by the sea, they fought many a gale with a courage and fortitude typical of Gloucester fishermen." One has only to walk to Gloucester's Beechbrook Cemetary to feel the burden this community has shouldered.

A SNAPSHOT IN TIME OF NORTHEAST FISHSTORY

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Ted has worked for the United States Coast Guard for the past twenty-three years in the Marine Safety Field. He spent ten years in the field inspecting passenger, cargo and other commercial vessels as well as conducting hundreds of marine casualty investigations. For the past ten years Ted has been the First Coast Guard District's Fishing Vessel Safety Coordinator and has provided the F/V Safety training for at sea boarding officers on Coast Guard Cutters and Stations along the coast from the Maine/Canada border to New Jersey.

The focus and intent of this paper is to organize historic casualty information and present it in a form consistent with present day statistics. We researched fishing vessel casualties by extracting contemporaneous reports published in the past 200 years and compared older information with current data used to describe F/V safety trends. We were assisted in this research by the First Coast Guard District, which has maintained a fishing vessel casualty database since the inception of the F/V Safety Regulations.

It's interesting to note that today's fishermen faced the same challenging external factors as their forefathers. Fish population declines, taxation and low prices constantly affected the health of the industry. The fisherman's work has been of interest to writers throughout American history: an article in the New Bedford Mercury in 1833 placed the number of fishermen prior to the American Revolution at 4,000. (The population of the country then was approximately four million people.) In 1848, another article put the number of whaling fishermen in New Bedford/Cape Cod area at 18,000 fishermen based on 25 men per vessel in a fleet of 875 vessels. The Gloucester and northern region's fleet was comprised of smaller schooners with 12 men per vessel. References to Gloucester and surrounding cities placed the number of fishermen at 8,000. With other New England ports, there were an estimated 35,000 fishermen in the area during the mid 1800s. While the number of active fishermen is constantly changing, the fishing population of today has not changed much proportionately from other periods in history. These estimates allow the possibility of making rudimentary assessments of casualty trends over a longer period of time.

The dominant fisheries in New England in the first half of the 19^{th} century were the whaling industry and a growing groundfish fleet on the Banks. Fish were abundant and could be caught within sight of land. As fishing became very profitable the number of fishermen increased, as did their methods. Soon, cod and whales began to disappear, which required fishermen to venture further from shore. This increased the risk by exposing the crews to more days at sea, more severe weather and in vessels not properly designed or equipped for the area of operation.

There were approximately 700 barks and brigs in the New England whaling industry and approximately 2,000 schooners on the banks by the mid 1800s. Vessel design capability, poor maintenance, lack of survival equipment, no communication and virtually no rescue resources doomed the vast majority of vessels lost at sea.

Whaling barks carried three to five whaleboats that were launched to harpoon whales and return them to the mother vessel. Each boat had a crew of three to five men led by the harpooner. Hundreds of fishermen died when struck or pulled over the side by whales. Many more were lost at sea. With the technological advance of the whale gun in 1847 there was no reason to deploy whaleboats and the death rate decreased accordingly.

What kinds of events led to casualties in the past? Older records tend to list vessel equipment and design as factors leading to injuries and deaths in the New England fishing fleet.

Sailing schooners dotted the coasts of Massachusetts and Maine. These vessels journeyed to the Banks and stayed for weeks and months at a time. However, in winter, the Banks were frequently the scene of treacherous storms. As technological advances were made, the frequency of casualty type that resulted in death underwent major changes. In the 1800s, almost 90% of all deaths were attributed to vessels capsizing or sinking. (In contrast, by the late 1900s, the major type of death in the industry was man overboard.) Fishing was done from dories that were launched over the side from larger vessels. Two to three men would hand-fish for the day, sometimes 10 or more miles from their vessel. These small dories and whaleboats accounted for the deaths of hundreds of fishermen.

During the first half of the 19th century, sinking and capsizing accounted for 52% of all deaths. Illness resulted in 19% of casualties. This included island fever, scurvy, pneumonia, consumption and various other illnesses. Many whale men contracted malaria while stopping at islands for supplies. 14% died at the hands of natives on uncharted islands or were killed in various ways by whales. The main risk factors during this period were vessel and equipment design, medical deficiencies and lack of geographical knowledge.

In the second half of the 19th century, offshore fisheries were predominate and this was reflected in the casualty statistics. Sinking and capsizing accounted for almost 75% of all casualties. Fishermen plied their trade further from shore and for longer periods creating more risk from weather and ill designed vessels. Medical advances reduced illness-related deaths from 19% to 1%.

During this later period, technology outstripped the need for whale oil. Colonel Edwin Drake developed the first oil drilling well in Pennsylvania in 1859 and soon whaling was an obsolete activity. The rapid demise of the industry resulted in a corresponding drop in fishing-related fatalities: the fatality rate in this later period was reduced from 14% to 1%. Man overboard accounted for 13% of all deaths.

No mention of maritime history in the New England area can be complete without discussing the role that weather has played in this industry. In 1851 alone, over 75 vessels and close to 200 fishermen were lost in one day. The papers of the day advised the fleet "in the future" to carry Admiral Farragut's new marine barometer to help forecast weather. (The National Weather service was formed as a result of these casualties, helping to mitigate the ongoing risk that weather posed to New England fishermen.) Technological advances like the marine barometer were perhaps the biggest contributors to F/V Safety in the 1800s.

As the 20th Century was ushered in, whaling as a major fishery was almost extinct. Rescue services were established and communication technology was rapidly developing. Ship building techniques and new fishing methods were reflected in the design, construction, and operation of modern fishing vessels. Hydraulic power was now used to operate deck gear through remote workstations. Net drums and hydraulics eliminated the need to launch dories, eliminating a major cause of fishing casualties. Electronic navigation and communications equipment were common on bridges by the 1960s.

As technological advances were made, the frequency of casualty type that resulted in death underwent major changes. In the 1800s, almost 90% of all deaths were attributed to vessels capsizing or sinking. In contrast, by the late 1900s, the major type of death in the industry was man overboard. Human factors comprise the biggest risk factor for the vast majority of recent deaths to fishermen in the New England area.

After the Fishing Vessel Safety Act of 1991 there began a steady decline in number of fatalities in the Northeast. From an average of 46 during the 70s and 80s, deaths were reduced to 20 in 1993, 15 in 94 and 9 in 1995. In the years 1996-1998 there were 10 deaths.

It appears current regulations may be as effective as possible. Technological advances have had a dramatic effect on the casualty rate in the industry. The risk associated with **vessel design and equipment** has been effectively reduced. Advanced communications and weather forecasting have reduced the risk associated with **weather**. That leaves the vessel's **crew** as the biggest risk. Of seven deaths taking place recently in the New England area, human factors were implicated in all these events.

The most effective initiative that can be undertaken to improve safety is to address human factors. Any new regulation must involve professional competency that encompasses fishing, nautical and safety skills. Non-regulatory initiatives should promote safety as a total concept, building awareness of lessons-learned both nationally and internationally. Technology has changed but people have remained basically the same. We must find effective ways to modify the behavior of fishermen that is both practical and realistic.

Tuesday, October 24, 2000

INNOVATIVE APPROACHES TO INVESTIGATING AND PREVENTING FISHING VESSEL CASUALTIES

Photograph and caption by Earl Dotter

A fisherman dons layers of insulated clothing topped with hooded rain gear, rubber boots and gloves, and releases the massive chain-linked dredge into the sea. Entanglement of hands and clothing in unguarded winches is always a possibility, especially when fishermen are working in wet, slippery conditions on the shifting work platform.

PROMOTING IMPLEMENTATION OF SAFETY MEASURES

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INTRODUCTION

Fishing is a high-risk occupation. Much effort has been put on safety education to fishermen and on developing and presenting technical solutions to reduce the hazards. In spite of this, the general experience of many experts in the field is that the degree of implementation of safety measures in fishing is low [Hughes 1994; Aasjord and Silseth 1995]. The experience of the present project team is that fishermen often reject the evidence of accidents in fishing. Also, technical measures to reduce the hazards are often considered to cost too much money. The purpose of the present study was to develop, apply and evaluate the results of a method to promote implementation of safety measures in fishing. The approach was based upon demonstrating the high frequency of accidents in commercial fishing, identifying the direct causes, coupling these to technical shortcomings on board specific vessels, presenting suitable technical countermeasures and the potential of such measures for reducing costs. Substantial participation of the fishermen themselves was considered essential to obtain the goal of adequate selection, acceptance and actual implementation of technical solutions.

METHODS

The method consisted of the following elements:

Analysis of serious accidents in fishing for 12 years retrospectively. Determining the frequency of such events was based on statistics reported to the Swedish Labor Market No-fault Liability Insurance. Case definitions were comprised of events leading to more than 30 days of sick listing, permanent disability or death. Hearing injuries and injuries while commuting to and from work were excluded;

Analysis of the monetary costs to victim and entire crew of serious accidents due to each such direct cause. This analysis was based on median time of sick listing as a result of different categories of direct causes. It was also based on economics data typical of three common types of fishing;

Inventory of suitable technical measures to reduce the risks;

Participatory safety inspection of 101 fishing vessels giving a list of urgent technical safety measures on each vessel;

Short-term follow-up of degree of implementation and of satisfaction with undertaken measures, performed through telephone interviews; and

Long-term follow-up of continued use of measures taken as well as of further safety measures and plans for such measures, performed through telephone interviews.

RESULTS

The t-analysis showed that approximately 12 serious injuries per 1000 fishermen were reported each year. The yearly rate of reported fatalities was 0.7 per 1000 fishermen. The most common activity at the instant of the accident was hauling of the trawl. The direct causes of the events fell into 17 different categories, the most common being falls in 28 percent of the cases studied.

The cost analysis of the 17 direct causes of injuries and death showed substantial costs for the victim and, under most circumstances, also for the rest of the crew. The safety inspection was performed following a checklist and on the 101 vessels as many as 1300 safety deficiencies and 130 ergonomics deficiencies were identified. Twenty of the vessels performed fishing with only one man on board a substantial part of the year. Twenty-two had a crew of four or more.

Six months after the safety inspection 80 percent of the vessels had taken measures against on average two of the identified risks. Forty-nine of the 160 measures taken concerned acquiring or taking up the use of safety glasses or hearing protections. The rest of the measures were rather evenly distributed over the entire range of items on the checklist. Forty men held the opinion that safety measures had a potential for reducing costs in fishing. Twenty-seven men felt unable to take a standpoint in this matter. They indicated that life and health was a matter of ethics and money should not or at least had not until then been considered in this context. Ninety-three of the fishermen appreciated the visit and safety inspection. One benefit of substance was considered to be the opportunity to discuss safety problems with a knowledgeable person from outside the fishing community.

Two and a half years after the inspection, 78 vessels were available for follow-up. Ninety-six percent of the measures taken previously aboard these ships were still in use and in all but one case the fishermen were satisfied with their function. Forty-five of the 78 vessels had corrected further hazards identified at the inspection. In all, 85 corrective/preventative actions were taken. Also, 49 measures to improve safety or ergonomics on board, not listed at the inspection, had been taken. All together 60 vessels had taken further such measures. The measures taken were distributed over most of the items on the checklist. Thirty-nine fishermen were considering plans for still additional measures and 14 men stated that other crews had shown interest in safety measures taken on board. When asked why identified hazards had not been eliminated, the most common answers were that the remaining measures were not considered necessary (18 men), strained economy (8 men), that they had not got around to it (5 men) or that they felt that no acceptable solutions were at hand (3 men). On the question "What do you consider necessary for you personally to take further safety measures on board?" most common answers were that the economy must be improved (24 respondents) or that it would take an accident to occur (13 respondents.) Seventy-four of the 78 fishermen wished to maintain continuous contact with the OHS in the manner practiced in the present study. Results of the present study are presented in further detail in Törner and Nordling [2000], Törner et al [2000a] and Törner et al [2000b].

DISCUSSION

A shortcoming of the method used in the present study was the absence of a control group of fishing vessels. This was, however, not considered possible to obtain in a reliable and ethical manner. It is therefore difficult to state how many of the safety measures would have been taken without the intervention of the present project. At the six-month follow-up the participating fishermen stated that 68 of the 160 measures taken were a direct consequence of the safety inspection within the project. It is not unlikely that concerning a portion of the remaining items implementation was, if not initiated, at least precipitated by participation in the project. Authorities and the fishermen's organizations carry a large responsibility for continuously keeping safety on the agenda and for developing strategies to support safety work economically. There is, in the opinion of the research team, room for improvement in this context.

CONCLUSIONS

The methodology used, based on direct contact and visits to specific vessels, is resource demanding but the results of the present study indicate that it is cost effective, since a substantial number of hazards were eliminated and the measures taken remained in long-term use. The results also indicate that activity in safety work may to a certain extent be self-generating.

More efforts should be placed on developing improved technical solutions to known safety problems in fishing and on demonstrating the benefits of such devices.

OHS services in fishing should develop strategies to satisfy the fishermen's interest in continued direct contact with safety experts, without significant costs for the individual fisherman.

ACKNOWLEDGEMENTS

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REFERENCES

Aasjord H, Silseth A [1995]. Tiltakspakke for ökt sikkerhet i fiskerflåten. Report Number MT40 F95-0124. Trondeim, Norway: Marintek, Sintef-gruppen.Trondheim, Norway.

Hughes LJ [1994]. Vessel safety program. Proc. National Fishing Industry Safety and Health Workshop, Anchorage, Alaska, Oct 1992. Washington DC, NIOSH: publ no 94-109, pp 180-188.

Törner M, Nordling, P-O [2000]. Occupational injury in Swedish fishing. Part 1: Analysis of injury statistics. Occ Ergo *2* (2): 91-104.

Törner M, Cagner M, Nilsson B, Nordling P-O [2000a]. Occupational injury in Swedish fishing. Part 2: Promoting implementation of safety measures. Occ Ergo *2*: (2): 81-89.

Törner M., Cagner M, Nilsson B, Nordling, P-O [2000b]. Follow-up of long-term effects of method for promoting prevention of occupational accidents. Arbete och Hälsa, 3. (Work and Health), Sweden: National Institute for Working Life.

QUOTA-BASED FISHERY MANAGMENT REGIMES

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INTRODUCTION

Fishery management practices can impact vessel safety in a variety of ways.[1] By establishing the framework and rules under which fishing vessel operators compete against each other, fishery managers dictate the spatial and temporal aspects of the fishing season, as well as who participates. Fishery managers also dictate specific input controls into fishing vessel operations such as limits on vessel size, limits on crew size, and limits on the amount or type of harvest gear utilized. These assorted controls are specifically designed to manage fishery effort, by limiting the catching power of a fleet of vessels. Under open access regimes, for example, fishery managers often have difficulty matching harvesting capacity (number of vessels or catching power) with biological productivity of the fishery resource/population. There is no separate limit to how much an individual vessel or company can harvest within the constraints of total allowable catch. This leads to a highly competitive operating environment in which individual fishermen attempt to maximize their catch for increased economic gain. This competition is known as "the race for fish" and is particularly fierce in open access fisheries characterized by overcapacity, seasons of short duration, and a high value/low volume resource [U.S. Congress, Senate 1999].

In certain fisheries (but not all), this race for fish strongly influences the safe operation of fishing vessels. This race encourages fishermen to operate in all weather and sea conditions, to operate without rest, and encourages risk-taking behaviors. None of these safety concerns can be readily addressed by the narrow confines of the vessel-based and crew-based regulatory approach provided in the Commercial Fishing Industry Vessel Safety Act (CFIVSA). These safety concerns, however, can be partially or even fully addressed within the context of changes in fishery management. National Standard Ten of the Sustainable Fisheries Act of 1996 requires that regional fishery management councils "promote the safety of human life at sea" when developing fishery conservation and management measures [Sustainable Fisheries Act 1996].

This paper explores the connection between fishery resource management and the safe operation of fishing vessels by focusing primarily on safety problems found in the Bering Sea/Aleutian Island (BSAI) King and Tanner crab fishery off the coast of Alaska. The paper then compares and contrasts the different fishery management regimes that currently exist in the BSAI management areas. The purpose of this review is to consider how different management regimes influence safety and how changes in fishery management can potentially improve safety.

SAFETY/ECONOMIC PROBLEMS IN THE BSAI CRAB FLEET

The fatality rate in the Bering Sea/Aleutian Island crab fisheries has approximately doubled in the past five years from an average rate of 127 fatalities per 100,000 Full Time Equivalent (FTE) workers from 1990 to 1994, to an average rate of 272 fatalities per 100,000 FTE workers during the 1995 to 1999 period [Woodley 2000].[2] This extraordinary jump has occurred despite this fleet's extremely high participation in the Coast Guard voluntary dockside exam program [Woodley 1999] and has also occurred despite a substantial increase in Coast Guard search and rescue (SAR) assets in the Bering Sea since 1995. The most common causes identified as leading to fatalities have been operating in poor weather, vessel overloading, crew fatigue, and combinations of the three.

A careful examination of the BSAI crab fleet, within the context of its existing fishery management regime and the fleet's economic performance, sheds some light upon the origin of safety problems within this fleet and also explains why current safety measures are not addressing the problem. The foremost problem with the Bering Sea crab fleet, from a fishery management perspective, is that despite efforts to limit overcapacity and fishery participants through a license limitation plan (LLP), the catching power within the fleet still far exceeds current available crab resources. This overcapacity is compounded by shrinking crab seasons and is further exacerbated by recent severe downturns in Bering Sea crab stocks.[3] As a result, the average vessel in the crab fleet is making less money. Since 1994, the annual ex-vessel value of the Bering Sea crab harvest from the four major crab fisheries has been well below the decade average, falling from U.S. $1.75 million per vessel in 1990 to U.S. $0.7 million per vessel from 1995 to 1998 [Natural Resources Consultants, Inc. 1999].

The outlook for the BSAI crab fisheries is not good. The Bering Sea opilio fishery, which is the staple fishery for the crab fleet, is in serious, albeit natural, decline. The guideline harvest level declined by 88 percent from 1999 to 2000, and it is expected that the 2001-2002 seasons will also be fished at a very low-level harvest strategy. This means that crab fishermen will have to maximize effort within the remaining crab fisheries to remain viable. These economic factors and limited options to participate in other fisheries, combined with the Olympic style derby type fishery, intensifies the race for fish in a fishery which already has one of the highest occupational fatality rates in the U.S.

MARRYING SAFETY AND ECONOMIC PERFORMANCE: A FUNCTION OF FISHERY MANAGEMENT

One of the major factors which has transformed the economic problems into a safety problems is the following relationship: to compete in a highly competitive open access fishing environment which is characterized by a short, intense season, a vessel with a greater catching power than its competitor has a better chance to catch more fish and obtain a greater economic reward. In the BSAI crab fleet, the catching power or capability of a vessel is related to a number of critical vessel and crew safety features: the number of pots a vessel is able to carry [Hermann et al 1998], how quickly gear is lifted, baited, and reset, and the willingness to work in all weather and sea conditions.

As more vessels have entered the fisheries and crab stocks have declined, there has been a proportional reduction in per vessel harvest and income. In an attempt to recapture this lost share, many vessel owners have increased their harvesting capability by investing in the ability to carry additional pots [Greenberg and Hermann 1994]. The safe carriage of additional pots often necessitates expanding the vessel dimensions by increasing the length or beam of the vessel [Poulson 1999]. Because such investments are extremely expensive and can cost literally a million dollars or more, not all owners can afford or are willing to take such measures, especially with the poor outlook for the fishery.

Another way to increase catching power is to carry additional pots beyond what the vessel can safely carry. A vessel that normally can carry 120 pots can theoretically increase its catching/earning power by 20 percent by adding 24 additional pots. Under the current regulatory regime, the number of pots that a vessel can carry is limited by the vessel's stability booklet/letter, or Alaska Department of Fish and Game (ADF&G) pot limits.[4] Adding pots beyond the vessel's stability requirements increases the center of gravity, decreases the freeboard of the vessel, and lessens the vessel's ability to right itself from external heeling forces such as wave or wind action, or internal forces such as free surface effect, improper loading, or tank management. These decreases in vessel stability make the vessel more prone to capsizing events. In heavy freezing spray and icing conditions, as is common in the winter months of the Bering Sea, vessels are even more susceptible to capsizing.

Despite the danger associated with overloading, operating in icing conditions, and operating with minimal crew rest, this is largely the normal operating conditions of the fleet [Woodley 1999]. These conditions are occurring not out of ignorance of safety regulations or lack of knowledge about vessel safety [Woodley 1999] but arguably, because of the extreme economic competitiveness within the open access crab fisheries. To be competitive, a vessel owner/ operator must maximize the harvesting capability of the vessel and maximize time spent fishing. This translates into maximizing pots carried, fishing in all conditions of weather, and fishing without rest.[5] Each of these factors influencing safety falls outside of the existing safety regime, and also falls outside of the changes proposed by the Coast Guard in its fishing vessel safety action plan. As will be demonstrated in the next section, changes to fishery management practices either by changing the fishery regime or by making changes in the fishery management plans would arguably be far more effective in addressing these safety problems than would additional vessel-based and crew-based safety regulations.

REVIEW OF FISHERY MANAGEMENT REGIMES

There are several different fishery management regimes currently practiced within the BSAI management area for both state and federal fisheries. These regimes include open access, Individual Fishery Quotas (IFQs), Community Development Quotas (CDQ), and American Fishery Act style fishery cooperatives. The following section will focus upon the four basic management systems, examining the safety features associated with each.

Open Access: The BSAI crab fleet provides just one example of how open access fishery management can impact safety. Another well-documented example of how an open access fishery can impact safety is the old halibut derbies in the State of Alaska. Prior to 1995, fishing for halibut in Alaska was an open access fishery. Over the years, the number of vessels participating in the fishery increased substantially, resulting in overcapacity [NRC 1999a]. As a result, seasons became shorter and shorter and the entire harvest was ultimately caught within a 24-hour, derby-style fishery. This race for fish "often forced participants…to fish in unsafe weather conditions, to work continuously for long periods without rest, and possibly overload their vessels due to limited openings" [NIOSH 1997]. As a result, these halibut openings had some of the highest search and rescue caseload and fatality rates of any given fishery in Alaska, with rates annually approaching 122 fatalities per 100,000 fishermen [NIOSH 1997].

Individual Fishing Quotas: Beginning in 1995, the North Pacific Fishery Management Council established a new fishery management regime called Individual Fishing Quotas (IFQs)[6] for halibut and sablefish. The implementation of IFQs rationalized the fishery in terms of the number of vessels participating and the speed at which the fishery progressed. The number of vessels dropped by approximately 50 percent and the number of days in the season increased from 24 hours to 245 days a year.[7] Instead of being forced to fish in less than optimal conditions or when the vessel or crew is not ready, fishermen can operate in a safer manner by harvesting their quota based upon their own schedule and can take into account weather and condition of the vessel and crew.

There is considerable evidence to suggest that IFQs have made this a much safer fishery. Search and rescue statistics from the Seventeenth Coast Guard District, show a sharp decline in the number of rescues in the halibut and sablefish fishery since the implementation of IFQs. (See Figure 1.) While there may be other factors involved which have influenced these numbers, it is widely believed that the IFQ program has had a positive impact on vessel safety in the halibut/sablefish fishery [NRC 1999a]. Additionally, surveys of Alaska halibut and sablefish IFQ holders from 1997 to 1998 indicate that 85 percent of those surveyed felt "IFQs have made fishing for halibut safer" [Knapp 1999]. This assessment is also verified by a recently completed study on fatality rates in the Alaskan halibut/ sablefish fishery, which indicates an average five-year decline of 15 percent in the fishery.

There is also evidence, however, that not all fisheries operating in an IFQ regime have enjoyed the same safety benefits as the halibut/sablefish fishery. Four surf clam/quahog vessels on the Mid-Atlantic in January 1999 were engaged in IFQ fisheries at the time they sank. It has been reported that in the surf clam fishery, because the quotas in the surf clam fishery are controlled by

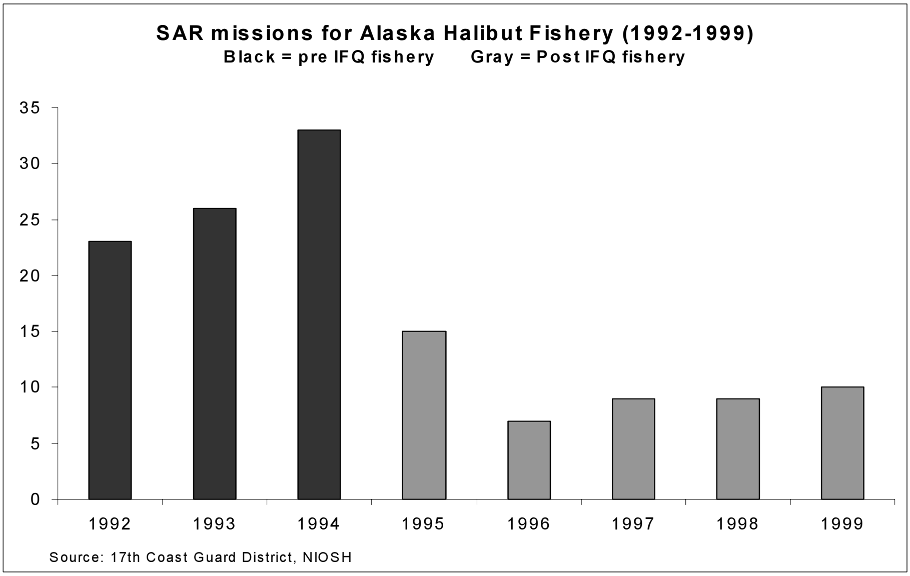

Figure 1. Alaska Halibut Search and Rescue Missions

the clam processors, vessel operators have little choice when to fish or how much to catch [Hall 1992]. This reduction in flexibility can negatively impact safety.

Canadian experience with enterprise allocations (similar to IFQs) in the Nova Scotia offshore fishery have also produced mixed results; where some safety issues have remained the same or worsened, others have improved. Of particular interest within these fisheries, however, is the virtual elimination of overloading and capsizing events since the introduction of the enterprise allocation system [Binkley 1995]. This has been attributed to vessels being able to determine their catch prior to departing for the fishing grounds and not needing to load up or harvest beyond the vessel's carrying capacity.

Community Development Quotas (CDQs): The Community Development program is a recently instituted quota-based allocation system. The CDQ program allocates a specific quota of the total allowable catch of various fisheries (including king and tanner crab) directly to groups of villages in western Alaska [NRC 1999b]. These village coalitions, called CDQ groups, may contract out their quota to be fished by commercial fishing vessels. As in the IFQ program, each vessel participating in the CDQ program is allowed to fish a pre-designated quota. Returning to the 1994 analysis by Hermann and Greenberg that described competition and pace of the crab fishery in terms of pots fished and pots pulled, it is clear that fishing for crab in the CDQ regime offers many differences that may translate into safety-enhancing features. This can be seen in Table 1, which compares (between a CDQ and open access fishery) the number of pots registered per vessel (a measure of competitiveness) and the number of pots pulled per vessel per day (a measure of fishery pace) for the 1998 and 1999 Bristol Bay red king crab and Bering Sea opilio fisheries.

Under the CDQ regime, the fishery is less competitive and slower paced. While the number of registered pots between the two fisheries is only slightly different, there is a substantial reduction in the number of pot lifts per vessel per day (due to longer soak times). As a result, the fishery provides for increased opportunity for rest (from four hours a day to eight hours a day), reduces stability concerns due to fewer pots being carried, and provides increased choice in determining when it is too rough to fish [personal communication with Kevin Kaldestaed, President of Kaldestaed Fisheries, 4 Jan 2000].[8]

Pollock Conservation Cooperative & American Fishery Act Type Cooperatives: Following the enactment of the American Fisheries Act (AFA) of 1998, nine companies operating 20 qualified U.S. flag catcher processor vessels formed the Pollock Conservation Cooperative (PCC). Owners formed the PCC to end the race for fish that had previously existed under the open access regime in the BSAI pollock fishery. The problems associated with the race for fish within the pollock fishery were not primarily safety related. With an average fatality rate of approximately 28 fatalities per 100,000 FTE workers since 1990, the BSAI pollock fishery has enjoyed a relatively solid safety record for the past decade. Instead, the race for fish within the at-sea processor sector of the pollock fleet was characterized by severe overcapacity, an ever increasing need for investment in more capacity to maximize catch, under utilization of the pollock resource, and economic instability within the fleet [At-Sea Processors Association 1999]. Since the enactment of the PCC, significant changes have occurred within the at-sea processor pollock fleet that have rationalized and slowed down the fishery. The following statistics compare the pollock A season averages from 1995-1998 under the open access regime for the 16 qualifying vessels, and the 1999 season under the Pollock Conservation Cooperative (PCC) regime for the 16 qualifying vessels [At-Sea Processors Association 1999]:

Table 1. Open Access & CDQ BSAI Crab Fishery Comparisons (Source ADF&G)

	1998	1999
Bristol Bay red king crab		
% Reduction in Pots Lifted	76%	76%
% Reduction in Pots Fished	6%	12%
Bering Sea opilio crab		
% Reduction in Pots Lifted	53%	48%
% Reduction in Pots Fished	6%	4%

Annual daily catch fell by 60 percent in 1999 compared to the 1995-1998 average.

Average hauls per day fell by 45 percent from the 1995-1998 average.

The season length increased from the 27.8 days average from 1995-1998 to 59 days under the PCC.[9]

While the slowing down of the fishery and the flexibility offered by the quota systems has not had an impact upon fatality rates (the fatality rate has remained at zero since 1995), vessel owners from several of the PCC companies have reported an approximately 50 percent reduction in processing crew injuries since the implementation of the cooperatives [personal communication with John Bundy, President for Glacier Fisheries, 25 March 1999]. This reduction in injuries has been attributed to a slower work pace and reduced fishing in poor weather conditions.

SUMMARY

Based upon the cursory assessments of the four principal fishery management system types being administered in the BSAI management areas, it appears that quota-based systems have several potential safety benefits over the current open access system. Not only can quota-based systems reduce overcapacity, they can also reduce the speed of the fishery, and reduce the emphasis on catching power. In terms of safety, this can translate into less fatigue, reduce the need to overload a vessel, and allow a master flexibility as to what type of weather in which he fishes. Each of these concerns have been identified as major problems within the BSAI crab fleet (as well as numerous other fishing fleets nationwide), and none of these safety improvements can be achieved within the existing framework of the CFIVSA. If advances in commercial fishing vessel safety are to be made beyond the existing national focus of vessel and crew-related safety remedies, changes in the fishery management regimes must be seriously considered.

REFERENCES

At –Sea Processors Association [1999]. "Preliminary assessment of the pollock conservation cooperative." Seattle: At-Sea Processors Association. Photocopied.

Binkley M [1995]. Risks , dangers, and rewards in the Nova Scotia offshore fishery. Montreal: McGill-Queen's University Press.

Greenberg J, Herrmann M [1994]. Allocative consequences of pot limits in the Bristol Bay red king crab fishery: An economic analysis. North Am J of Fisheries Mgmnt *14:* 307-317.

Hall A [1992]. ITQs-Solution to the 'tragedy of the commons' or tragedy for the common man? Nat Fisherman, November, 1-b.

Hermann M , Greenberg J, Criddle K [1998]. An economic analysis of pot limits for the Adak Brown king crab fishery: A distinction between open access and common property. Alaska: Alaska Fishery Research Bulletin *5:* 25-38.

Natural Resources Consultants, Inc. [1999]. "Status of Washington based commercial fisheries and the fleet's future utilization of Fishermen's Terminal" Seattle: Natural Resources Consultants, Inc. Photocopied.

National Institute for Occupational Safety and Health [1997]. Commercial fishing fatalities in Alaska: risk factors and prevention strategies. Current Intelligence Bulletin 58. Washington, D.C.: DHHS (NIOSH) Publication No. 97-163.

National Research Council [1999a]. Sharing the fish: toward a national policy on individual fishing quotas. Washington, D.C.: National Academy Press.

National Research Council [1999b]. The community development quota program in Alaska. Washington, D.C.: National Academy Press.

Poulsen E H [1999]. Economic feasibility of the industry funded license buyback for the Bering Sea crab fleet [Master's thesis]. Washington: University of Washington.

Sustainable Fisheries Act [1996]. Vol. 100., part 5, 3559.

U.S. Congress. Senate [1999]. Committee on Commerce, Science, and Transportation. Testimony of Dr. David Fluharty before the Committee Hearings on Magnuson-Stevens Fishery Conservation and Management Act. 106th Cong., 1st sess., 29 July.

Woodley C [1999]. "A Review of the 13th & 17th Coast Guard district at the dock stability and pot loading survey for the 1999 Bristol Bay red kingcrab season." Seattle, WA: 13th Coast Guard District. Photocopied.

Woodley C [2000]. Developing Regional Strategies in Fishing Vessel Safety: Integrating Vessel Safety and Fishery Management [Master's thesis]. Washington: University of Washington.

FOOTNOTES

1. Quota-based fishery management is a highly controversial subject. The thoughts expressed in this paper reflect only the opinion of the author, and not the U.S. Coast Guard.

2. The vast majority of the 67 fatalities in the BSAI crab fleet from 1990 to 1998 have been capsizing events (64 percent), man overboard (27 percent), and industrial type accidents(9 percent).

3. In 1999 these declines have resulted in closures of two major crab fisheries (St. Matthew blue king crab and Pribilof Island redking crab), a 50 percent harvest reduction in Bristol Bay red king crab, and an 88 percent reduction in Bering Sea opilio crab harvest.

4. As a conservation measure designed to curtail fishery speed and effort, ADF&G has limited the individual number of pots a vessel can fish. These pot limits are not a safety measure because the number of pots a vessel is allowed to fish under ADF&G rules is not based on individual vessel stability criteria.

5. As a safety measure, ADF&G provides wet storage areas so that vessels can store unbaited pots near the fishing grounds prior to the season. Ideally wet storage reduces the number of pots a vessel must carry at one time. Due to shrinking season lengths, many vessel operators feel there is not enough time to travel to the wet storage areas to retrieve their pots and instead opt to carry as many pots as possible.

6. An IFQ is defined as "a Federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or units representing a percentage of the total allowable catch of a fishery, that may be received or held for exclusive use by a person" (NRC 1999).

7. Although the season is 245 days, most vessels do not fish the entire period, but fish until their individual quota is exhausted.

8. Kaldestaed Fisheries is a partner with the Bristol Bay Economic Development Corporation, a CDQ group.

9. This reduction is impressive considering the pollock quota available has been cut by 50 percent as a result of reallocation among sectors.

AN INNOVATIVE INVESTIGATION OF THE RELATIONSHIP BETWEEN FISHERIES EQUIPMENT DESIGN AND MARINE AND OCCUPATIONAL ACCIDENTS IN THE INSHORE SCALLOP FISHERY OF THE NORTHEASTERN UNITED STATES

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BACKGROUND

This paper documents efforts to address safety problems affecting the inshore scallop fishery occurring in coastal waters of the State of Maine, United States of America. Comparison of analysis of safety problems and design of preventive interventions must include a review of the regulatory authority and controls governing the affected fishery. The regulatory structure of this fishery has the State (provincial) government responsible for resource management regulations and the Federal (national) government responsible for management of safety conditions within the fishery. Safety regulations in place for vessels of this size (typically between 8 to 15 meters in length) and operating area are limited to mandatory carriage of maritime survival equipment. There are no construction or design standards or controls in place for vessels of this size, and there is no authority for the vessels to be inspected for minimum standards of materiel condition. Agencies of the federal and state government lack the authority to require professional competency licensing for masters or crew members for fishing vessels of this size. Vessel owners are required to be licensed by the State government to participate in the fishery. This licensing authority requires no qualification of professional competency and is utilized for conservation control purposes only. Both federal and state government agencies require mandatory reporting of accidents affecting vessels in this fishery. The U.S. Coast Guard rarely enforced these regulations prior to establishment of a dedicated fisheries safety effort in 1993. Accident records maintained prior to 1993 did not record the fishery the vessel was engaged in or the equipment type in use. Therefore, records that do exist prior to 1993 are thought to be highly incomplete and difficult to incorporate into an historical analysis of safety trends within this fishery.

In the absence of authority to regulate design, construction, maintenance, and operating standards for vessels in this and other fisheries, the U.S. Coast Guard established in 1993 a safety program intended to identify accident trends and develop and initiate preventive interventions. Restricted by the absence of regulatory authority, participation of the fishery in this program is voluntary in nature, although regional Coast Guard commanders have bolstered this program by tasking safety program personnel to participate in accident investigation processes. The safety initiatives detailed in this paper are an evolutionary development of the voluntary safety program initiated in 1993.

DESCRIPTION OF THE FISHERY

The harvest of scallops from inshore waters of the State of Maine is by regulation limited to winter months. Regulations allow open access by fishing vessels owned by permitted individuals during the harvest season, which typically runs from November 1 through April 15. Vessels are not limited to individual or regional quotas. The design of harvest equipment is strictly regulated, as is a minimum shell size for retained scallops. Vessels are not subject to operating area restrictions. Harvest is limited to the hours between sunrise and sunset each day. There are no restrictions on vessel size, design, or crew size. Fisheries divers engaged in hand harvest of scallops comprise a small portion of the scallop fishery. The vessels and safety conditions of this hand harvest sector are not included in this paper.

Vessels utilized for scallop dragging are typically between 8 to 15 meters in length, with a few larger vessels utilized for offshore fisheries engaged in the fishery on a seasonal basis. Vessels are typically of fiberglass construction, although wood hulls and occasionally steel hulls are employed. Many of the vessels employed in the fishery are utilized seasonally in other fisheries, typically employing stationary gear. In 1998, 775 vessel owners were permitted to employ their vessels in this fishery. (The vast majority of these own a single vessel.) This number was the highest number of permitted individuals in this fishery in recent years. Vessels typically operate with two crew members. Many vessels will be operated by a single individual at some point during the fishing season. Crew sizes as high as six have been observed, although these crew sizes are generally limited to the highly competitive first few days of the fishing season.

Construction of the fishing apparatus, locally referred to as a “drag”, is highly regulated for conservation control purposes. These devices consist of a chain mail bag fixed to a steel frame designed to drag the device firmly against the seabed as the vessel tows the device across fishing banks. Heavy chains on the bottom of the drag behind the steel frame are installed to dig into the seabed and scrape scallops (and other bottom sediment) into the chain mail bag. Scallops and the larger chunks of sediment from the seabed are retained in the chain mail bag and recovered to the vessel, typically after 10 to 15 minutes of towing. The vessel tows the fishing apparatus by a single wire.

IDENTIFICATION OF ACCIDENT TYPES

Within two years of the establishment of a dedicated fisheries safety program by the U.S. Coast Guard a distinct pattern of serious worker injuries and adverse events involving vessels was identified in scallop vessels. Vessels in this fishery were observed to suffer a wide range of adverse events, although an alarming number of capsizes and serious injuries were recorded. In the investigation of these incidents, fisheries safety officers (trained as maritime transportation safety officers) observed a wide range of equipment handling systems in use on board vessels in the scallop fishery. This range of equipment design was unique to the scallop fishery. In most commercial fisheries of the northeast United States, fishing equipment and vessel handling systems have evolved to similar designs. The diversity of equipment in use in the scallop fishery, which appeared to be based on regional designs, is considered unique to this and related fisheries in the northeast United States.

HISTORICAL SAFETY APPROACH

Fishery safety efforts traditionally employed by the U.S. Coast Guard include the conduct of investigations to determine the causative factors of an adverse event, for the purpose of preventing similar accidents in the future. Historically, the findings of investigations would form the data employed in fisheries safety efforts. Sequences observed in the documentation of safety incidents would form the basis of preventive efforts, which would be conducted on a vessel-by-vessel basis. This process was effective in the identification of individual vessels in danger of repeating previously documented events, and once identified, in advising the vessel operator of the potential for the formation of a similar sequence.

This process is extractive in nature, with data being drawn from event sequences and opinions formulated into safety recommendations exclusively by safety personnel. By excluding the affected population from the identification of risk and the formation of safety recommendations the process is essentially an open loop, with the affected population receiving only the opinions and recommendations of others regarding risks they face. This results in three distinct problems in the proper identification of risk and formation of effective preventive solutions. First, the affected population does not participate in the identification of risk, and may hold different perceptions of risk or possess valuable experience outside of the observed patterns. Second, the process of advising vessel operators of conditions observed in sequences is effective at avoiding repetitive accidents, but is ineffective at evaluating problems on a fleet wide basis, when effective solutions may lie not in the maintenance of equipment, but in its very design. Third, the process of advising affected populations of safety recommendations formulated solely by safety personnel does not allow the population to comment on the perceived economic or efficiency aspects of proposed preventive solutions, which can affect acceptance of solutions otherwise considered effective.

DEVELOPMENT OF AN INNOVATIVE APPROACH

When the pattern of serious injuries and vessel damage was identified, a response to the safety problems in the inshore scallop fishery was initiated. The wide range in equipment types observed in this fishery created a problematic application of the historical safety approach. The wide range in patterns being experienced by the different equipment types did not lend for easy categorization of events. A poor understanding by safety personnel of the economic and regional conditions that resulted in a wide range in equipment types forced the development of a preventive strategy designed to maximize inclusion of the affected population.

EXCESS OF ACCIDENTS

Previous efforts to include the affected population in development of preventive solutions were complicated by the differing perceptions of risk held by fishermen and fisheries safety personnel. Historically, safety efforts were focused on the prevention of serious injuries, deaths, or vessel loss, with certain event sequences being especially important to address through safety programs. To effectively include the affected population in a discussion of risk, it is especially important that the population and the safety agency view the problem as one which creates an excess of injuries or loss, with safety incidents occurring above levels considered acceptable for the activity involved. In the inshore scallop fishery, the number of vessel capsizes being experienced constituted a significant percentage of the total number of capsizes experienced in all fisheries, with 9 of 13 recorded incidents occurring in the inshore scallop fishery. Serious acute injuries, including amputation and fatal injury resulting from "struck by" incidents were also recorded in this fishery sector while not being observed in any other sector of the commercial fishing industry. Historical documentation of these incidents was compelling evidence for members of the inshore scallop fishery that their fishery was experiencing excessive injuries.

INTERRELATIONSHIP OF MACHINERY DESIGN TO ACCIDENT FORMATION

Historically many incidents in the commercial fisheries are classified as human error in the operation of essentially hazardous machinery. In several of the capsize incidents experienced in the inshore scallop fishery, vessel operators involved in the incidents reported minor errors in judgment or vessel handling as the cause of the event. The practice of behavioral controls to prevent harm involving inherently dangerous equipment results in the perpetual need to conduct activities under all service conditions using the exact same behavioral controls. Elimination of a hazard through engineering design will allow for variance in behavior of operators, thereby creating an inherently safer environment for the crew of the vessel involved.

In the inshore scallop fishery, the use of behavioral controls to prevent serious safety incidents was widespread. In the investigation of both vessel capsizes and acute injuries incidents, fisheries safety personnel repeatedly encountered descriptions of vessel handling and work practices that could be employed to prevent injury and vessel loss. The widespread use of behavioral controls to prevent harm rather than the use of engineering controls indicated a good opportunity for introducing effective engineering solutions to mitigate safety problems.

CHARACTERIZATION OF EQUIPMENT HANDLING SYSTEM

Recognition of highly regionalized designs of hull-equipment design prompted an effort to identify and characterize the equipment systems in use. During the 1997-1998 inshore scallop fishery season, fisheries safety personnel were deployed on Coast Guard vessels and on commercial fishing vessels through out the season to identify every different type of vessel-equipment system in use. This effort resulted in the identification of nine distinct designs, all of which were photographed and video taped for analysis. An engineering analysis of these vessel-equipment designs resulted in the characterization of three basic types of vessel-equipment designs. These designs, and their use in various situations, are described in the following paragraphs.

Single wire systems: Five of the designs utilized a mast/boom system and a single hydraulic winch system. The crew utilizes this winch system to set the fisheries apparatus overboard to the seabed, to tow the apparatus through the water, and to recover the apparatus to the vessel and suspend it above the deck for access.

Two wire systems: Two of the designs utilized a towing frame and independent mast/boom system to handle the fisheries apparatus. One hydraulic winch system was used to set the fisheries apparatus to the seabed, to tow the apparatus across the seabed, and to recover the apparatus to the side of the hull. A second hydraulic winch system was used to recover the fisheries apparatus on board and suspend the equipment from the mast/boom system for access by the crew. These designs involved manual interaction with the equipment by the vessel crew to make and disconnect the connection of the second winch system at each cycle of the fishing operation.

Two wire, one wire on equipment systems: Two of the designs involved two hydraulic winch systems utilized to set, tow, recover and suspend the fisheries apparatus. In these designs only one of the hydraulic winch systems is connected to the fisheries apparatus. The second hydraulic winch system is utilized to cycle rigging systems to facilitate the suspension of the fisheries apparatus for access by the crew.

Washington County System, Design: Single wire system

Basic Description: This design uses a single wire, led directly from the drag winch through a towing block mounted at the head of a boom carried on the vessel's centerline. The arrangement allows for the drag to be suspended above the deck of the vessel for access by the crew, but results in a towing point very high in the rigging.

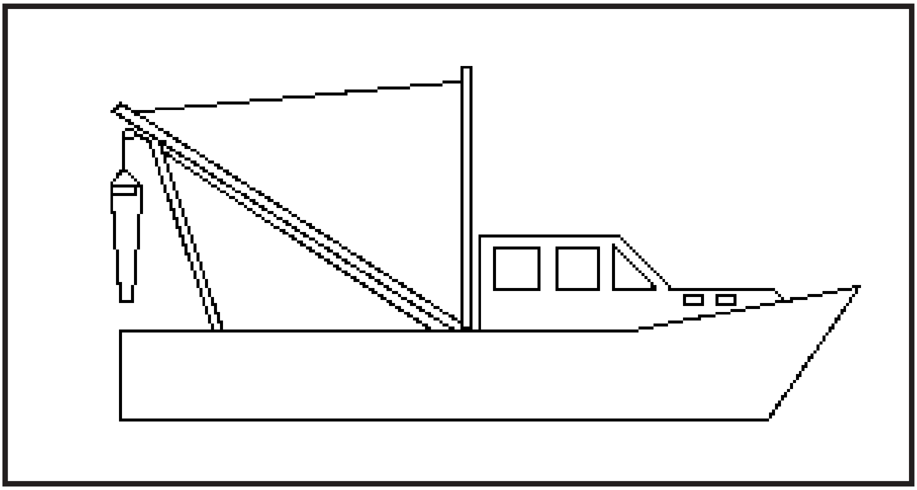

Figure 1: Washington County System, drag recovered.

Fixed A-Frame System, Design: Single wire system

Basic Description: In this design, towing and lifting are accomplished by a single block located on the vessel's centerline above the transom of the vessel. The towing block is suspended from a fixed A-Frame, typically supported by struts leading forward on the vessel. In some variants, the forward struts have been observed to be wire or chain, with a slight rake to the A-Frame.

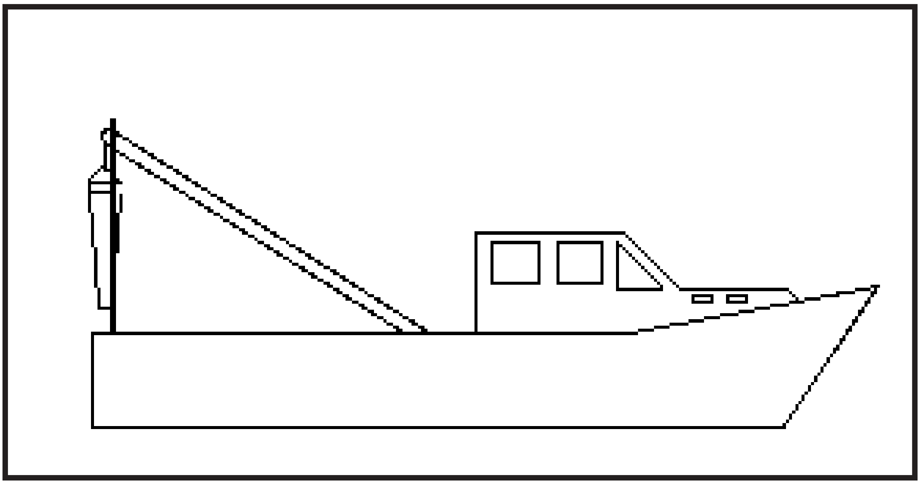

Figure 2: Fixed A-Frame system, drag recovered.

Harpswell System, Design: Single wire system.

Basic description: This design makes use of a single wire rigged to a block mounted on a frame at the after end of the vessel. The Harpswell rig frame resembles the frame used in Dropping Frame designs, and is mounted to the vessel on pins that allow it to pivot fore and aft. The frame of this design moves through a much smaller arc, and does not appreciably lower the height of the towing point. This design allows the vessel to recover and suspend the drag outboard of the transom, then use the frame to shift the laden drag forward, over the transom of the vessel.

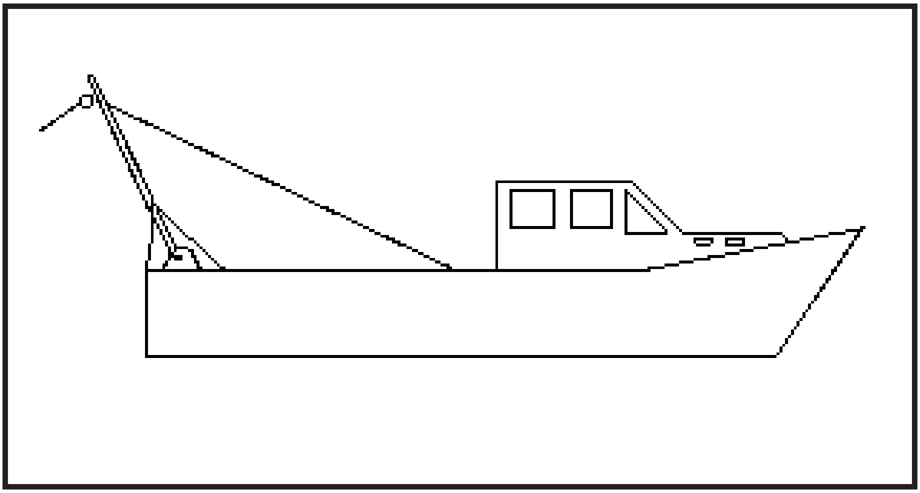

Figure 3: Harpswell system, drag deployed.

Rocket Launcher System, Design: Single wire system.

Basic description: The "rocket launcher" system is a single wire system, designed to tow the drag off the stern of the vessel. The scallop drag is contained in a pivoting cage, which allows the drag to be emptied through the jaw of the drag without the need for persons to stand beneath the suspended weight of the drag.

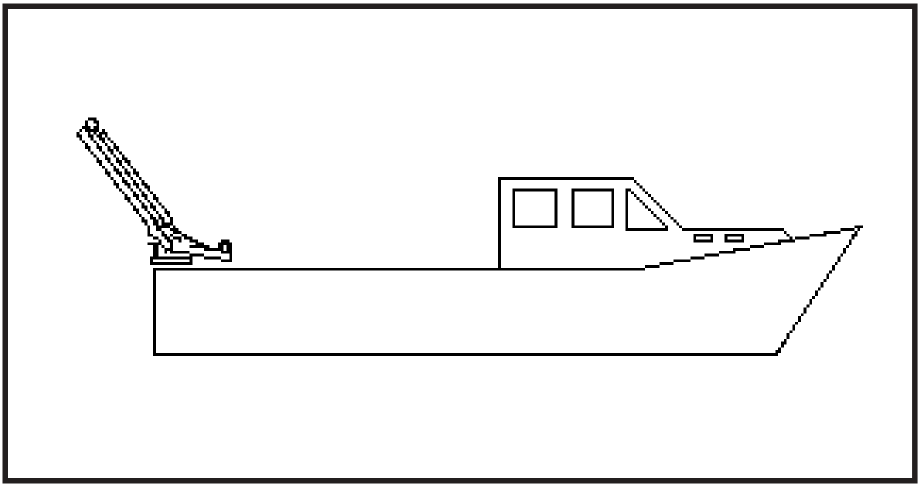

Figure 4: Rocket launcher system, drag recovered.

Single Point Side System, Design: Single wire system.

Basic description: This design makes use of a boom-mounted athwartships to set and recover the drag. The boom is positioned so that the height of the boom is sufficient to suspend the drag aloft without use of a second wire. As the height of the towing point at the head of the boom is sufficient to generate significant heeling moments, these vessels will use a lizard to lower the effective towing point when the vessel is engaged in dragging.

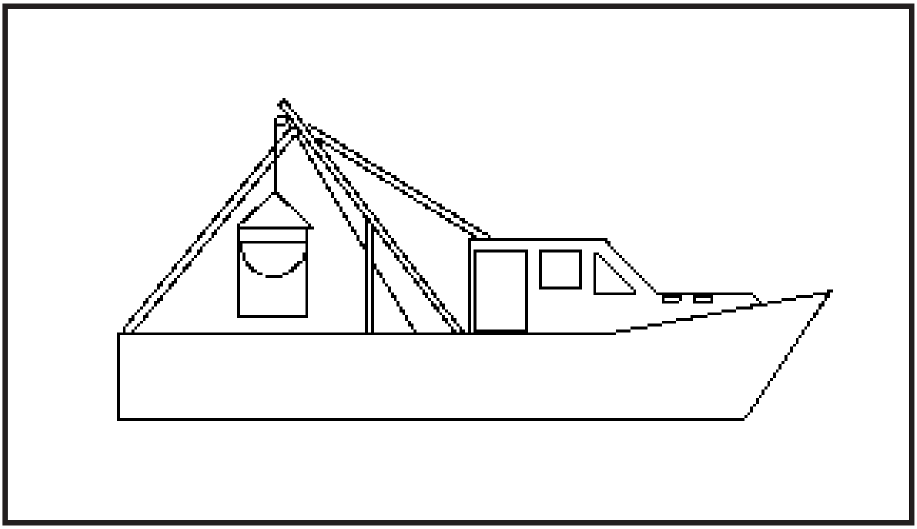

Figure 5: Single point side system, drag recovered.

Quarter Drag System, Design: Two-wire system.

Basic description: This design utilizes two wires. One wire is dedicated for towing purposes, typically rigged to a block suspended from a towing frame positioned at the quarter of the vessel. This wire is used to set, tow, and recover the drag. When the drag is recovered, the crew will make a second wire or fiber rope (called a cargo line) to the head of the drag by a hook. By slowly easing out on the towing wire and hauling in on the cargo line, the weight of the drag is shifted forward below the boom head block, and then hoisted aloft until the drag clears the gunwale of the vessel.

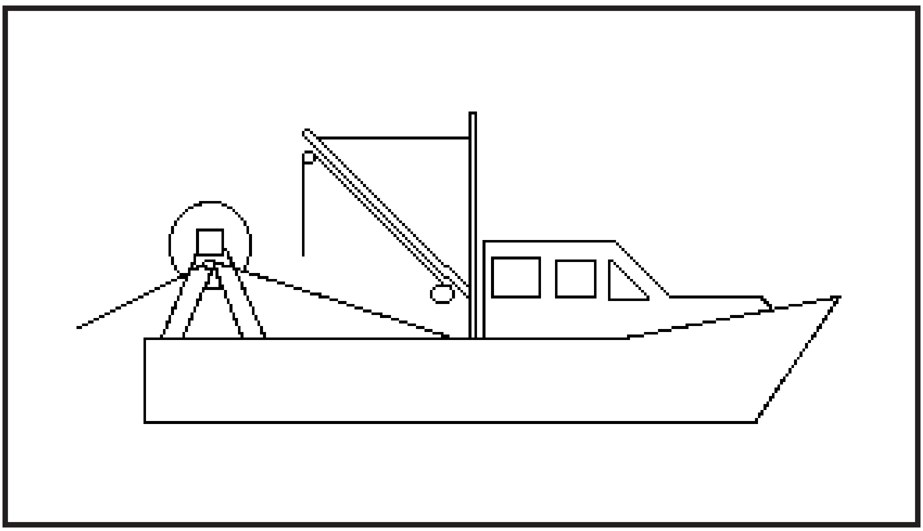

Figure 6: Quarter drag system, drag deployed.

Side Drag System, Design: Two-wire system.

Basic description: Two separate wires are used in this system. One wire is dedicated for towing purposes, typically rigged to a block suspended from a towing arm positioned amidships. This wire is used to set, tow, and recover the drag. When the drag is recovered, the crew will make a second wire or fiber rope (called a cargo line) to the head of the drag by a hook. By slowly easing out on the towing wire and hauling in on the cargo line, the weight of the drag is shifted aft below the boom head block, and then hoisted aloft until the drag clears the gunwale of the vessel.

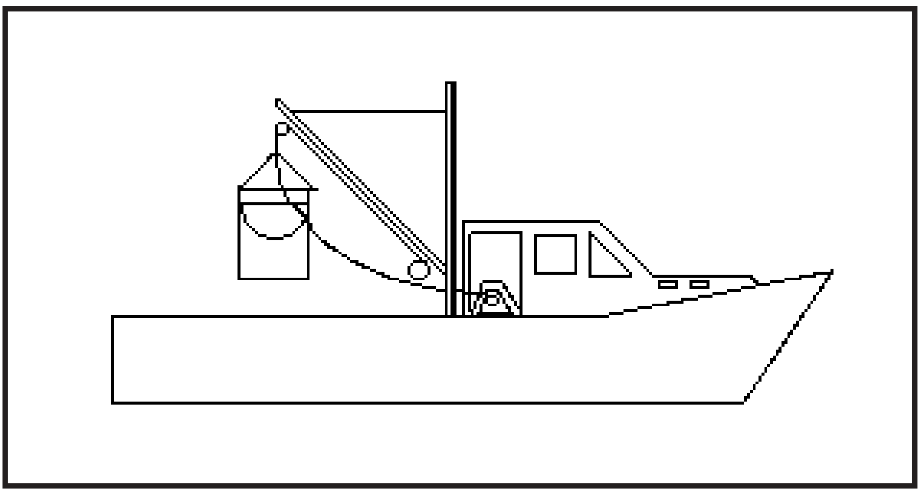

Figure 7: Side drag system, drag recovered.

Flying Block System, Design: Two-wire system (one wire on drag).

Basic description: This design is very similar to the Washington County design, except that towing block is fitted to a wire lead through a second block fitted to the boom head plate. This second block is used to lower the towing block when the vessel is towing.

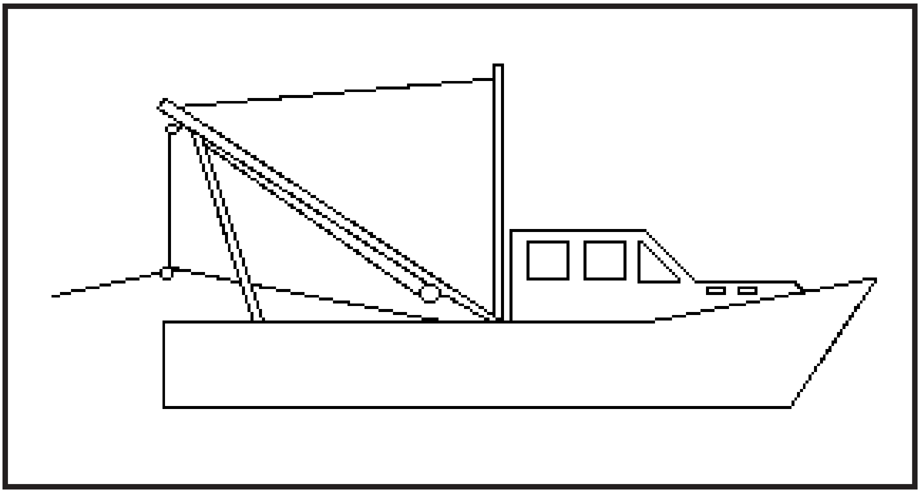

Figure 8: Flying block system, drag deployed.

Dropping Frame System, Design: Two-wire system (one wire on drag).

Basic description: This design involves a frame mounted over the work deck of the vessel, fitted to swivels mounted to the gunwales of the vessel. The drag wire is led to a towing block on the frame. A topping lift is led from a second winch to a block at the masthead, then to the top of the frame. This arrangement allows for the frame to be lowered from a position over the work deck of the vessel to a position roughly parallel with the gunwales of the vessel.

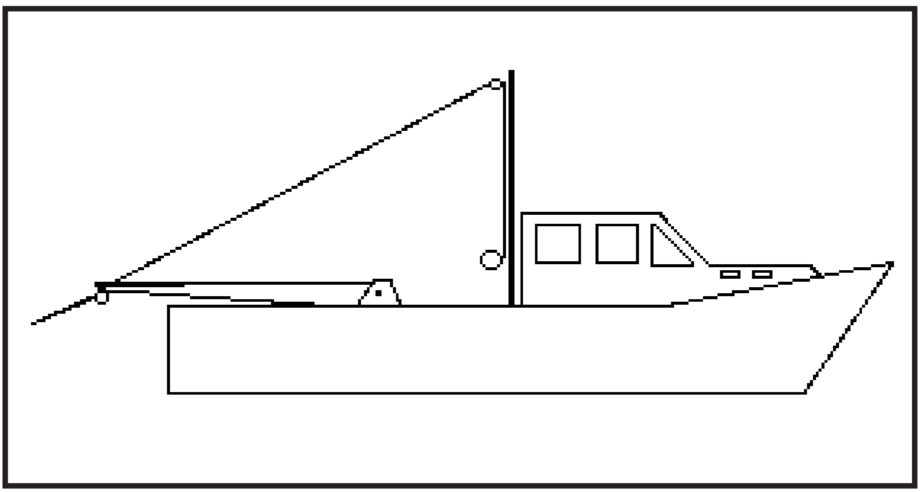

Figure 9: Dropping frame system, drag deployed.

LINK OF INJURY/ACCIDENT DATA TO MACHINE TYPE

Preliminary efforts to characterize the nature of accidents being experienced in the scallop fishery identified three basic types of circumstances responsible for the majority of known serious safety incidents. Two of the circumstances involved vessel stability, resulting in vessel capsizings. Some of the capsize incidents were suffered while towing fishing apparatus across the sea bed. These incidents are referred to as dynamic incidents, as energy of the vessel's propulsion system contributed to the forces involved in the capsizing. The remainder of the capsize incidents occurred while the vessels were engaged in lifting laden fishing apparatus from the water to recover catch. These incidents are referred to as static incidents; as forces from the vessel's propulsion equipment did not contribute to the heeling moment resulting in capsize. The remainder of the known serious incidents involved injury to crew members in what are best described as classic industrial injuries. In these incidents, persons were injured (in one instance fatally) by rigging failure or by entanglement in hydraulic winches during fishing equipment recovery operations.

A review of vessels involved in serious incidents appeared to reveal an interrelationship between equipment handling system design in use on a vessel and the types of accidents being suffered. Specifically, vessels towing from points aloft in their rigging appeared to be suffering the bulk of the dynamic stability incidents, while vessels towing and lifting equipment from the sides of the vessels appeared to be suffering the majority of the static stability incidents. The majority of serious occupational type incidents appeared to be occurring on vessels designed to handle equipment over the side of the hull.

By linking observed incident types to the taxonomy of vessel-equipment designs, a fishery specific terminology was developed that allowed fisheries safety personnel to achieve highly effective communications with the affected population. To explain the vessel-equipment designs and conduct effective demonstrations of accident sequences and operating parameters, tabletop models of the nine basic designs were constructed, and a 30-minute videotape detailing on board working conditions of each of the vessel-equipment designs was produced. Development of these tools allowed vessel operators to compare the characteristics of their vessels to unfamiliar designs.

Table 1: Dispersion of accident types by vessel-equipment classification

	Dynamic capsize	Static capsize	Serious acute injury
Single wire	3	1	0
Two wire	1	3	2
Two wire, one on gear	0	1	1

COMMUNITY BASED INVOLVEMENT

Equipped with tools to demonstrate and a taxonomy classifying the different vessel-equipment designs in use in the inshore scallop fishery, fisheries safety personnel began a process of involving the affected community in the identification of risk and the development of preventive solutions. This process was conducted by scheduling a series of town meetings, to which each vessel operator residing in the town was invited. The agenda for these meetings included presentation of the nine basic vessel-equipment designs and an explanation of the accident types that had occurred and were of concern to the Coast Guard. In an open comment type format, each of the nine vessel-equipment designs was then reviewed. The advantages and disadvantages of each vessel-equipment type, and the likelihood that each type could avoid causing specific actions leading to injury or vessel loss was identified and discussed by the groups of 10 to 20 vessel operators. The comments of each discussion were recorded so the product of all meetings could be reviewed and analyzed for common and disparate opinions and experiences. In this process, it was found that the models and fishery specific terminology were highly effective at prompting group analysis of safety incidents experienced within a given region, and in the identification of specific engineering controls that vessel operators considered crucial to avoiding injury or vessel loss.

At the start of this process it was recognized that the absence of accurate historical records severely limited the development of an accurate analysis of safety conditions affecting this fishery. The implementation of an interactive process of studying safety problems permitted the collection of data pertaining to basic safety parameters related to vessel-equipment design and injury/vessel loss history. These data were collected through a questionnaire administered to the participating individuals (vessel owners). An unexpected source of data was found in the open forum meetings conducted with fishermen. The dialogue between fishermen and between fishermen and safety personnel that was fostered by the open forum format allowed the fishermen to draw on their extensive experience and knowledge of historical safety problems and enabled them, as a group, to shed new light on safety problems and the interrelationship between occupational and marine safety incidents.

The relating of experiences and previously unrecorded history by seasoned vessel operators clearly documented the evolution of vessel-equipment designs in this fishery. Operating in an unregulated environment, vessel-equipment designs have been modified through the years as vessel owners attempted to evolve toward equipment that was profitable, efficient and safe. In open group discussions on the potential for design modifications, the experience of seasoned vessel operators proved very valuable for identifying problems that the fishery had previously evolved beyond. Historical input from seasoned fishermen proved exceptionally valuable for identifying the link between occupational injury risks and stability hazards, and documented that the evolution of vessel-machinery designs that minimized occupational injury tended to result in an increase in stability-related risk. This finding proved to be one of the more valuable elements of the closed loop, interactive research method.

Conventional safety investigation systems rely heavily on injury/fatality/vessel loss data as the basis for the design of preventive solutions. Upon finding an unresearched safety problem, the application of a conventional open loop, extractive process presumes that the problem will continue unabated until sufficient data is recorded from which to formulate preventive measures. On the other hand, unresearched safety problems addressed through an interactive method allows the affected population to participate in the identification of risk, and can recover historical data and previously unrecorded risk factors invaluable in the development of preventive solutions. Because the interactive methodology captures historical data, there is no need to observe unsafe conditions for years before formulating effective prevention strategies.

Inclusion of the affected population in the development of preventive strategies results in early consideration of economic and efficiency concerns of the fishery, which prevents energy and resources from being directed toward effective but inherently unacceptable preventive solutions. The identification of potential preventive measures within the scope of economic efficiency allows for engineering resources to be focused on measures defined by and acceptable to the community. Including the affected population in this manner ultimately improves the communication problems often encountered in the delivery of preventive measures developed in conventional open looped safety efforts.

COMMUNITY BASED INVESTIGATION MODEL

The techniques used to investigate injuries, fatalities, and vessel loss in the Maine inshore scallop industry can be generalized as a model for investigating other safety concerns within the maritime and occupational safety communities. The technique, called the Community Based Investigation Model (CBIM) is a sequence of five activities conducted by the investigator: Note excess, suspect a cause, classify, link, and use community-based involvement. When applied, the CBIM is a powerful approach that engages the actual members of the industry that are being examined in the investigation. This section presents the model, and fully describes the five sequential components of a Community Based Investigation.

As demonstrated with the inshore scallop industry, many occupational health investigations simply extract information from the industry with perhaps little or no feedback supplied to those who are studied. With the CBIM, the investigation process is interactive. The subjects of the study are engaged in all parts of the study, and in fact, help determine the direction and focus of the study.

In many ways, the CBIM is a consultative process more than an investigative technique with a high level of interaction between the study leader and the study participants. As such, recommendations for safety improvements reach the industry in a near real-time period, with many of the recommendations originating from the industry itself. The role of the government regulator shifts quite readily from investigation and enforcement to education and assistance. The five components of the CBIM illustrate and enforce this relationship.

NOTE AN EXCESS

The initial component of the CBIM is the identification of an excess of injury, fatality, and/or vessel loss/damage rates for a specific operation or industry. This step is crucial, for it identifies the reason for the investigation by the investigating agent and the community being investigated. Because the industry participants are partners in the investigation, the reason for the study must be clearly stated and readily understood by all participants. By adopting the "excess" orientation for the study, the investigation will be conducted on statistically significant occurrence rates that are abnormal for the industry.

SUSPECT A CAUSE

To determine the focus of the study, the second phase of the investigation must develop a hypothesis for the cause of the injuries, deaths, and or vessel loss/damage, with the hypothesis being very broad rather than being narrow and sharply focused. Using this broad view, causation should be hypothesized as behavioral, environmental, operational, or mechanical causes. The excess rates and a suspect cause for the excess establish the initial framework for the study. It is conceivable that multiple suspects could be identified as causes for the events and used in the community based investigation technique.

CLASSIFY

Using the suspect cause hypothesized to be responsible for the excess of accidents, the industry needs to classify the cause into a taxonomy of four steps. It is suggested to conduct these meetings within the industry's home community to increase participation rates of the industry subjects, provide context for the discussions, and as to show the participants that their participation is valued. The presentation focuses the industry on the study's methodology and frames their attention on the scope and interim findings of the study.

The goal of these meetings and any subsequent discussions is twofold: education of the community and focused analysis by the investigators. During the community discussions, the participants have the opportunity to review their industry from a unique perspective. They will see their individual platforms as one member of a class of platforms and realize these platform classes correlate with the occurrence of adverse events. Their observations and comments on the investigation's interim results and methodology will help correct any misconceptions made by the investigators. Also, the participant's presented solutions to problems benefit from the instant review and refinement by other members in the community discussion group. As the investigators conduct these discussions with various groups within the industry, they serve as a conduit within the industry to educate members about the findings. It is very likely that the community will begin to identify specific problems associated with the industry classification categories that did not surface during the investigation. This insight, combined with the review of the areas warranting additional investigation identified by the study directors, identify topics that require further analysis by the investigators. For example, the participants may highlight unique situations and practices that have not yet resulted in an excess of harm, but have the potential to do so. The investigators can then focus their resources on these specific areas that have been determined by the industry participants and the investigators themselves.

CONCLUSIONS

The analysis of the inshore scallop industry using an innovative investigation method was presented as a case study from which the CBIM was derived. The unique attribute of this investigation technique is the active involvement of the industry participants in the study. Rather than simply extracting study data from the participants, the participants are partners in (linear) feed-forward systems, the CBIM is multidimensional (iterative) and analogous to a closed loop system. The assessment of the study findings is done in near real time, with corrections to the study's assumptions, results, and industry practices initiated during the study.

The community-based investigation promotes increased dialogue between the investigators and the industry participants as they partner to correct unsafe industrial practices. This partnership establishes a new role for the investigators as they shift from regulators to educators. This also establishes a new role for industry and captures industry knowledge and experience not available through the usual accident reports, vessel inspections and emergency room reports. The model suggests that the solution to unsafe practices is not additional regulation and enforcement of the industry, but rather increased education and development of safe practices. The government officials conducting the investigation become partners with the industries, and provide the service of educating members about the potential for injuries or vessel loss, suggest best practice methods, and extract areas needing additional investigation. This paradigm shift is certainly one from which that all parties, the investigators and industry participants, immediately benefit.

The CBIM is a powerful technique to identify and resolve systematic safety problems within an industry. For the inshore scallop industry, the CBIM identified the necessity to view the vessel and harvesting equipment as a single machine, to analyze machine characteristics, and classify the machines into types. It brought scallop fishermen into the process and made their valuable input part of the knowledge base. As a result, these participants learned more about the systematic problems with their industry, and were able to offer solutions, and identify areas requiring additional investigation. This investigation methodology is a powerful tool that partners the safety perspective of government regulators with the economic efficiency perspective of industry participants. Together, this team can identify unsafe practices and design improvements to the industry that will be accepted.

CAUSES & CONTRIBUTING FACTORS – ANALYSIS OF ACCIDENTS INVOLVING FISHING VESSELS IN CANADA

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The Canadian Transportation Accident Investigation and Safety Board, commonly known as TSB, is a Canadian federal government agency mandated to improve transportation safety by:

> Conducting independent investigations, including, when necessary, public inquiries, in order to make findings as to their causes and contributing factors;
>
> Identifying safety deficiencies as evidenced by transportation occurrences; and

Reporting publicly on its investigations and public inquiries and on the related findings.

The TSB's sole objective is to advance transportation safety, which is predicated upon the identification of safety deficiencies and associated risks. As such, the investigations are carried out with the prime purpose of identifying safety deficiencies in transportation occurrences and to propose corrective safety action designed to eliminate or minimize risks associated with any such deficiencies.

TSB is independent of other government departments that regulate or operate elements of the marine, rail, commodity pipeline, and air transportation systems. It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board does not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

TSB APPROACH TO ADVANCING TRANSPORTATION SAFETY

Generally, an investigation of any occurrence has three main objectives:

a. To find out "What happened?" (i.e. to satisfy curiosity);

b. To determine "Who did it?" for the purpose of apportioning blame, liability; and

c. To improve safety.

Traditional investigations placed more emphasis on objectives (a) and/or (b). Objective (a) will be met if the investigation can just determine the cause. In a traditional investigation, once the *immediate cause* of an accident is found, the process of investigation often stops at that point without further examining the information about cause such as underlying factors and contributory conditions. Determination of *immediate cause* is useful in identifying who had the last opportunity to intervene and prevent the accident. It does little in terms of understanding of the unsafe conditions, which lead to unsafe acts in the first place.

With objective (b), the investigation will be looking for who is to blame with a view to establishing damage compensation and punishment (civil/criminal liability.) For example, an investigation might conclude upon discovering the fact that a collision occurred because the master of the fishing vessel did not proceed at a safe speed. Possible underlying factors such as the requirement to maintain a tight sailing schedule, to take advantage of a per-trip fishing quota, or the need to work long hours resulting in fatigue due to a small complement, etc. were usually left undetermined. As such, cause determination or apportioning blame by itself would not do much to improve safety.

Today, more and more investigations are conducted to learn from the accidents and thus improve safety. As indicated above, the ultimate objective of TSB investigations is to *improve safety*, transportation *safety*. To that end, TSB investigations are conducted to identify inadequacies in the system, which could cause or contribute to the probability and/or severity of an accident or an incident.

WHAT IS "SAFETY" AND HOW TO IMPROVE IT?

The Oxford dictionary defines *"safety"* as "*freedom from danger or risks.*" Risk has two elements and is commonly defined as the product of the probability of an adverse outcome and the severity of that outcome.

$$\text{RISK} = \text{PROBABILITY} * \text{CONSEQUENCE}$$

To improve safety means to eliminate or reduce risks. Risk can be treated by reducing *probability* and/or minimizing the *consequences*. To do so, one must understand the causes and underlying factors that contribute to both elements of the RISK equation. If the focus of an investigation is only on the causal factors and on preventing "recurrence", it will limit the potential for safety improvement by not considering the second element of the risk equation. Many of us can think of an accident that had factors at play that were not causal, but that contributed to the severity of the outcome. An obvious example would be inadequate lifesaving equipment and inadequate competence and training in marine emergency duties. Another could be the design characteristic of the vessel that allowed a relatively minor incident to become a serious accident. Eliminating such deficiencies will do nothing to prevent a future accident, but it may significantly improve safety by reducing the severity of consequences.

DETERMINATION OF CAUSAL, CONTRIBUTING AND UNDERLYING FACTORS

Since its inception in 1990, TSB has systematically analyzed its investigative findings to arrive not only at the proximate causes but to understand the underlying factors that caused or contributed to the severity of accidents. Today, several models, analytical tools, and techniques exist to assist the investigator/analyst in analyzing accident causation not only for the purpose of understanding "WHAT" happened but also "WHY" it happened, by establishing the root causes and contributing factors to the accident.

Dr. James Reason of the University of Manchester developed one such model. While some analysts refer to this as the "*Swiss Cheese Model*," it is much better known as *"Reason's Model*." (See Figure 1.) TSB safety analysts in all modes of transportation often use this model. The second layer represents unsafe act(s) committed by frontline operator. Fortunately, a well-designed system has built-in defenses (the first layer in the model), physical or administrative, to mitigate the circumstances of such unsafe acts. But the model requires us to look beyond the immediate circumstances of the accident. It will force the user to examine all the preconditions at the time of the occurrence, including such things as fatigue, stress, operating practices, etc. The fourth

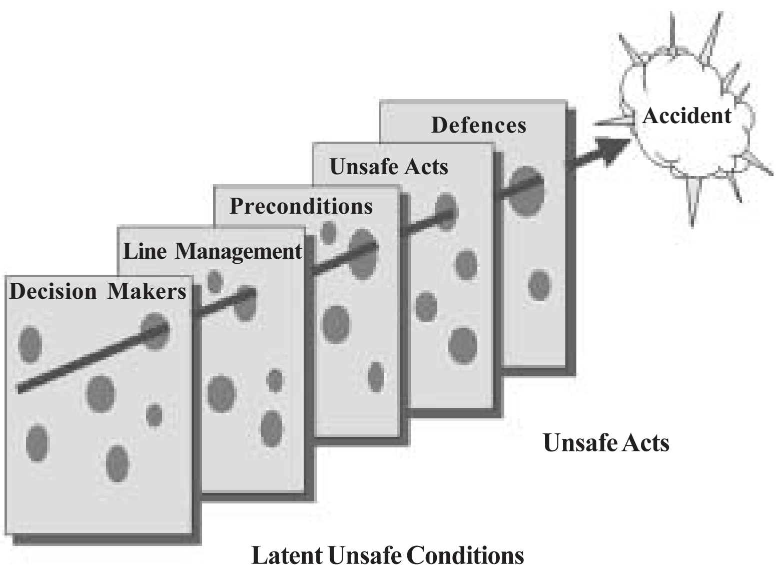

Figure 1: Reason's Model

layer represents the effects of line management in such areas as training, maintenance, operating procedures, etc. The fifth layer depicts all high-level decision-makers such as regulators, owners, the designers, manufacturers, and the unions, etc. Reason suggests that these decision-makers frequently make “fallible” decisions and these latent defects stay dormant waiting for someone to commit an unsafe act and thereby triggering a potential accident scenario. If the system’s defences function as intended, benign outcomes result; if they do not, the result may be a tragedy. Reducing or eliminating safety deficiencies can be represented by a reduction in the size or number of holes, and thereby reducing the probability of an accident. The Reason Model is particularly useful in illustrating the concept of multiple causality.

The General Error Modeling System (GEMS) (see Figure 2), also proposed by Dr. Reason, is used by analysts to look beyond unsafe acts committed by front line operators. The GEMS framework is used to determine the origin of that particular act or causal condition. For the scope of this paper, it is sufficient to recognize that to uncover the underlying causes behind the decision of an individual or group, it is important to determine if there were any factors in the work system that may have facilitated the error and the unsafe act. Human performance analysts at TSB use this model to identify underlying human and organizational factors.

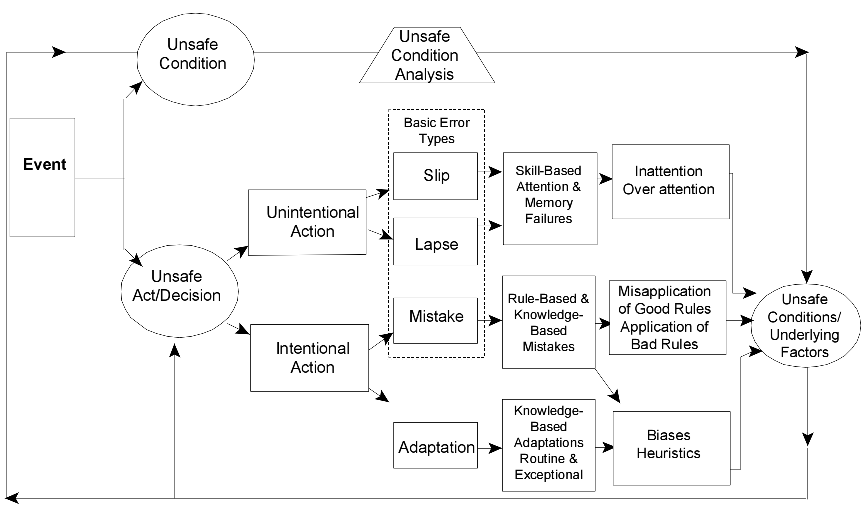

Figure 2: General Error Modeling System

OVERVIEW OF ACCIDENT STATISTICS on FISHING VESSELS

During the period 1975-1999, the TSB recorded a total of 19,000 shipping accidents involving 21,000 vessels. Approximately 50 percent (10,370) of them were Canadian fishing vessels. Of these vessels, more than half measured less than 15 gross tons. Since 1988, about half of the vessels involved in marine accidents have been fishing vessels.

In 1999, 532 shipping accidents, involving 577 vessels, were reported to TSB. About half of the vessels involved were fishing vessels; about 15 percent were foreign-flag vessels in Canadian waters and the remainder involved other types of Canadian-flag vessels. A total of 44 vessels were reported lost in the same period, of which 39 were fishing vessels. Note that there were approximately 26,000 federally licensed fishing vessels in Canada. The following table depicts a brief overview of the types of vessels involved in shipping accidents reported over the past ten years.

Table 1 - Vessels Involved in Shipping Accidents by Type of Vessel

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Cargo	76	68	52	41	48	34	28	20	25	25
Bulk Carrier OBO	129	121	135	132	141	120	97	60	67	71
Tanker	49	32	27	25	26	15	24	13	18	14
Tug	82	68	48	43	57	52	46	38	43	42
Barge	98	97	41	34	42	51	43	31	24	35
Ferry	33	37	26	29	28	27	22	17	22	22
Passenger	24	26	34	20	17	20	18	15	27	19
Fishing	586	481	467	380	445	389	322	320	253	280
Service Vessel	59	52	50	31	44	36	24	30	27	35
Non-commercial	23	38	26	32	23	29	16	12	18	14
Other	13	10	9	11	11	3	15	18	8	20
Total	**1,172**	**1,030**	**915**	**778**	**882**	**776**	**655**	**574**	**532**	**577**

In 1999, the most frequent types of shipping accidents involving fishing vessels were grounding flooding, fire/explosion, and foundering/sinking in that order. While grounding and flooding accidents are the most frequent; foundering/sinking and capsizing accidents generally result in more severe consequences in terms of lives lost or damage to vessels. Most fatalities reported under the "Other" types of accidents involved fishing vessels, which had gone missing. (See Table 2.)

Table 2 - Canadian Fishing Vessels by Type of Accident*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Fatalities**
Collision	38	31	18	23	38	17	8	12	8	21	11
Capsizing	19	16	8	11	7	14	9	10	8	3	40
Foundering/ Sinking	57	50	34	34	36	40	27	28	13	22	50
Fire/Explosion	92	68	68	57	62	54	52	48	33	37	2
Grounding	154	108	131	109	111	98	88	75	65	74	10
Striking	66	67	59	32	35	24	12	22	29	15	1
Ice Damage	16	4	17	8	10	8	14	16	9	6	0
Propeller/ Rudder/ Structural Damage	33	28	38	36	27	28	36	25	13	30	0
Flooding	84	65	55	41	77	69	51	58	51	55	0
Other	12	22	30	18	21	20	11	15	16	10	24
Totals	**571**	**459**	**458**	**369**	**424**	**372**	**308**	**309**	**245**	**273**	**138**

* This table excludes the few foreign-flag vessels involved in shipping accidents in Canadian waters.

** Number of fatalities is for the 10-year period.

SUMMARY ANALYSIS OF SAFETY DEFICIENCIES

Since 1992, the Board has systematically identified several safety deficiencies and made over 30 safety recommendations with a view to mitigating risks in the Canadian fishing industry. The most commonly found safety deficiencies identified in these recommendations are summarized in the following subsections:

INADEQUATE TRAINING AND AWARENESS

Lack of crew training and knowledge in survival techniques aboard Canadian fishing vessels has been found in many investigations as a factor attributable to both the frequencies of accidents as well as to the severity of consequences.

Until recently, there were no regulatory requirements in Canada for personnel operating small fishing vessels of less than 100 gross registered tons to be certificated for competency in navigation, seamanship, safety, vessel stability and survival skills. However, these vessels constitute over 95 percent of the registered Canadian fishing fleet. At present, the Certification and Safe Manning Regulations are being revised to require competency and training for officers on Canadian fishing vessels of 60 GRT and over.

Most fishermen do not have formal training in vessel stability and are unable to extrapolate the stability of their vessel under different conditions. (As of October 2000, there are no stability requirements for fishing vessels of less than 15 GRT in Canada unless they are engaged in herring and capelin fishery.)

TSB investigations consistently reveal that fishermen who were involved in serious occurrences often lacked adequate nautical skills and knowledge of safe operations. Many fishermen did not have formal training or knowledge to respond effectively to distress situations. Crews' failure to properly secure watertight openings, failure to wear survival suits, failure to carry and/or properly operate locating devices, such as electronic position indicating radio beacons (EPIRBs), and lack of familiarity with lifesaving equipment such as life rafts have contributed to the loss of lives in many occurrences.

In Canada, unqualified crew members with inadequate watchkeeping abilities have contributed, at least in part, to between 45 and 50 percent of all collisions, groundings, and strikings involving fishing vessels. Several collision and grounding occurrences investigated by the TSB suggest that lack of formal training in the use of radar, radar plotting, and other safe navigational procedures (e.g. reduce speed, sound fog horn, post dedicated lookout, etc.) have exacerbated the situation leading to such occurrences.

INADEQUATE SURVIVAL EQUIPMENT, SKILLS AND DRILLS

The survival of the crew when abandoning ship at sea depends largely on the capability and reliability of the survival equipment, as well as the crew's familiarity and skill in using that equipment. One person's knowledge of life raft deployment, distress signal use, or emergency response could easily save an entire vessel and crew.

In recent years, at least five fishing vessel occurrences were reported to the TSB in which problems regarding the use of life rafts were identified. In April 1995, a 44 ton fishing vessel sank; two of her crew drowned when the life raft capsized. In November 1995, a 27 GRT fishing vessel capsized and sank rapidly; the life raft had to be cut free from the securing lashings as none of the crew knew that the raft was outfitted with a knife. On the same day, another fishing vessel sank, taking the life raft with her before the crew had time to deploy it. A 1995 safety study, sponsored by the Alaska Marine Safety Education Association (AMSEA), that evaluated the effectiveness of AMSEA courses in emergency preparedness and survival training targeted at commercial fishermen in Alaska from January 1991, to December 1994 found that "*none of the 114 fishermen who died during the study period were graduated from the courses, and none of the 64 vessels on which a death occurred had a course-trained person on board*" [Perkins 1995]. Unfortunately, lives are still being lost due to crewmembers' unfamiliarity with the use of their lifesaving equipment or emergency procedures.

On the other hand, the TSB has also witnessed at least three occurrences where crews survived severe winter conditions in North Atlantic waters for several hours because they were able to deploy and use the life saving equipment as intended. In the January 1993 sinking of the scallop trawler *Cape Aspy*, ten of the survivors were rescued from their life raft after three hours, and one other was pulled alive from the frigid sea approximately six hours after the vessel sank. Immersion suits were credited for saving the lives of these survivors. The most recent example is the sinking of the 56-meter long 877 GRT shrimp fishing vessel *BCM Atlantic* off the coast of Labrador on March 18, 2000. While shooting a trawl at night, on shrimp fishing grounds off Labrador, the *BCM Atlantic* struck a piece of ice. The vessel was holed in the shell plating in the vicinity of a common bulkhead between the engine-room and the cargo hold; the vessel flooded and then sank. All 26 persons on board donned immersion suits and abandoned ship into three life rafts. After drifting in the life rafts over three hours in -11 °C, all 26 people were recovered. No serious injuries or pollution resulted from this occurrence. This rapid and successful abandonment was attributed to the crew being able to properly deploy and use the lifesaving equipment as a result of the recent boat drill.

DOWNFLOODING — UNSECURED HATCHES, DECK/ BULKHEAD OPENINGS

Since 1975, failure to secure openings on decks and below decks has contributed to the loss of at least 20 fishing vessels and 28 lives. Openings in watertight bulkheads are common on fishing vessels for the convenience of movement of crews, equipment, and cargo. All vessels are designed and equipped with means to secure such openings. However, leaving such accesses unsecured and/or open at sea has caused several occurrences of multiple compartment flooding in fishing vessels. TSB investigations have consistently found that many fishermen were not aware that breaches of watertight integrity provided by the bulkheads and hatches vitally affected the seaworthiness of the vessel and subsequently their safety. In a 1998 accident involving a 13-m long fishing vessel, the investigation attributed the downflooding through two unsecured fish hold hatches to the loss of the vessel. There was no permanent device for securing those covers. No trace of the wreck or of three of the five crewmembers was found.

VESSEL MODIFICATIONS, ADDITION OF WEIGHT ITEMS AFFECTING STABILITY

In Canada, fishing vessels over 15 GRT are subject to safety inspection every four years. (Vessels less than 15 GRT are not required to be inspected.) Between these inspections, many vessel owners make modifications to their vessels by adding various structures, heavy items, fishing gear, and equipment without being aware that such modifications can adversely affect the vessel's stability, reduce the freeboard, and compromise crew safety in adverse weather conditions. Fishermen do not normally notify the authorities of such modifications to reassess vessel stability characteristics. There is currently no procedure for marine surveyors to systematically account for such modifications.

UNSAFE LOADING & OPERATIONAL PRACTICES

Often, accidents occurred when fishermen misuse or exceeds the ship's capability causing it to lose its inherent stability and/or allowing the ship to be overwhelmed by external environmental factors such as wind, waves, ice, and seas, etc. TSB investigations over the years indicated that many crews on fishing vessels do not fully appreciate that their day to day operating procedures and loading practices may be creating unsafe conditions. Unsafe loading practices such as improper penning of fish holds, improper handling and excessive stowage of fishing gear and lobster traps, have led to several accidents.

INADEQUATE DRAINAGE OF SHIPPED SEAS OFF DECKS, FREEING PORTS

Canadian regulations require fishing vessels to be fitted with freeing ports of adequate area to facilitate rapid and effective freeing of shipped water from the deck. It is not uncommon to find freeing ports welded or bolted shut on many fishing vessels to prevent the catch or equipment from slipping through. Apparently, the crews do not always realize the perilous effect of water retained on deck. One can see from the above that sometimes the adequacy of the "regulations" was not an issue but rather the issue is of compliant culture and enforcement.

STABILITY AND STABILITY INFORMATION

Approximately 75 percent of capsizing and foundering accidents are attributable to stability. Many stability-related accidents involving fishing vessels are largely attributable to human factors. In most instances, vessel operators were not familiar with stability, safe loading and operating practices, and guidelines or restrictions necessary to maintain the stability of their vessels under various operating conditions. Analysis of at least three fishing vessel accidents suggested that many fishermen and fishing vessel operators are not aware that modifications and the addition of items can adversely affect the stability of the vessel and, consequently, the safety of the crews.

In several cases, stability booklets containing information on stability characteristics and various loading conditions for fishing vessels are complex and the information is not user-friendly. Consequently, essential information is not being put to effective use.

HOURS OF REST FOR CREWS ON FISHING VESSELS

Today's competitive environment, with diminishing resources at sea such as in salmon and lobster fisheries, places pressure on fishermen to take undue risks and to operate in adverse weather conditions for frenzied stretches of hours and days with whatever crew is available, trained or otherwise, inducing fatigue and performance degradation.

In Canada, regulations affecting hours of rest do not apply to personnel employed on Canadian fishing vessels. The requirement for daily periods of rest for persons employed on a ship is addressed in the Safe Manning Regulations; however, these regulations specifically exclude fishing vessels. In its report on the investigation into the grounding of the stern trawler *Zagreb*, it was found that the officer of the watch on the *Zagreb* had worked 11.5 hours prior to the grounding, after 10 days of fishing on a six-hours-on/six-hours-off work schedule. The grounding resulted in the total loss of the vessel. As a result, the Board expressed its concern with the frequency of fishing vessel accidents in which issues related to crew fatigue were found to have contributed.

FIRE AND EXPLOSION

As previously depicted in Table 2, fire/explosion is the third most frequent type of event involving fishing vessels. While occurrences involving fire incurred more severe vessel damage than other accidents, they generally resulted in fewer fatalities or fewer serious injuries per accident than other types of small fishing vessel accidents. The TSB has not conducted an in-depth analysis of fires on fishing vessels; however, information gathered during investigations indicates that unsafe operating procedures and practices, inadequacy in housekeeping, improper installation and maintenance of electrical equipment, machinery, and piping contribute to most fires and explosions.

RISK CONTROL — PROBABILITY & CONSEQUENCE REDUCING FACTORS

Risk can usually be controlled through a combination of four approaches: terminate risk; transfer risk; treat risk; and tolerate risk.

It is obvious that preference should be given to developing safety measures that will completely eliminate the deficiencies to prevent similar adverse consequences in the future. Regrettably, such solutions are often the most expensive and are often times impossible. Since this is a safety conference, we are not interested in transferring risk. In most cases, where the risk associated with potential safety deficiencies cannot be eliminated in a complex system, such as fishing vessel operations, the system should be made more tolerant to risk by building one or more of the following defenses/barriers in the system: [1]

Designing for minimum hazards;

Installation of safety devices; provision of warning devices, signs, placards, etc;

Establishment of procedures and practices; and

Provision of training and awareness.

Our experience indicates that administrative interventions, such as rules, regulations, procedures, and training, etc., alone may not provide an effective hazard control in many circumstances, especially when the level of risk is very high. TSB believes that while rules compliance is necessary for accident prevention, it alone is not sufficient to advance safety. In a complex system such as transportation, even the most rigorous set of rules will not cover every contingency; interpretation by individuals will be required to cover unanticipated situations. Indeed, notwithstanding their knowledge of the rules, even the most motivated employees are subject to the normal slips, lapses, and mistakes that characterize human behavior. The TSB embraces the “defense in depth” philosophy which seeks multiple and diverse lines of defense to mitigate the risks of normal human errors.

CONCLUSION

It is evident that human and organizational factors play an important role in overall system safety. Acknowledging this fact is an important first step in accident prevention. Based on the information presented above, it is apparent that an increased awareness and training for fishermen in operational safety and survival skills will substantially improve the safety record of the fishing industry. A caveat, however: training is no substitute for poor design. Today’s competitive environment places pressure on fishermen to maximize vessel utilization with minimum crew size inducing stress, fatigue, and resulting performance degradation. When stressed, fatigued, overworked, etc., skills and methods obtained through training usually fail.

I believe that the fishing industry's safety record can be improved, but this will require systematic attention to safety on the part of government agencies and the industry as a whole, namely owners, operators and most importantly, the fishermen themselves.

REFERENCES

Ayeko M [1992]. Safety Deficiency Analysis Approach to Fishing Vessel Safety. The Proceedings of 2nd International Symposium on Safety and Working Conditions Aboard Fishing Vessels. Villagarcia de Arosa, Galicia, Spain.

Ayeko M [1997]. In Search of Causal and Contributory Factors In Stability-Related Accidents. The Proceedings of 6th International Conference on Stability of Ships and Ocean Vehicles — STAB'97. Varna, Bulgaria.

Haile PG [1997]. Draft Manual for Safety Deficiency Analysis. Canada: Transportation Safety Board.

Perkins R [1995]. Evaluation of an Alaskan marine safety program. Pub Health Rprts, *10*:110.

FOOTNOTES

1. While there are some disagreements as to the order of effectiveness in intervention (known as "safety precedence sequence,") safety professionals are unanimous in proposing these barriers/interventions.

IMPROVING SAFETY IN THE ALASKAN COMMERCIAL FISHING INDUSTRY

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Objectives: Over 90 percent of deaths in Alaska's commercial fishing industry were due to drowning, following vessel sinkings. In the early 1990s, the U.S. Commercial Fishing Industry Vessel Safety Act required the implementation of safety measures for all fishing vessels. The purpose of our study was to examine the effectiveness of these measures in reducing the high fatality rate of Alaska's commercial fishermen.

Study Design: Alaska Occupational Injury Surveillance System and Alaska Trauma Registry data were used to examine fishing fatalities and injuries. Demographic, risk factor, and incident data were analyzed for trends.

Results: During 1991-1998, there was a significant ($p<0.001$) decrease in Alaskan commercial fishing deaths. Significant progress has been made in

saving lives of fishermen involved in vessel sinkings. During 1991-1997, 536 fishermen suffered severe injuries (437/100,000/year). These injuries resulted from being entangled, struck or crushed by equipment (60 percent) and from falls (25 percent).

Conclusions: Vessel sinkings still continue to occur, placing fishermen at substantial risk. Efforts toward improving vessel stability and hull integrity and avoidance of harsh weather conditions must be made to further reduce the fatality rate. The nature of nonfatal injuries reflect that modern fishing vessels are complex industrial environments posing multiple hazards. Measures are needed to prevent falls and improve equipment handling and machinery guarding.

INTRODUCTION

For many years, commercial fishing has been well-known as a dangerous occupation. Numerous publications have been written about the hazards of commercial fishing in the U.S. and Alaska [Schnitzer 1993; NRC 1991; NTSB1987; Knapp 1991; Storch 1978]. More recent studies show a reduction in fatalities in Alaska since the implementation of the Commercial Fishing Industry Vessel Safety Act (CFIVSA), and has also shed light on continued problems that current regulations have not addressed, such as machine hazards on deck [NIOSH 1997; Husberg 1998; Lincoln 1999]. This more recent literature also recommended that the approach to improving safety in the fleet be augmented by concentrating on preventing vessel capsizings and sinkings from occurring in the first place, as well as continuing to prepare crew to react to them if they do occur [NIOSH 1997; Lincoln 1999].

The purpose of this paper is to update the information from previous studies to illustrate the continued progress in reducing fatalities in the commercial fishing industry in Alaska, as well as to address a more complete spectrum of injury by evaluating the nonfatal injuries on board fishing boats. Injury prevention programs are described that have been implemented as a result of our surveillance efforts to address the safety problems in the commercial fishing industry in Alaska.

MATERIALS AND METHODS

The Alaska Occupational Injury Surveillance System (AOISS) is a comprehensive surveillance system for fatal occupational traumatic injuries. It contains information on demographics, location, cause of injury, weather conditions, emergency gear, personal protective equipment, and work experience. Usually, press releases from the Alaska State Troopers, reports from news media, calls from the Alaska Occupational Injury Prevention Program (OIPP) Coordinator, or from jurisdictional agencies alert us to new cases. Data from other agency sources are entered to supplement the AOISS database. The National Institute for Occupational Safety and Health (NIOSH) Alaska Field Station (AFS) shares AOISS data and reconciles tabulations with the OIPP and the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) program within the Alaska Department of Labor and Workforce Development.

The Alaska Trauma Registry (ATR) is a population-based trauma registry that collects information from all 24 acute-care hospitals in Alaska. Information is abstracted from hospital medical records and added to the ATR database. The ATR consists of information on persons who are injured. Also, those injured have to either be admitted to a hospital, transferred from an emergency department to another hospital for admission, or declared dead after they arrive at the hospital. Trauma registries are a unique source of injury surveillance and prevention data. Demographics, geographic information, disability, medical cost, payment source, cause of injury, discharge diagnosis, and severity scoring are a few examples of data that are collected. The ATR is managed by the State of Alaska Department of Health and Social Services, Division of Public Health, Section of Community Health and Emergency Medical Services in Juneau, Alaska.

The AFS emphasizes non-regulatory collaborative responses in our intervention efforts. Strong working relationships have been established with many other federal, state, municipal, and nongovernmental agencies. These relationships have been formalized into the Alaska Interagency Working Group for the Prevention of Occupational Injuries (AIWG). Industry and workers are also asked to be full partners in planning and executing interventions and in providing ongoing surveillance data to track success or failure of these interventions. The NIOSH Alaska Field Station provides assistance to the AIWG in organizing, analyzing, and interpreting surveillance data. Based on this data and collaboration, several injury prevention strategies have been established and implemented.

RESULTS

FATALITIES

Commercial fishermen represented 217 (33 percent) of the 648 occupational fatalities that occurred in Alaska during 1990-1999. Given the mean full-time equivalent Alaska commercial fishing workforce of 17,500, this is equivalent to a fatality rate of 124/100,000 workers/year. This rate has decreased from the rate reported in 1991 through 1992 (200/100,000/year); however, it is still over five times as high as the overall occupational fatality rate for the state (22/100,000/year) (Alaska, 2000) and 28 times the overall U.S. occupational fatality rate of 4.4/100,000/year [CDC 1993].

The fatality rate among fishermen varied considerably by type of fishery: shellfish (primarily crab) had the highest (407/100,000/year), followed by herring (204/100,000/year), and halibut (119/100,000/year) (See Figure 1— Fishery-Specific Fatality Rates). Fisheries differ in geographic location of fishing grounds,

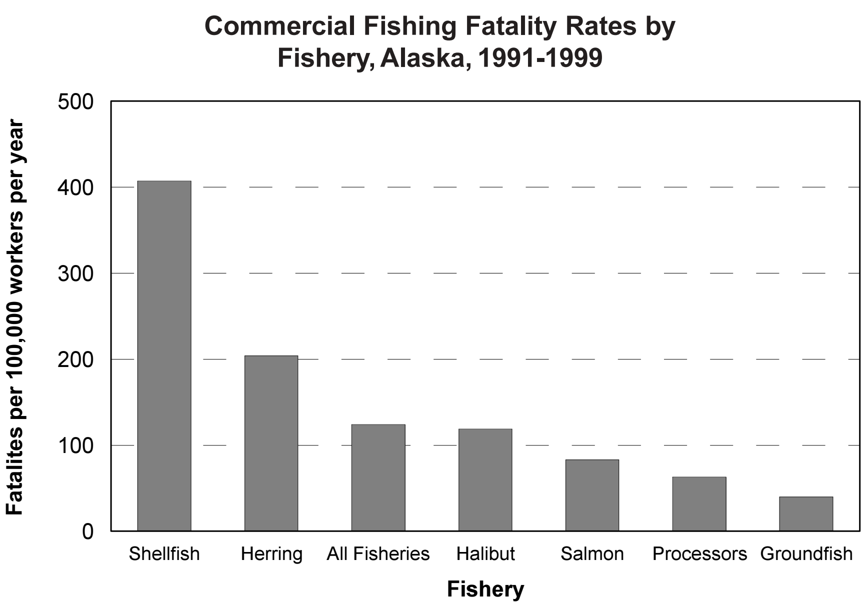

Figure 1: Fishery-Specific Fatality Rates

type of harvesting equipment and techniques, time of year, and duration of seasons. Crabbing, a shellfish fishery, is particularly hazardous because harvesting of crab species in Alaska generally takes place during the winter, which is often characterized by rough weather.

Most fishermen drowned and/or died from hypothermia (186, 86 percent), as the result of vessel-related events (vessel sinkings or capsizings) (133, 72 percent), falls overboard (43, 23 percent), diving incidents (5, 3 percent), or other drowning event (3 percent). Other fatalities were due to deck injuries (16, 7 percent), or some other event (15, 7 percent). Of 133 fatalities in vessel-related events, the largest number (61, 46 percent) of fishermen were participating in the shellfish fishery. Of those falling overboard (man overboard [MOB]) and drowning, 22 (51 percent) were also participating in the shellfish fishery. Fatalities from falling overboard were categorized by cause of immersion: entanglement in net or line (12, 27 percent), observed fall (12, 27 percent), unobserved fall (victim missing from vessel) (10, 23 percent), or being washed or blown into the water (10, 23 percent). None of these workers wore personal flotation devices (PFDs). Of the 71 fishermen who drowned in vessel-related events and for whom PFD/immersion suit usage was available, 54 (76 percent) were documented not to have been wearing any type of PFD or immersion suit, whereas 17 (24 percent) were wearing such devices. (For 62 fishermen in vessel-related events, it is unknown whether they were wearing any type of PFD or immersion suit.) On the other hand, among survivors of such casualties, 34 of 47 were wearing PFDs or immersion suits. Thus, odds ratio calculation shows that survivors of these vessel-related events in which at least one person drowned were 8.3 times (95 percent CI=3.59-19.24) more likely to have been wearing a PFD or immersion suits than were decedents.

The CFIVSA was implemented from 1990-1995. This act requires specific safety equipment (i.e. life rafts and immersion suits) and training (i.e. drill instructor training and first aid) for fishermen. From 1990-1999, Alaska experienced a 49 percent decline in all work-related deaths including a 67 percent decline in commercial fishing deaths (1990-1992 average compared to 1997-1999 average). By 1999, there had been a significant ($p<0.001$) decrease in the number of deaths in the Alaskan commercial fishing industry (See Figure 2).

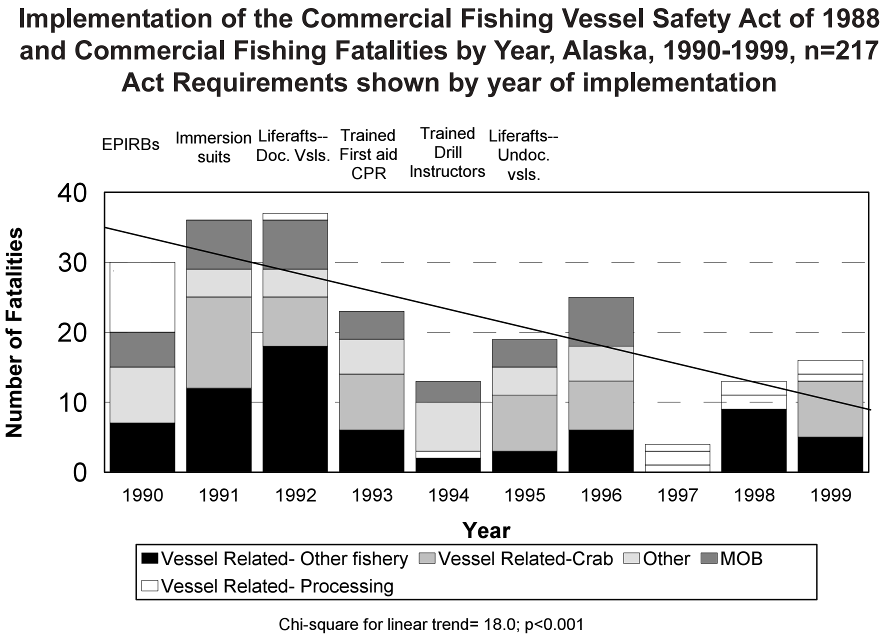

Figure 2: Fatality Trend Line During and After CFVISA

AFS analysis of USCG vessel casualty statistics for 1991 through 1999 revealed that the number of vessels lost per year have remained relatively constant (mean 34, median 36), as have the number of workers on board (i.e., number of persons at risk) (mean and median 106), whereas remarkable progress has been made in the case-survivor rate (number survivors ÷ number on board) in this type of incident. The case-survivor rate has increased from an average of 78 percent in 1991-1993, to 92 percent in 1994-1996, and then to an average of 94 percent from 1997-1999 (See Table 1— Case Fatality Rate). (Information is not available for 1990.) These data only represent fatalities due to the loss of a vessel, therefore, MOBs, crushings, and fires are not represented.

NONFATAL INJURIES

From 1991 through 1997, commercial fishing had the highest number of injuries as recorded in the ATR. However, by 1998, the construction industry (621) had overtaken commercial fishing (587) as the industry with the highest number of hospitalized injuries from 1991-1998. Commercial fishing had an average

Table 1: Recent Decrease in Case Fatality Ragte, Alaska Commercial Fishing Industry, 1991-1999

Year	Number of Vessels Lost*	Workers on Board*	Worker Fatalities**	Case Fatality Rate***	Case Survivor Rate
1991	39	93	25	27%	73%
1992	44	113	26	23%	77%
1993	24	83	14	17%	83%
1994	36	131	4	3%	97%
1995	26	106	11	10%	90%
1996	39	114	13	11%	89%
1997	31	84	1	1%	99%
1998	37	124	9	7%	93%
1999	28	104	11	11%	89%

* Source: U.S. Coast Guard 17th District Fishing Vessel Safety Coordinator.

**Fatalities from capsized or lost commercial fishing vessels only.

***Case Fatality Rate: (number killed/number at risk) x 100 percent.

annual hospitalized injury rate of 4/1,000 workers, ranking third behind the logging (18/1,000) and construction industries (6/1,000). There has been a slight decline in the number of nonfatal injuries in the industry.

The three most common types of injuries were fractured bones (279), open wounds (73), and burns (29). Extremities were the body regions most often injured with 184 to the upper extremities and 171 to the lower extremity. The third most common body region mentioned was the spine (35).

Machinery (187) was the leading cause of nonfatal hospitalized injuries in the commercial fishing industry. Falls (149) ranked a close second, followed by being struck by an object (98). Narrative descriptions of injury events revealed that falls most often occurred into holds, through open hatchways, and as a result of slipping on ladders and gangways. Injuries from machinery often involved equipment unique to this industry. “Crab pots” (baited cages weighing up to 800 lbs. empty which are maneuvered by cranes on deck) and “crab pot launchers” were listed in the records as factors in a number of injuries. A crab pot launcher is a hydraulic lift which raises and tilts the pot over the top of the gunwale where the pot slides into the water. Bait choppers, powerblocks, cranes, and winches were also repeatedly mentioned as being factors in these injuries. It is not possible to do an analysis based on fishery using ATR data.

DISCUSSION

Contributing factors in commercial fishing deaths vary from those for nonfatal injuries to workers in this industry. As mentioned previously, most commercial fishing deaths result from the loss of a vessel due to capsizing or sinking. If commercial fishing is going to continually become safer, capsizings and sinkings must be prevented by concentrating on vessel stability and hull integrity. MOB prevention and successful retrieval from the water are also important to further improve safety in the fleet. ATR data show that most nonfatal injuries occur while working on the vessel (either on deck or below). Nonfatal injuries are more commonly caused by machinery on deck, falls, and/or being struck by objects with most of these injuries occurring in the crab fishery.

ALASKA INTERAGENCY WORKING GROUP- FISHING SUBCOMMITTEE

The focus areas that were identified from the AIWG to prevent fatalities include addressing the stability problems and MOB prevention and rescue on crabbing vessels. The focus areas identified for nonfatal injuries include examining the problems with deck layout and machinery and how this relates to deck injuries.

DOCKSIDE ENFORCEMENT PROJECT

The Fishing Subcommittee of the AIWG developed a project to address the issues of vessel stability in the Bering Sea crab fleet. Members of the committee (primarily in the USCG) developed and organized groups starting in October 1999, to board crab vessels in Dutch Harbor, King Cove, and Akutan, Alaska, in conjunction with Alaska Department of Fish and Game personnel during their tank inspections to check compliance with on board stability instructions. The USCG enforced stability instructions on overloaded vessels with Captain of the Port authority detaining overloaded vessels. There has been strong industry for this project. The subcommittee is also using this project as a way to collect information on MOB experiences and risk factor information among crab fishermen.

DECK SAFETY PROJECT

The subcommittee also determined that attention should be given to worker safety around deck machinery, an area that appears not to have been adequately addressed by current safety regulations. Efforts are needed to better define the relationship between the vessel, fishing equipment and the worker. The NIOSH Alaska Field Station started an engineering design project in October 2000 to address some of these issues. This project is first addressing safety concerns on board crab boats and plans to also look at other vessel types.

Many of the injuries in the ATR occurred while working in the proximity of a crab pot launcher while fishing for either crab or cod. Recommendations to fishermen for the prevention of these injuries could come from safety and machine guarding lessons learned in general industry. For example, installing a machine guard on the bait chopper to prevent hands from entering the blades, or painting a yellow line for a “safety zone” around the perimeter of the crab pot launcher to serve as a reminder for the fishermen to stand behind the line while the launcher is in motion. Painting the launcher itself a bright color and/or with reflective paint could help fishermen to see the launcher under low light conditions, to be aware of its location and movement. Such measures require further evaluation.

The NIOSH Alaska Field Station has initiated a project to examine the deck environment surrounding the deployment and retrieval systems (e.g. cranes, “power blocks”, pulleys, winches, lines, nets, crab pots, and crab pot launchers) of fishing equipment from a mechanical and safety engineering perspective.

Additional areas to focus on include machine guarding, separating workers and lines, and fall prevention.

The NIOSH Alaska Field Station is continuing to study the causes of these deck injuries, develop strategies to prevent them, and evaluate safety practices that some crews already have in place. This information is communicated to other fishermen, captains, and vessel owners to increase awareness of the problem to discuss potential solutions. These ideas could then be personalized and individually implemented with the intent of increasing safety awareness and preventing these types of injuries.

The NIOSH Alaska Field Station organizes, analyzes, and interprets data for action. Both successful safety regulations (CFIVSA) and non-regulatory collaborations resulting in intervention efforts have proven to be effective in reducing deaths in Alaskan commercial fishing industry. Fishery-specific approaches like the Dockside Enforcement Project and the Deck Safety Project can also be tailored to suit needs in other fisheries. The NIOSH Alaska Field Station is very interested in further collaboration, and invite individuals/groups interested in preventing injuries and fatalities in this industry to contact us.

REFERENCES

Centers for Disease Control and Prevention [1993]. Commercial fishing fatalities–Alaska, 1991-1992. MMWR, *42*(18):350-359.

Husberg BJ, Conway GA, Moore MA, et al. [1998]. Surveillance for nonfatal work-related injuries in Alaska, 1991-1995. Am J Industrial Med *34*:493-498

Knapp G and Ronan N [1991]. Fatality rates in the Alaska commercial fishing industry. Alaska Sea Grant College Program, Pub No. AK-SG-90-03. Anchorage, Alaska:University of Alaska, Institute of Social and Economic Research.

Lincoln JM**,** Conway, GA [1999]. Preventing commercial fishing deaths in Alaska. Occup Environ Med *56:* 691-695.

NIOSH[1997]. Current Intelligence Bulletin #58: Commercial fishing fatalities in Alaska, risk factors and prevention strategies. Cincinnati, Ohio: U.S. Department of Health and Human Services, Public Health Service, U.S. Public Health Service, Centers for Disease Control and Prevention, Natonal Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-163.

National Research Council, [1991]. Fishing vessel safety: blue print for a national program. Washington, D.C.: National Academy Press.

National Transportation Safety Board [1987]. Safety study, uninspected commercial fishing vessel safety. Washington, D.C.:PB87-917003.

Schnitzer PG, Landen DD, Russell JC [1993]. Occupational injury deaths in Alaska's fishing industry, 1980 through 1988. Am J Public Health *83*: 685-688

State of Alaska [2000]. Occupational-related fatalities in Alaska, 1990-1999. Alaska: Department of Health and Social Services Bulletin No. 16 .

Storch RL [1978]. Alaskan king boat casualties. Marine Technology *15*: 75-83.

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FISHERMEN'S PERCEPTIONS OF RISK

Photograph and caption by Earl Dotter.

A First Mate repairs a jammed pulley block at the end of an outrigger. Heavy steel 'birds' have just been lowered from the starboard and port side outriggers to increase the stability of the boat on the open ocean.

FISHERS' ATTRIBUTED CAUSES OF ACCIDENTS AND IMPLICATIONS FOR PREVENTION EDUCATION

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INTRODUCTION

Commercial fishermen are employed in one of the most dangerous jobs in Canada [Marshall 1996]. Additionally, fishermen downgrade the risk of their occupation through their tendency to not report work injuries [Jensen 1996]. This lack of reporting injuries ties into the way they look at the issue of risk in their profession. Fishermen have established a pattern of denial and trivialization as part of their occupational subculture [Pollnac et al 1995]. They do this in order to relieve the psychological pressures that occur when they are forced to constantly face the reality of the dangers of their occupation. This propensity to deny risk and not report non-life-threatening injuries confounds the statistical analysis of overall work related injuries and results in a lack of documentation of the risk in the occupation.

Policy makers have traditionally ignored the human, behavioral, and attitudinal factors even though American and Canadian analysis of fishing vessel accidents indicate that human factors directly or indirectly contribute to 70 percent to 90 percent of incidents [National Research Council 1991]. Researchers have not usually considered fishermen’s accident stories, and have often functioned from an objective and quantifiable view of the world. This study challenges the traditional concept of the objective world and its "technical control" approach to knowledge by focusing on fishermen's subjective interpretations of fishing safety. Instead of starting with information accumulated by "experts" and data taken from government files, this study starts by looking at the fishermen's own words.

Research by Thompson et al [1998], on the broader topic of workplace safety, affirms the importance of perceptual data of the workers. Their research acknowledges that workers possess insight and sensitivity surrounding unreported workplace accidents. It concludes that this insight possibly makes the workers' perceptual data, "the preferred criteria for safety research."

The intent of the study described here was to legitimize fishermen's knowledge and accumulated experiences. It also shares the complex world of lived experience from the point of view of those who live it. This study identifies fishermen's attributed causes of accidents through an analysis of their descriptions and offers an alternative way of looking at prevention education for fishermen.

METHODS

This research involved naturalistic inquiry; therefore the researcher employed a qualitative methodology. The participants were 12 professional fishermen who lived and worked on the West Coast of British Columbia. A purposeful sampling strategy was used to ensure that the participants came from a variety of backgrounds in terms of ethnic origin, age, position of crew or skipper, gender (see Table 1), vessel type, and size. The vessel types included seiner, gillnetter, troller, dragger, longliner, and trapper. The vessels ranged from 30 to 70 feet and construction materials included steel, fiberglass, wood, and aluminum. All participants had either experienced a personal occupation related injury or been involved in a maritime emergency incident.

Fishing accidents occur within a complex, multilayered, social environment. Fishermen live in, work in, shape, and are shaped by that environment. Their personal accounts of their accidents were the essence of this research. Interviews were the primary data source, capturing the fishermen's own words, their view of their accidents and their attributed causes. Interviews were tape recorded with the permission of the participants. The researcher transcribed

Table 1. Summary of the Ethnic Background and Additional Socio-cultural Details of the Participants

Participant number	Ethnic Background	Skipper or Crew	No. of Yrs. Fishing	Age	Family Attachment to Fishing	Sex
1	Yugoslavian	Skipper	30 years	45	Extensive, many generations, including family in Yugoslavia	Male
2	British/Nfld.	Skipper	40 years	72	Over 100 years of family fishing on B.C. west coast. Not in Britain.	Male
3	British	Skipper	43 years	56	Grandfather & father fishermen since 1930's. Not in Britain.	Male
4	Nova Scotian	Skipper	20 years	38	Uncle, brother fishermen. Not father. Not others in past generations.	Male
5	First Nations	Skipper	40 years	58	Extensive, all male relatives fishermen for many generations.	Male
6	First Nations	Crew/ Skipper	38 years	55	Extensive, all male and some female relatives fishermen for many generations.	Female
7	First Nations	Crew/ Skipper	23 years	37	Extensive, all male and some female relatives fishermen for many generations.	Male
8	Japanese	Skipper	45 years	59	Father fisher, but not prior generations in Japan.	Male
9	French Canadian	Crew	5 years	32	No prior family history of fishing.	Female
10	Vietnamese	Crew	6 years	21	Father fisher. Prior family history of fishing in Vietnam.	Male
11	Japanese	Skipper	28 years	36	Grandfather & father fishermen on B.C. west coast. Not in Japan.	Male
12	Norwegian	Crew/ Skipper	5 years	24	Father, brother fishermen in Canada. Grandfather some in Norway.	Male

the interviews, coded, and organized them within a conceptual framework. Each transcribed interview was analyzed for significant themes. Through this inductive process, 22 categories of attributed causes emerged.

Attribution theory was selected as the conceptual framework through which to analyze the data gathered from the fishermen's descriptions of their accidents. It was selected because of its straightforward approach to analyzing the causes of events and its use in other workplace safety research. A central principle of attribution theory is that people are active information processors who attempt to make meaning out of observed events [Heider 1958, Kelley 1967].

Heider [1958] initiated the examination of how people process information. He made the foundational causal distinction in attribution theory when he stated that the outcome of an action depends on two factors, those within the person (internal) and those within the environment (external). Internal attributions assign the origin of the behavior to personal characteristics and inclinations, whereas external attributions assign the origin of the behavior to environmental pressures and situational conditions. This is called the locus of causality dimension. Weiner proposed a second causality dimension because for both internal and external causes, some remain constant, while others fluctuate [Weiner 1985, Weiner et al 1971]. He labeled these stable and unstable. For example, he classified task difficulty as external and stable, and effort as internal and unstable. In the context of workplace safety, different attributions will result in different approaches to accident prevention. The locus of causality and stability dimensions are represented by two intersecting lines on the conceptual framework (see Figure 1 in "Results") and create four quadrants: external/stable, external/unstable, internal/stable and internal/unstable.

People are most likely to focus on making an attribution when the event has a negative outcome, or personal consequence [Shaver 1985, Weiner 1986]. A work related accident represents an event with a negative impact. DeJoy [1985, 1994] suggests that these attributed causes play a role in all practices incorporated into a company's overall safety plan, and that the attributions personnel make regarding safety and accidents drive the decision making process more than the causes themselves.

A person's (in this study, the fisherman's) ideas of causality are significant determinants of their future behavior. The person must first assign a cause or causes to an outcome. They can then consider a prescription for future action.

Weiner [1985] suggests, "one might argue that adaptation is not possible without causal analysis."

The analysis of the fishermen's words was modeled on the works of Weiner [1985, Weiner et al 1972], and the attributed causes were assigned to the quadrant category that most closely matched those that he had worked with. For example, he assigned luck (as an attributed cause) to the external/unstable quadrant, and ability to the internal/stable quadrant.

Three strategies were employed to examine the trustworthiness of the researcher's judgments regarding the transcripts and final interpretation of the data [Lincoln & Guba 1985, Marshall and Rossman 1989]. The strategies included using a research partner (consistency,) conducting a participant review (credibility,) and comparing with another study (triangulation). All three strategies indicated agreement with the researcher's interpretation of the data.

RESULTS

The participants of this study attributed the causes of their accidents to all quadrants of the orienting framework, indicating a broad distribution of causes. (See Figure 1.) They attributed multiple causes to a given accident and their explanations were complex. The fishermen's perspective and their words were critically important in this study. Key phrases that reflect some of the specified attributed causes are presented below (as indicated by the bold type in Figure 1.)

INTERNAL/STABLE

Knowledge: Some fishermen attributed a cause to be the lack of Knowledge in relation to a specific piece of information that was missing, or that was not applied properly to the circumstances and had a significant effect on the outcome. Six of the 12 participants cited some lack of knowledge as one of the causes that contributed to the accident. Two described situations that related to a combination of the weather and a new fishing ground, two described issues that related to the use of equipment, and two cited events that related to an inexperienced crewmember standing in the wrong location.

Participant 11: "That was the first time that I have ever anchored in there…but you think that you know everything…" (sinking of boat).

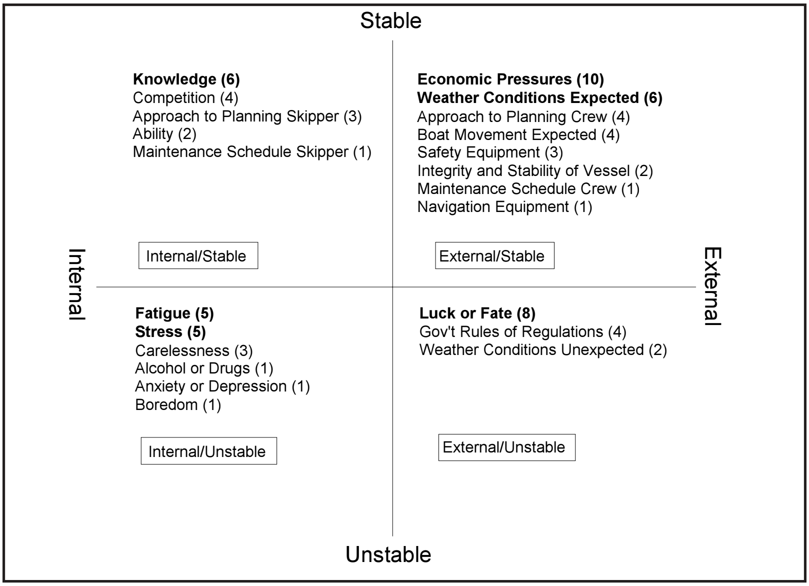

Figure 1. "Categories of causes" nested within the two dimensions that frame the fishermen's attributed causes of accidents.

(*The numbers in parentheses, represent the number of participants who attributed each cause as a factor in their accident. The causes in bold/italics are reviewed in detail.)

Participant 5: "I didn't realize that it (the pump) was actually pumping in…"(flooding.)

Participant 2: "I didn't realize that there was this pause with it (the sounder)…I was fooling with it when I shouldn't have been, I had enough knowledge to do it without it…" (grounding.)

Participant 7: "…it wasn't a safe place to be…we warned him not to stand there." (Crushing injury to leg.)

EXTERNAL/STABLE

Economic Pressures: The most frequently attributed cause of accidents related to economic pressures. Ten out of 12 of the participants included economic pressures as one cause of their accident. The fishermen brought up concerns about money issues and worries of catching enough fish to buy or pay for new equipment, ongoing bills, or to keep the crew and/or the company satisfied.

They cited these pressures as part of the decision making process that led to the outcome.

Participant 3: "I needed to have…that extra money from catching that extra fish…I had a new net…to pay for…" (man overboard.)

Participant 6: "…to pay the bills…the first two drifts…are the best for the whole day…"(crushing injury to hand.)

Participant 9: "we wanted to keep fishing…he (the skipper) had a big investment into the boat and the (new) equipment …"(near loss of boat.)

Participant 11: "…they (the crew) are out here to make money and every fish that comes aboard means money to them."(Sinking of boat.)

Participant 12: "…put ourselves under pressure…otherwise no one is going to make…any money."(Downflooding of boat.)

Weather Conditions Expected: There was a difference between fishermen's attributed cause where they had been caught "off guard" because of the weather versus a cause where they had knowingly "challenged" the weather. For weather conditions expected, some fishermen had been fully aware of adverse weather conditions and had simply accepted them as normal. Six of the 12 participants attributed one of the causes of their accident to weather conditions expected. In comparison, only two participants attributed one of the causes of their accident to weather conditions *un*expected.

Participant 11: "Well, right off the start, we knew that there was bad weather…and thought there wouldn't be much of a problem." (Sinking of boat.)

Participant 9: "…it said there was gonna be storms…there were about 42 or so other boats around us…After a couple of days the fleet was down to 12 boats. They were heading for cover cause they heard about a big storm coming." (Near loss of boat.)

Participant 10: "…it was first of all the weather out there was really bad…because of the wind, the amount of action…" (foot entangled in line.)

The fishermen tended to view bad weather as an accepted aspect of the job and treated what most people would view as an extraordinary situation as ordinary.

INTERNAL/UNSTABLE

Fatigue: The participants attributed fatigue as part of the cause of their accident in five out of 12 of the interviews. Three out of five of the fatigue descriptions occurred when the skipper simply had to get some sleep. This resulted in a less experienced crewmember taking the wheel or the skipper falling asleep at the wheel. The other two were situations when the crewmember was tired out from days of fishing. Fishermen described fatigue as being an expected part of the job but they also realized that it added another challenge to their ability to perform their job safely.

Participant 4: "…I got him up first to watch…So I just get my head down and almost fell asleep and we got 60,000 pounds of fish on board, and I feel, bang, right under the keel…" (Grounding.)

Participant 8: "…everybody tired of course…so I was on the wheel…I fall asleep…"(Striking a rock.)

Participant 10: "…and you get really tired…It is very tiring…I had just woken up, I wasn't fully awake yet…wasn't really watching…" (Leg entangled in line.)

Stress: All five participants who included stress as one cause of their accident were skippers. Stress was attached to the responsibility of being the skipper and all that entails, from making a good catch, getting a good price for the fish and everyone making money, to coping with competition of other boats, and keeping crew or company happy.

Participant 1: "…the stress factor…the captain's got all the pressure…feels like you are going to war…pressure from the boss…"(Partial finger amputation.)

Participant 3: "…a very stressful day…hurried…in the heat of the situation…the stress of trying to catch as many fish…" (Man overboard.)

Participant 4: "…I had stress from the economics of the times…stressful due to the government and we knew it wasn't good to be there…" (Grounding.)

The issue of ultimate responsibility weighed heavily on the skippers with concern for the company and/or crew.

EXTERNAL/UNSTABLE

Luck or Fate: Next to economic pressures, the second most cited cause related to the fishermen's mention of luck or fate. This cause was noted by eight of the 12 participants. Most fishermen used the word luck and often attached it to a phrase like, "It could happen to anybody," or "It was just one of those accidents...." Some fishermen seemed to take a broad approach to how luck affected them or how it was part of the cause of the accident.

Participant 2: "Well, I always said if I didn't have bad luck I wouldn't have any. If it has got to go wrong, I'll be at the top of the list..." (Grounding.)

More frequently, they saw that luck or fate played a role in their survival despite the danger.

Participant 9: "We made it back. Guess when your number's up, your number's up, and ours wasn't up yet ... somehow I guess it wasn't our time yet...." (Near loss of boat.)

Participant 3: "Luckily the net on the drum had caught itself and it wasn't paying out anymore so I had something tight to pull myself back onto the boat....lucky, (because) if the drum hadn't stopped…" (Man overboard.)

Many fishermen seemed to use luck or fate as a "catch-all" cause that was mainly expressed as an afterthought on how or why they survived the situation or were spared from more severe consequences. When luck or fate was mentioned, it was *not* focused upon as a primary issue.

The foregoing has given examples of the six most frequently cited attributed causes of accident in the fishermen's own words.

DISCUSSION AND RECOMMENDATIONS

Through fishermen's own accounts, and the analysis of those stories, this study found that fishermen attribute their accident to a broad spectrum of causes, a significant portion of which reside outside techno-rational concerns that focus on maintenance of machinery, and safety equipment in general. This suggests that more complex issues are involved. The logical question to ask is what can this research offer to the field of prevention education for fishermen if attributed causes for accidents reside both in the techno-rational (external/stable) and significantly in the other three quadrants of attributions (external/unstable, internal/stable, and internal/unstable).

Causes that fishermen attribute to their accidents offer insights into their safety considerations. This study identified 22 categories of causes as cited by participants. Nine of the 12 participants attributed causes of accidents that were located in all four quadrants of the conceptual framework. This is of interest because current training regimens tend to address concerns that reside in the external/stable (or techno-rational) quadrant.

This study is not concerned with whether fishermen's attributed causes of accidents are correct or incorrect. Rather, it suggests that the wide spectrum of attributed causes need to be acknowledged when considering the content of prevention education programs for fishermen.

Recommendations include making the collective attributed causes of accidents visible to fishermen as part of prevention education. One way to do this would be to focus the attributed causes of fishing accident through the lens of risk taking.

The American Society of Safety Engineers defines risk assessment as "the amount or degree of potential danger *perceived* (italics added) by a given individual when determining a course of action to accomplish a given task" [Abercomie, 1988.] It is the fishermen's perceptions of risks and attributed causes that are likely to direct their actions toward safety. These *perceived* causes provide insight into the initial steps of the risk assessment process and offer possibilities for prevention education.

From a practical adult education point of view to discuss attribution theory and safety with fishermen is unrealistic. It is more realistic to speak to fishermen about their perceived risks, and how the findings of this study might augment their understanding and assist them in reassessing their awareness of risk. In short, fishermen might ask themselves, "yes, these are what I identify as leading to my accident – in retrospect, was that taking an informed risk?"

Participatory group discussions and activities would allow the fishermen to discuss their own accident and near misses. They could be given a list of the 22 categories of causes identified from this study and asked to rank the causes according to their perception of the risks associated with each.

The comparison of risks in the suggested activity may help convey the nature and size of a specific risk estimate for fishermen. Such comparisons would be a starting point for them to systematically address risks attached to different decision options. In the future, they may reconsider options available to them during their decision making process and more readily ask themselves the questions, "Am I taking an informed risk? What can I do to control or eliminate that risk?" Without the discussion and exercise these risk comparisons may not be apparent.

Fishermen's attributed causes of accident represent a link to their perceived safety concerns. Instead of trying to down play or ignore the fact that fishermen take risks, the proposed approach suggests acknowledging the attributed causes of accident. Using that information, fishermen can then gain insight into their own risk taking and decisions to minimize those risks.

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REFERENCES

Abercombie SA, ed. [1988]. The dictionary of terms used in the safety profession. 3rd ed. Des Plaines, IL: American Society of Safety Engineers, p. 49.

DeJoy DM [1985]. Attributional processes and hazard control management in industry. Jof Safty Rsch, *16:* 61-71.

DeJoy DM [1994]. Managing safety in the workplace: an attribution theory analysis and model. J of Safty Rsch*, 24*(1), 3-17.

Heider F [1958]. The psychology of interpersonal relationships. New York: Wiley.

Jensen OC [1996]. Work related injuries in Danish fishermen. Occ Medi, *46*(6), 414-420.

Kelley HH [1967]. Attribution (theory) in social psychology. In Nebraska Symposium on Motivation*: 15*:192-238. Lincoln: University of Nebraska Press.

Lincoln Y, Guba E [1985]. Naturalistic inquiry. Beverly Hills, CA: Sage Publications.

Marshall C, Rossman GB [1989]. Designing qualitative research. Newbury Park, CA: Sage Publications.

Marshall K (1996, Summer). Job-related mortality: Perspectives on labour and income. Ottawa: Statistics Canada (Perspectives Catalogue No. 75-001-XPE).

National Research Council of the United States [1991]. Fishing vessel safety: Blueprint for a national program. Washington, DC: National Academy Press, pp. 13-14.

Pollnac RB, Poggie JJ, VanDusen C [1995]. Cultural adaptation to danger and the safety of commercial oceanic fishermen. Human Organization, *52*(2), 153-159.

Shaver, KG [1985]. The attribution of blame: Causality, responsibility, and blameworthiness. New York: Springer-Verlag.

Thompson RC, Hilton TF, Witt LA [1998]. Where the safety rubber meets the shop floor: A confirmatory model of management influence on workplace safety. J of Safty Rsch *29*(1):15-24 p. 21.

Weiner B [1985]. An attributional theory of achievement motivation. Psych Rvw, *92*(4):548-573.

Weiner B [1986]. An attributional theory of motivation and emotion. New York: Springer-Verlag.

Weiner B, Frieze IH, Kulka A, Reed L, Rest S, Rosenbaum RM [1971]. Perceiving the causes of success and failure. Morristown, NJ: General Learning Press.

RISK PERCEPTION AMONG FISHERMEN AND CONTROL OF RISKS THROUGH PARTICIPATORY ANALYSIS OF ACCIDENTS AND INCIDENTS

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INTRODUCTION

Although occupational injuries and fatalities are common in commercial fishing, safety work is often not given priority by the fishermen. The opinion among the fishermen that safety measures induce additional cost, which may not be carried by these small enterprises, was approached in another study [Törner et al 2000]. However, behavioral and psychological factors should also be considered in the context of safety work. As stated by Runyan [1993], safety work should focus on both structural and psychological change. In studies of commercial fishing, attitudes of fatalism and risk acceptance, risk perceptions, social norms, and cultural patterns have been claimed to counteract active safety work and rather be directed towards handling the job, in spite of the risks [Pollnac and Poggie, 1989; Murray and Dolomount, 1994]. Stimulating safe behavior through attempts to increase risk awareness is a common strategy. This may not, however, lead to altered behavior as long as present behavior is more or less imperative, as may well be the case in commercial fishing, or if the subjective value of the risky behavior outweighs the risks. The purpose of the present study was to investigate fishermen's attitudes towards risks in their occupation and attempt to influence these attitudes towards an enhanced sense of controllability of risks and towards an increased activity in safety work.

METHODS

A questionnaire investigation was performed of fishermen's attitudes (n = 92) toward risks in their occupation. The investigation focused on associations between psychological factors such as accident experience, perceived personal risk, perceived manageability of risks, locus of control, risk acceptance and technical knowledge, and on activity in safety work. The questionnaire study was based on certain concepts from stress research. Problem focused coping refers to the degree to which the individual copes with stressful (here hazardous) situations through attempts to control risk factors and increase his competence to exercise such control. The degree of active, problem focused coping is, according to theory, influenced by perceived personal risk, perceived manageability of the threat and individual coping resources, such as individual beliefs about locus of control over one's fate [Rotter 1966] and skills that can be used in coping.

Subsequent to the questionnaire study two discussion groups were formed, each consisting of two to three fishing crews. The groups met six times over eight months. The meetings were led by a psychologist and an ergonomist who were well-acquainted with fishing. The role of these group leaders was mainly to keep the discussion on the track and to pose questions. An Occupational Health and Safety (OHS) engineer also participated in each group to offer technical support and also to learn how to conduct this type of meeting. Between meetings the crews were requested to log incidents and accidents in connection to the fishing activity. At the meetings each incident and accident that had taken place on the vessels since the preceding meeting was related by the crews and analyzed in a structured manner. The analysis was directed towards tracing the course of events, identifying the basic cause of the incident/accident as well as the releasing factors. During and after the analysis the group discussed possible preventive measures.

Results of the intervention (i.e., the discussion groups) were evaluated through a follow-up questionnaire study (six persons where each individual was his own control) and an interview with the fishermen participating in the discussion groups comprised of ten persons. (One could not be reached). The interview contained 20 questions about the amount of activity crew members spent in safety-related activity, and their attitudes about this work. We asked these questions both before and after participation in the discussion groups. We also asked them about the methodology of the study, and their attitudes toward continued participation in discussion groups of a similar character. In order to minimize the effect of bias, a person unknown to the fishermen performed the interviews.

RESULTS

The initial questionnaire study showed that the fishermen considered the risks in connection to ten typical working situations in commercial fishing as moderate but satisfaction with safety was relatively low. The risks were perceived as manageable to a relatively high degree. Fatalism was not a predominant trait, i.e. the fishermen to a high extent perceived an internal locus of control. Also, fearlessness or risk acceptance was moderate. Activity in safety work was expressed as relatively high. Fishermen who expressed confidence in risk control through technical measures and working methods reported higher activity in safety work. Activity in safety work was also positively correlated to perceived sufficiency of technical knowledge to handle equipment on board whereas a negative correlation was found between activity in safety work and fatalism. No association was found between activity in safety work and age, experience as fishermen or accident experience (victim or witness), respectively.

During the eight months of the intervention 43 incidents and accidents were reported. The analysis showed that in 34 of these cases the basic cause was of a technical nature, 5 were caused by deficient work organization and 4 cases were caused by faulty actions by an individual at the instant of the event. The most common factors were weather conditions (16 cases), deficient routines (10 cases) and equipment in bad shape (8 cases). In the interview follow-up of the discussion groups the fishermen stated an increased activity in safety work. The participants also stated a higher interest in safety issues and an interest in continuing the discussion groups.

The questionnaire follow-up indicated that the perceived level of risk was lower after the intervention concerning working situations that had not been much discussed during the meetings, whereas risks in connection to those situations that had been discussed were perceived as higher after participating in the discussion groups. There was a lower perceived manageability of risks after the intervention but also a tendency towards a decrease in fatalism and fearlessness. Increased activity in safety work was also found in this follow-up.

DISCUSSION

The questionnaire study indicated that effective intervention strategies for increasing activity in safety work should be based on raising risk awareness in parallel with raising the sense of risk manageability through technical measures and improved working methods. This is in concordance with the theories of problem focused coping being influenced by perceived personal risk, perceived risk manageability and perceived locus of control.

Since activity in safety work showed no correlation with accident experience, intervention strategies may also be made more effective if learning from experience be developed (i.e., by identifying courses of events and how these may be influenced through preventive measures at different stages.)

As many as 34 of 43 accidents and incidents were caused by technical shortcomings. This is, in a way, encouraging since it shows the large potential for effective and reliable prevention through technical measures.

Certain types of events occurred repeatedly. One example of this was slipping. These incidents were, however, often not noted in the incident/accident logbook, but only reported on direct questions. Injuries involving falls to the same level were found in another study [Törner and Nordling, 2000] to be the most common cause of serious accidents in Swedish fishing, and slips were the mechanism behind 15 percent of serious accidents in fishing reported to the Swedish Labor Market No-fault Liability Insurance in a 12-year period. This indicates that the most prevalent hazards are ignored just because they are so prevalent.

The finding that there was a decrease in perceived manageability of risks after the discussion groups was obviously surprising and discouraging. It is possible that the eight months during which the groups met was too short a time to obtain the goal of increased perceived manageability. At the same time it should be noted that there was a tendency towards increased risk awareness for those working situations that had been discussed to a major extent during the meetings, that the activity in safety work had increased while fatalism and fearlessness had decreased. It should also be noted that the statistical power of this follow-up questionnaire study was low, since it encompassed only six persons.

All the interviewed fishermen expressed an interest in continuing the group meetings, under the leadership of the OHS Services. In this case they felt that participation of more crews would be beneficial and some felt that the meeting frequency could be somewhat reduced.

ACKNOWLEDGEMENTS

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REFERENCES

Lazarus R , Folkman S [1984]. Stress, appraisal and coping. New York: Springer.

Murray M, Dolomount M [1995]. Accidents in the inshore. Safety attitudes and practices among Newfoundland inshore fishermen, Stage 2. Report to the Occupational Health and Safety Branch, Government of Newfoundland and Labrador, Canada: Department of Employment and Labor Relations.

Pollnac RB, Poggie JJ [1989]. Social and cultural factors influencing fishermen's awareness of safety problems. In: Proceeding of the International Symposium on Safety and Working Conditions on Board fishing vessels. Canada: Rimouski, Québec.

Rotter JB [1966]. Generalized expectancies for internal versus external control of reinforcement. Psych mngphs*, 80*:1-28.

Runyan CW [1993]. Progress and potential in injury control. Am Jnl Pub Hlth*, 83*:637-639.

Törner M, Cagner M, Nilsson B, Nordling, P-O.[2000]. Occupational injury in Swedish fishing. Part 2: Promoting implementation of safety measures. Occ Erg, *2:* (2): 81-89.

Törner M, Nordling,P-O [2000]. Occupational injury in Swedish fishing. Part 1: Analysis of injury statistics. Occ Erg *2*: (2): 91-104.

THE USE OF NARRATIVE THEORY IN UNDERSTANDING AND PREVENTING ACCIDENTS IN THE FISHING INDUSTRY

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INTRODUCTION

Research into the causes of accidents in the fisheries is limited (Murray et al 1993) and has tended to be descriptive with limited reference to broad theoretical frameworks. Over the past decade there has been a sustained debate about broad epistemological and methodological issues within the social sciences. Among others, there has been increasing interest in narrative theory. This approach basically argues that human beings are natural storytellers and that the exchange of stories permeates our everyday social interaction [Murray 1997, 1999, 2000]. Narrative psychology seeks to explore the different stories that people tell, not only for the insight they provide into the actual character of the experience described, but also for the insight they offer into the identity of the storyteller and of his or her culture. The aim of this study was to collect and interpret fishermen's stories about accidents. It is argued that detailed analysis of these stories not only provides insight into the causes of accidents but can also suggest strategies for prevention.

METHOD

The study focuses on Newfoundland inshore fishermen. Newfoundland is a large island off the east coast of Canada, which was largely settled by Irish and English people in the seventeenth and eighteenth century. Interviews were held with more than 40 fishermen from different parts of the island. The fishermen were selected at random and included men of different ages and with varying amounts of experience at sea. The interviews were semi-structured and sought to obtain from the participants extended narrative on a series of items including:

The experience of being a fisherman;

Their perceptions of accidents, causes and possible means of prevention of injuries, fatalities and/or other adverse events; and

Their perceptions of various safety measures.

All these interviews were held either in the union office or the home of the individual concerned. Interviews ranged in length from 40 to 90 minutes. All the interviews were tape-recorded and subsequently transcribed. It should be noted that none of the fishermen expressed any concern about being tape-recorded and most seemed keen to provide extensive details about their experience of fishing and of accidents they had experienced or observed. The interviews were subsequently transcribed and read for consistent themes.

FINDINGS

JOYS OF FISHING

Fishing was something that the men enjoyed although they found it difficult to express in words the reason for this. They described a sense of freedom, the feeling of achievement in getting a good catch, the whole lifestyle of being a fisherman, all of which they found attractive. For example:

"I loves it...the excitement I finds, when you are hauling the trap you can see the fish going, right...same as when you're taking gear back, you see the fish coming on the gear. Going and just getting the fish. It's something...whatever job you likes, a carpenter likes seeing a house go up, well, I likes to see fish coming in, same thing I suppose."

The character of the typical working day varied substantially depending upon such factors as the weather and the fishing season. When conditions are good the fishermen will put to sea before dawn and not return until after midday. As one said:

"You goes three to four o'clock in the morning, and you don't be in till one or two in the day. When you gets in then you gets rid of your fish...you're baiting up till seven in the evening, and by the time you gets home then, right".

CHANGES IN FISHING

In an attempt to contain the rapid decline in fish stocks the government has recently introduced substantial restrictions on the amount and type of fish that can be caught. This has had a direct impact on the livelihoods of the fishermen. It also has had a more indirect impact as the fishermen attempted to evade the regulations they also increased the dangers of fishing. One fisherman described this process:

"Well, like I said earlier, they're going to risk stuff, like the crab fishery last year, you know, if that had to be at a time when there's a breeze of wind, there's fellows going to go, I mean, and that's going to force me or you to go, or I might be the first one to go, then you'll go, I mean, that's ensured, that quota system is not a good system, and anything to do with quota is going to have more risks involved in it. You can give me a quota today and I'm still going to get it as quick as I can because I wants to get at another fishery. I mean, a quota is not the answer to safety in a fishery. And it's not going to nothing for it; whatever kind of quota it is, not in my view. When we were fishing in our communities, there's always fellows who took risks, they're not going to change it...they can bring what rules and regulations they like, people are going to...that's version of it, as long as that fish is there to catch. But, I mean, you weren't pressured, you knew that you were going to go back again tomorrow or the next day, if the weather turned bad, and get fish again. But, I mean now, if you don't, if you goes out the next day to catch it, there's some fellow to arrest you, see, that's the difference, and there's more pressure on people today, a lot more pressure on people today in the fishery than there were years ago. A lot more pressure...fellows are stressed to death sure."

DANGERS OF FISHING

Most of the fishermen agreed that fishing was a dangerous occupation but in addition, there were certain avoidable risks. As one fisherman put it:

"Dangerous yes, but again, there's a difference. There's two kinds of dangers. There's dangers that's carelessness, and there's dangers that you just can't avoid. Sometimes you got to be in danger, in the fishery. (There's) a real lot of danger that you just can't avoid."

Taking risks was part of being a fisherman, and risks could not be avoided. Admittedly some fishermen took more risks and others fewer but overall to ensure a good catch most fishermen agreed it was necessary to take risks, e.g.:

"That's the nature of it, I mean, there's some people, it's like anything, there's some people more knowledgeable about a thing, whether they gains it through experience or goes to school, in the fishery people are going to take risks, while the fishery is there, bigger risks than the other people, some people are more successful at it than others, and some people are not taking as big of a risk as long as they makes a go of it, you know, that's the nature of people, the way I sees it."

One particular account is very dramatic in portraying the almost existential plight of the fisherman battling with the elements:

"I'll give you one instance...I went off on the Burgeo Bank there the summer before last. It was a beautiful morning, there wasn't a hair of wind. I left here twelve o'clock in the night...I got off and I sat my gear, and I laid down and had a nap. And when I got up there was about thirty foot seas and about forty mile winds. And I was out there in a twenty eight foot boat...She rolled down a couple of times and took water over her side and I never seen it done before, or since. It was pretty frightening. Like I say, it was the way the wind was, it was running the same way my gear was going, so I hauled my gear and left to come back in. It was pretty frightening, coming in there was times that I said my prayers, I tell you."

This story has many classic features. It is dramatic, it pitches the central character in a battle against the elements. It has a moral message: do not trust the signs of calmness because danger can easily be concealed. Finally, it restates the message that danger is part of fishing.

An added risk recently was the fact that because of the restrictions on fishing, many fishermen now go to sea alone. In this situation one slip could have serious implications, e.g.:

"You got to be careful with nets too. When you're setting nets by yourself, if you happen to get tangled in them you're gone. At least if you had a buddy, he could stop the door and go back for you, or something. If you get caught by yourself, you're not coming back...if you step in the wrong place, you're going on."

With the restrictions and the added competition from their fellow workers fishermen felt pressure to take risks they would not have taken previously such as going to sea in rougher weather, overloading their boats, or going close to the rocks, e.g.:

"You're right out there at the lumpfish you have a tendency to fish too close to the shore, or you are fishing around sunkers, and you know that when you are fishing closer to them that the fishing is better, and there is lots of times when you will end up tapping your boat on the rocks, but you always get a lot more lumpfish than the other fellows if you are fishing around those spots in particular. So if you want to take the chances, maybe if there is ten guys out there maybe one guy will take the chances and go that close and hang in close to the bank, and with the wind on the shore and the wind on the sunkers, if something happens, and the engine cuts off on you, then you are going to be ashore on the rocks, and then she's all over."

In this account the fisherman is giving a very complicated explanation of the sequence of events that precipitate an accident. He is not saying that the fisherman is to blame but rather certain circumstances are encouraging greater risk taking which in certain situations on certain days may increase the likelihood of an accident occurring.

Besides the government restrictions on fishing, another recent change that has indirectly had an impact on safety at sea has been the introduction of new technology. In this case this new equipment has led fishermen to ignore possible sources of danger. For example:

"I've been kind of careless my own self, especially out there by my own self, and I got an autopilot put on my boat, and usually I'm back there doing the fishing and the boat is just throttling off on her own. A couple of times I've almost run into people my own self. Just by not keeping a good watch out. Back in the stern quarter doing the fish and the boat was coming on...I've had a few close calls myself...If I had two fellows on board, coming in on land like that, one of us would be up there watching where you were going and the other fellows would be doing fish. So when you are by yourself, you can't be two places the one time, so...And you got to try to get the fish done before you gets in there. I've almost runned into a couple of docks my own self. Shook me up a bit...almost runned ashore one time."

Throughout this extensive account the fisherman is trying to balance the competing explanations. On the one hand he had not been keeping watch but on the other he had to get the fish cleaned. Blaxter [1993] in her analysis of working class women's accounts of illness noticed a similar tendency to try to accommodate or balance what might seem contradictory explanations.

DISCUSSION

The overall purpose of the study was to clarify the factors that contribute to the high rate of accidents among fishermen. The method employed was the collection and interpretation of detailed narrative accounts about their working life from a sample of fishermen. This paper has presented some extracts from these accounts to illustrate some central themes.

Most of the fishermen agreed that the fishing industry is inherently dangerous. This was due to a variety of factors including the unpredictable nature of the weather and the sea and the physical demands of fishing and of the equipment. Despite these dangers most of the fishermen enjoyed this work. Indeed the very excitement due to these dangers could be said to contribute to this high level of job satisfaction. Recently, however, the government-imposed restrictions had contributed to a high level of demoralization.

In view of the dangerous nature of the work the fishermen had to continually exercise caution and be aware of changing circumstances. It was obvious that while the work itself was inherently dangerous the actual level of risk for the individual fishermen could be ameliorated by care and caution. In explaining this process the fishermen gave considerable detail to balance individual responsibility against uncontrollable circumstances.

Admittedly, certain fishermen were more risk-taking than others. But these individuals were the exception rather than the rule. However, the recent government restrictions and controls over the fisheries were encouraging more fishermen to take risks as they attempted to maintain their livelihoods.

While the study has implications for the design of safety measures it is also of interest to those health psychologists interested in how individuals reconstruct events as narrative, how they link events together into a storyline. When the opportunity arose in the interviews the fishermen eagerly recounted tales. It is important to emphasize their tales are not objective summaries of past events but stories told to justify the teller's viewpoint and to evoke sympathy from the listener. Some of the fishermen were aware themselves of the influence of this perspective taking on story construction.

The accounts begin with a reaffirmation of the positive aspects of fishing as an occupation. In doing so the fisherman silently contrasts his lifestyle (that of a professional) with that of the urban dweller (only a worker). His life is one of challenge and independence rather than one of routine and dependence. In their tales of accidents the fishermen often gave complicated explanatory accounts. Thus the fishermen were able both to accept responsibility but simultaneously attribute it to working conditions.

In developing prevention strategies it is important to address these issues. One method is to develop a narrative-based safety intervention [Cole 1997]. This would involve the development of a variety of narrative exercises, e.g. drama, which would provide fishermen with the opportunity to discuss a range of scenarios and the opportunities to take preventive actions. This form of intervention is more action-oriented rather than didactic. Its aim would be to actively involve the fishermen in the development of safety measures rather than imposing a safety framework.

REFERENCES

Blaxter M [1993)]. Why do victims blame themselves? In Radley A (ed.) Worlds of Illness. London: Routledge.

Cole HP [1997]. Stories to live by: A narrative approach to health behaior research and injury prevention. In Gochman DS (ed.) Handbook of health behavior research, Volume 4. New York: Plenum.

Murray M [1997]. A narrative approach to health psychology: background and potential. Jnl Hlth Psych, *2*:9-20.

Murray M [1999]. The storied nature of illness. In Murray M & Chamberlain K(eds.) Qualitative health psychology: Theories and methods. London: Sage.

Murray M [2000]. Levels of analysis in narrative health psychology. Jnl Hlth Psych, *5*: 331-341.

Murray M, Fitzpatrick D, O'Connell, C [1993]. Fishermen's blues: Factors related to accidents and safety among Newfoundland fishermen. Wrk & Strs, *8*.

HEALTH AND LIFESTYLE SURVEY OF SCOTTISH FISHERMEN

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INTRODUCTION

Scottish fishermen have received very negative press coverage over the last decade or so. The media has suggested that the Scottish fishing industry is characterized by a chronic drug problem and that fishermen's health in general is poor. In recent years there have been a number of high profile fatalities at sea and it has been suggested that these incidents are the result of a culture of poor health and poor safety in the industry.

The industry itself has been concerned by the speculation about fishermen's health and safety practice. However, the industry was unable to deny or confirm any of these allegations, with any certainty, as very little research has been conducted into Scottish fishermen's health, lifestyle and affect on safety. In order to discover what the health and lifestyle problems facing fishermen are, the industry set up a committee known as FISH (Fishing Industry Safety and Health) with the aim of examining and addressing any health problems affecting fishermen.

A literature search showed that there had been very little previous research done on Scottish fishermen. What little research had been done showed that there might be cause for concern regarding alcohol consumption. A study conducted into the "*Incidence of treated alcoholism in North – East Scotland, Orkney and Shetland fishermen*" [Rix et al 1982] suggested there were high rates of alcoholism in Scottish fishermen.

A study was designed to gain data on a range of health and lifestyle issues. The study is ongoing, results are still being finalized. The findings presented in this paper are taken from our preliminary analysis.

METHODS

The Health and Lifestyle Survey was developed through extensive consultation with fishermen, industry representatives, an occupational and environmental health doctor, a health promotions specialist in health in the workplace and staff at Banff and Buchan College, Department of Nautical and Maritime studies. The survey was designed to cover a wide range of health issues such as diet, smoking, alcohol consumption, mental health, use of prescribed and illicit drugs, injuries at sea, and accidents at sea. It also covered age, type of boat, occupation, how many boats worked on during career, and which region of Scotland the respondent was from, to see if these factors influenced health.

The questionnaire was piloted in 18 fishermen attending Banff and Buchan College to undertake their class 1 and class 2 certificates (skipper and mates certificates). The questionnaire was handed out to the fishermen and completed under classroom conditions. Feedback was then obtained to check on the ease of completion, appropriateness of questions, understanding of questions, and time to complete the questionnaire.

Following this, some minor changes were made to the wording of a few questions, then another postal pilot was undertaken. This was to simulate the real conditions of using the questionnaire by post and testing the response rate. The pilot was quite successful and fishermen had no problems filling out the questionnaire. We achieved a response rate of 58 percent.

Identifying the sample for the main survey proved problematic. The only comprehensive list of fishermen that exists was in the form of a tax deduction book held by the tax office. It was estimated this book contained contact addresses for over four thousand fishermen. (The tax deduction scheme was set up by fishermen themselves to make it easier for them to pay their taxes). However, for confidentiality reasons it was not possible to obtain access to this list. Ideally, the research team wanted to be able to define and identify the whole population of fishermen so that a sample could be randomly identified to receive the questionnaire. However, there was no mechanism to do this. As a compromise the research team used fish selling offices as agents for obtaining the names and addresses of fishermen. Fish selling offices act as agents for skippers, selling their catch and calculating wages for the crew. In total we received 1400 names from the fish selling offices. We also obtained 750 names from the Scottish Fishermen's Federation Hand Book, which lists the names and addresses of skippers who are members. This gave us a total of 2011 names after duplicates had been removed.

A questionnaire, explanatory covering letter and reply paid envelope were posted to 2011 fishermen. Two reminders were sent and the data was entered onto a statistical database for analysis. The final response rate was 57 percent (n=1150). The following results are from our preliminary analysis, final results are still being compiled and will be available in 2001.

Table 1 shows the factors that Scottish fishermen perceived as being the main factors that affected their health. Lack of sleep, lack of exercise and financial stress were the three factors that fishermen saw as having the most impact on their health. The cold and damp working conditions and heavy smoking at

Table 1: Fishermen's perceptions of factors affecting their personal health

Variable	Affects health		Does not affect health		Not sure		Missing	
	No.	%	No.	%	No.	%	No.	%
Lack of sleep/fatigue	707	61.5	327	28.4	45	3.9	69	6.0
Lack of exercise	631	54.8	370	32.2	64	5.6	82	7.1
Financial stress	612	53.2	409	35.6	62	5.4	56	4.9
Cold/damp working and deck conditions	566	49.9	466	40.5	45	3.9	71	6.2
Heavy smoking at sea	531	46.2	423	36.8	58	5.0	135	11.7
Stress/worry about bad weather	509	44.2	525	45.7	44	3.8	71	6.2
Poor diet	504	43.8	486	42.3	50	4.3	110	9.6

sea as well as worry about bad weather and a poor diet were also areas that are clearly of concern to Scottish fishermen.

Bad weather, lack of sleep and the poor condition of boat were the three factors that were rated highest as factors affecting safety. The health condition of crew and of themselves and use of alcohol and drugs at sea were other areas that fishermen perceived as affecting their safety. (See Table 2.)

Back injuries were the most common type of injury sustained at sea. Leg or arm injuries, cuts requiring stitches, other hand injuries and head injuries were also fairly common. Only 25 percent of fishermen stated that they had

Table 2: Fishermen's perceptions of factors affecting their personal safety at sea

Variable	Affects safety		Does not affect safety		Does not apply to my boat		Missing	
	No.	%	No.	%	No.	%	No.	%
Bad Weather	1016	78.6	67	5.8	33	2.9	26	2.3
Lack of sleep/fatigue	701	61.1	180	15.7	192	16.8	55	4.8
Poor condition of boat	438	37.9	145	12.7	495	43.2	58	4.1
Health condition of crew	246	20.6	417	36.4	418	36.5	59	5.1
Your own personal health	201	17.5	494	43.0	387	33.7	61	5.2
Use of alcohol by crew	166	14.5	58	5.1	850	74.2	57	5.0
Use of illegal drugs by crew	147	12.9	33	2.9	895	78.1	56	4.9

never been injured at work. (See Table 3.) Eighty-two percent of fishermen who smoked indicted that they would like to give up smoking. Only eight percent indicated that they would not like to give up with a further ten percent being unsure. Thirty-eight percent of respondents smoked. (See Figures 1 and 2.)

Table 3: Incidence of injuries at sea

Variables	Frequency	Percent
Back injury	366	31.9
Leg or arm injury	249	21.7
Cuts requiring stitches	247	21.6
Other hand injury	223	19.5
Head injury	179	15.6
Sunburn	47	4.1
Chemical burns	32	2.8
Loss of finger	30	2.6
Rib injury	17	1.5
Cuts and bruises	11	1
Hernia	10	0.9
Burns	9	0.9
Eye	9	0.8
Never been injured at work	291	25.4
Other	67	5.8

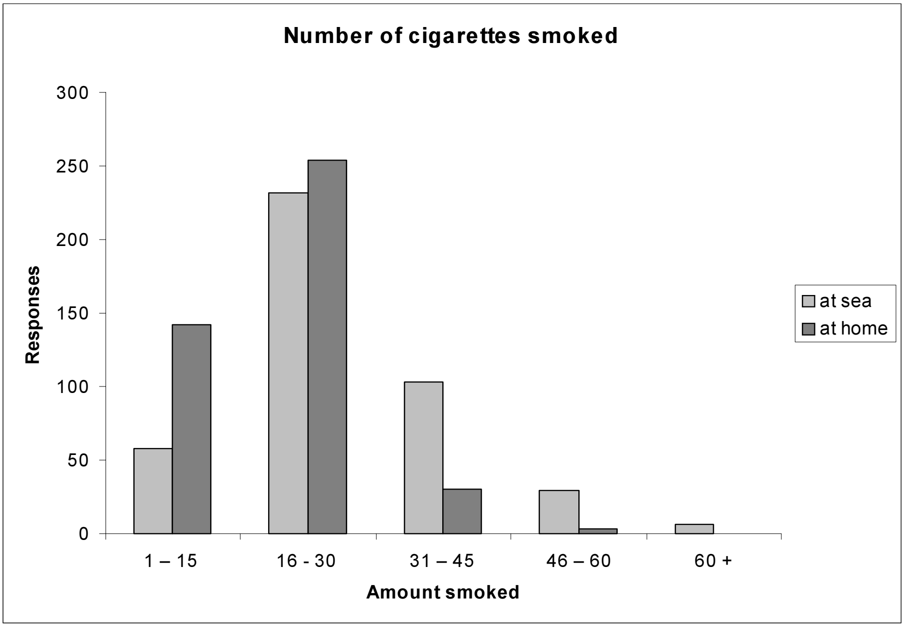

Figure 1: Number of cigarettes smoked at home and at sea

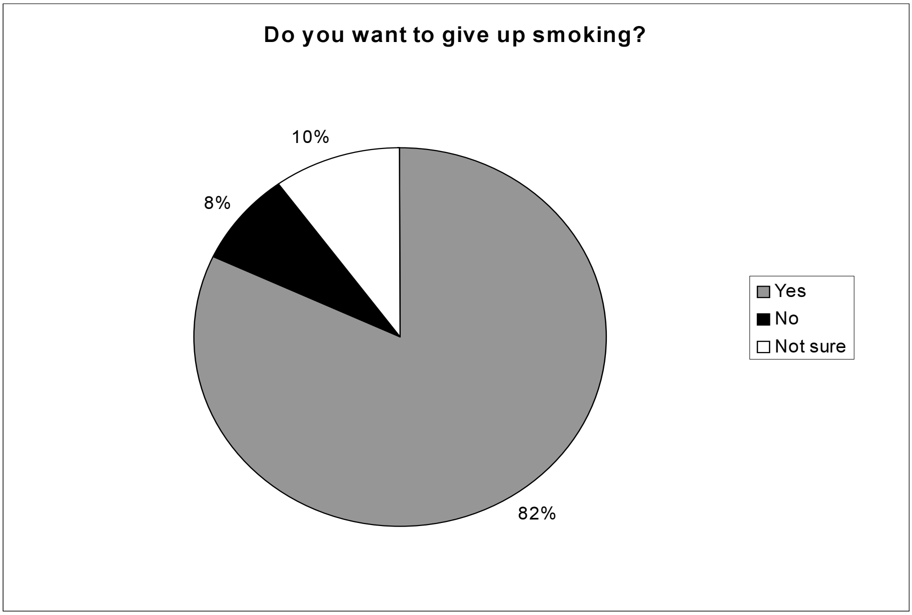

Figure 2: Fishermen's attitudes to giving up smoking

Thirty percent of fishermen ate fruit and vegetables at home more than once a day and 43 percent ate fruit and vegetables once a day. In total, 73 percent of fishermen ate fruit and vegetables at least once a day or more when at home. Only one percent said they never ate fruit and vegetables at home. Twenty-three percent of fishermen ate fruit and vegetables at sea more than once a day and 40 percent ate fruit and vegetables once a day. In total, 63 percent of fishermen ate fruit and vegetables at sea more than once a day. Six percent of fishermen ate no fruit and vegetables when at sea. (See Figure 3.)

DISCUSSION

Scottish fishermen perceived lack of sleep/fatigue as being the main factor affecting their health. Many commented that their irregular sleep patterns had a detrimental impact on their health.

Lack of exercise and financial stress were additional factors that rated highly. Respondents clearly find it difficult to take regular exercise at sea. The confined space of the boat and the long working hours make it difficult to find time and

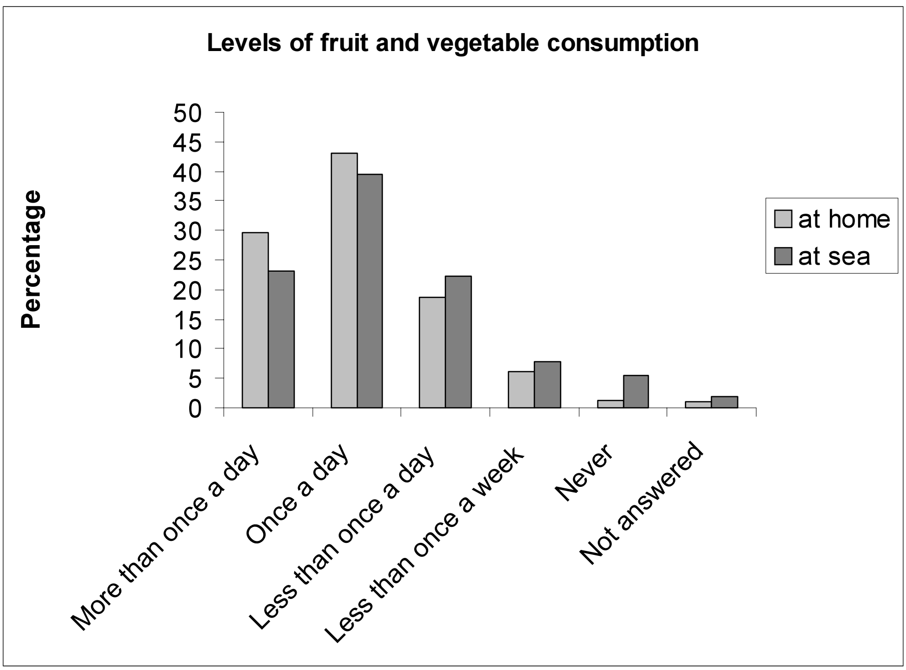

Figure 3: Amount of fruit and vegetables eaten by Scottish fishermen

space to exercise. Many legislative changes are viewed as making it harder for fishermen to make a living and are perceived by many as causing stress and anxiety about money. An additional effect of financial pressure is that many boats have to spend longer times at sea to ensure they catch their entire quota. Respondents saw longer trips to sea as being detrimental to health. Smoking, diet, stress, and worry about bad weather and cold damp working and deck conditions were other areas of concern to fishermen.

Bad weather was the factor that fishermen perceived as most affecting their safety at sea. As explained above, fishermen feel they are forced to work in worse weather conditions due to financial pressures. Lack of sleep again was a factor that rated highly. Thirty-nine percent of fishermen thought that the poor condition of their boat was a factor that affected their safety at sea. Personal health, the health of the other crew, and use of drugs and alcohol at sea were the other main areas of concern to fishermen.

Back injuries were by far the most common injury sustained by fishermen. This can probably be attributed to the amount of heavy lifting and bending that fishermen are exposed to in their daily work. Leg or arm injury, cuts requiring stitches, other hand injuries, and head injuries were all common injuries sustained by Scottish fishermen.

Thirty-eight percent of fishermen smoked and fishermen tend to smoke more at sea than they do at home. The smoking rate is considerably higher than the Grampian region average of 29 percent for male smokers. (Grampian region is the area of Scotland where the vast majority of fishermen are based.) It is encouraging however, to find that 83 percent of fishermen that smoked stated that they would like to quit. (See Figure 2.) The effects of passive smoking are an issue requiring consideration. This should be an area of major concern to the industry. There are no designated smoking areas on the majority of boats and some nonsmoking fishermen are likely to be exposed to high levels of passive smoking.

Questionnaire results suggest that fishermen are eating fruit more at fairly regular intervals. However, evidence from other areas of the study, especially the health diary program, suggest that fishermen are consuming vegetables regularly but are also eating lots of fried food and unhealthy snacks.

CONCLUSION/FUTURE DEVELOPMENTS

The results of the questionnaire show that there is room for improving Scottish fishermen's health. Although the final results are not yet available, the preliminary findings have been presented to the FISH committee. FISH has recognized that problems exist and is keen to devise strategies to try and improve fishermen's health. In 2001, FISH hopes to run a series of workshops and seminars aimed at improving fishermen's health. The results of the health and lifestyle survey will help form the basis of material for these workshops and seminars. It is also planned to hold a number of health promotion initiatives aimed at fishermen.

ACKNOWLEDGEMENTS

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REFERENCES

Rix KJB, Hunter D, Olley PC [1982]. Incidence of treated alcoholism in north - east Scotland, Orkney and Shetland fishermen, 1966-1970. Brit J Industr Med *39*: 11-17.

Tuesday, October 24, 2000

SUCCESSFUL INTERVENTION PROGRAMS

Photograph and caption by Earl Dotter

After a net is released, heavy steel doors weighing a ton each are deployed. They open the mouth of the net and keep it to the bottom as the boat trawls forward at about 3 knots. The crewmember says, "When it's flat...calm like this, we'll sure pay for it later."

THE ICELANDIC SHIP REPORTING SYSTEM *ICE-REP*

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Captain Snorrason was born in Reykjavik in 1957. He started as an AB seaman in the Icelandic merchant fleet in 1973 and finished the Navigation School in Reykjavik in 1978. CAPT Snorrason served as a deck officer on RO/RO, general cargo and pallet carriers and was promoted to Master in 1984 in Icelandic State Shipping. He joined the National Life-saving Association of Iceland (now Icelandic Association of Search and Rescue (ICE-SAR)) in 1991 as a principal and manager for the Maritime Safety and Survival Training Centre and a master of the training vessel Saebjorg. CAPT Snorrason has been in the Icelandic Maritime Accident Investigation Committee since 1996, member of the Safety Education Committee since 1992 and several committees regarding maritime safety related matters. He has been the Vice-Chairman of the International Association for Safety and Survival Training (IASST) since 1999.

In the early 1960s Icelandic fishermen started to talk about a system they could use for reporting their whereabouts, sailings, and fishing in the matter of search and rescue if something went suddenly wrong and they were not able to send out any distress calls. At that time the fishing fleet consisted mostly of small fishing boats fishing on local banks but also as far as on the Newfoundland banks and banks of Jan Mayen.

Accidents at sea is the biggest factor in any progress to gain more safety as regulations are not an act that government makes unless it is necessary. It was not until 1967 that some government action took place, through the promotion efforts of the National Life-saving Association of Iceland, (NLAI) which had documented the need for ship surveillance systems for many years. Their efforts to effect a national system was aided by public sentiment during a maritime disaster. The Icelandic fishing vessel *Stígandi* sank August 19, 1967, on the fishing banks of Jan Mayen. The crew managed to launch a lifeboat and a life raft, but were not able to send out a distress call. They spent five days in the life rafts and life boats. This is the longest known period that Icelandic seafarers have been in life rafts. The crew told the media after the rescue that during their time in the lifeboats they saw several ships passing by in the fog but no one noticed them as none were looking for persons in distress.

This incident opened the eyes of the public, the government, and the seafarers for the need to establish a safety surveillance system for the fishing fleet. The Parliament put forward legislation establishing the Icelandic Ship Reporting System (ICE-REP) in May 1968 and the NLAI was contracted by the Póstur & Simi (Icelandic telecommunication network) to run and operate the system. ICE-REP has been in the hands of the NLAI ,which now has changed its name to ICE-SAR.

Ever since the requirements for staffing this project called for watch officers with extensive navigation and fishing experience. Newly hired staff were well aware of the behavior of the fishing fleet, through their own experiences.

The idea of this system was to let all vessels report their departure and arrival to port and while at sea to report by grid system their position every morning and evening. This was a manual system but it could be up to 14 hours between reports from a ship. Nevertheless, every ship could send as many reports between the actual reporting period as they thought would be necessary for their safety. The morning reporting period was from 10:00 to 13:30 and the evening period between 20:00 to 22:00. As soon as each period was over a list of missing vessels in reporting their whereabouts was sent to all coastal stations, which called them up. Within a reasonable time if nothing was heard from the vessel a rescue team was alerted.

In 1985, the operation center became the first MRCC station in Iceland with the call sign MRCC-Coastal and 24-hour watch.

The idea of making automatic reporting system for ships was put forward in connection with a project for the Icelandic Air Traffic control system in 1978. That was done by the University of Iceland, which, in cooperation with the National Life-saving Association of Iceland, started trials in 1988. Later on, the University was drawn back from the development of the system and a firm, Stefja, took over their part. Ten ships were used during the trial period, and in 1999 the system was finally ready for operation and vessel transmitters were ready for manufacture. The formal opening of the Automatic ICE-REP was in May 2000.

The system consists of three major parts described below.

NETWORK

The network has sites all around the coast that receive information from ships. Information from vessels is sent by VHF or Inmarsat depending on the position of vessel to coastal stations. Network controllers receive information from coastal stations and forward them to the communication server and on further to the ICE-REP operation center. Information can also be sent to the Internet as can be seen on http://www.tracscape.com/demo/

VESSEL TRANSMITTERS

The transmitter sends constant information about the vessel's position, course and speed. The transmitter is fully automatic and has indication lights that assures the crew the message is being transmitted. An emergency button is also on the transmitter and has to be pressed for five seconds in order to activate. Messages show up on the screen at the ICE-REP station instantly in the event of such emergencies. Vessels using Inmarsat send information twice every 24 hours.

INFORMATION SYSTEM

The systems display messages from ships on screen at the ICE-REP station - MRCC-Coastal. For vessels covered by the automatic ICE-REP system, information is received every 30 seconds, and if no message is received for 15 minutes or more then an alert is given. The message handler is the most vital part of this system. He or she reports to the officer on watch if a vessel is missing or sending distress call. The message is categorized by the vessel position, which means that the vessel not responding to the system but known to be in port is a minor alert, while those believed to be at sea comprise red alerts. Every Icelandic vessel is listed in the ICE-SAR information system with information of owner, operator and master including phone numbers, which gives the officer on watch the instant ability to contact needed personnel regarding the missed reports from the vessel.

ICE-SAR is now fully automatic and all ships 24 m and shorter are required to be equipped with ICE-REP transmitters, excluding pleasure craft. All ships longer than 24 m use INMARSAT for ICE-REP every 12 hours. By the end of August 2000, 1400 vessels were equipped with transmitters for ICE-REP and by the end of 2000, a total of 2700 vessels are expected to have transmitters sending their whereabouts to the system.

Photograph and caption by Earl Dotter

The crew of a sea urchin dragger unload their totes of urchins at the breakwater in Eastport, Maine, U.S.A. at low tide. The tides average 18 feet from high to low, a rate of over one inch a minute.

WORK PRACTICES, ENTANGLEMENT OF LOBSTERMEN, AND ENTANGLEMENT PREVENTION DEVICES IN THE MAINE LOBSTER FISHERY: A PRELIMINARY SURVEY

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BACKGROUND

Commercial fishing has been recognized as a hazardous occupation for centuries. Sir Walter Scott wrote in *The Antiquary* (1816), "It's no fish ye're buying, it's men's lives."[1] The working conditions for commercial fishermen are very hazardous and factors associated with commercial fishing deaths are complex. Gear type, fatigue, and environmental conditions contribute to the severity and frequency of these incidents.

By the mid-1980s, hazards in the commercial fishing industry captured the attention of Congress, which enacted the Commercial Fishing Industry Vessel Safety Act of 1988. During 1990-1995, the CFIVSA required fishing vessels to begin carrying specific safety and survival equipment and required certain crewmembers to have training in first aid and how to conduct emergency drills on fishing boats. However, deck safety was not addressed by these regulations.

According to data from the 1997 Census of Fatal Occupational Injuries (CFOI) published by the Bureau of Labor Statistics, the fishing industry ranked second to the logging industry for the highest occupational fatality rate. That year, timber cutters sustained 128.7 fatalities per 100,000 full time workers; the fishing industry sustained 123.4 fatalities per 100,000 full time fishermen.[2] With the 1997 United States national average for all industries at 4.8 fatalities per 100,000 full time workers[3] the fishing industry is on the order of 25 times more hazardous than all occupations combined.

In Maine, from 1993-1997, the average number of lobster licenses of all classes issued annually by the Department of Marine Resources was 5681.[4] The occupational fatality rate for lobstermen was 14 per 100,000 licensed lobstermen,[5] more than 2.5 times the national average for all industries (4.8 per 100,000) (Note the comparison is between licensed lobstermen both full and part time and full time workers. The figures for lobstermen are not normalized to full time lobstermen. Therefore, the actual rates would likely be higher.) From 1993-1999, seven lobstermen drowned after falling overboard.[6] Conditions on the boats suggested that trap rope entanglement was a likely cause.[7] Anecdotal reports indicate that the prevalence of the entanglement of lobstermen in trap rope is high. When they become entangled in trap rope, they can be pulled into the water and often are not able to free themselves from the rope.

Lobsters are fished by placing a baited, rectangular mesh trap (size: 0.5 m by 0.5 m by 1.0 m, and weighing 2-4 kg) on the sea bottom (5-20 meters deep) connected to a surface buoy by a rope, "trap rope". One to ten traps may be connected to the same rope. Traps are periodically (every one to three days) pulled up into a boat using a winch (pot hauler), the trapped lobsters are removed, and the trap is cleaned of debris and re-baited.

There are four basic activities associated with lobstering:

- Buoy pick-up - the buoy is gaffed, and the trap rope is placed in the pot-hauler (winch);
- Freeing snarls - gear caught on another set of traps is untangled;
- Setting gear - lobster traps are baited and thrown overboard; and,
- Shifting gear - a large number of lobster traps are hauled-up and transported to another fishing ground.

This study was undertaken to gather data on the prevalence of personal entanglement in trap rope, to understand the work practices associated with entanglement, and to learn from fishermen what work practices and engineering controls would 1) reduce the risk of entanglement, 2) help lobstermen escape from an entanglement, and 3) facilitate re-boarding in the event that a lobsterman was pulled overboard from an entanglement.

METHODS

An interview guide for this cross-sectional study was developed and piloted with lobstermen. The guide consisted of eight sections: background information, description of lobstering practice, description of vessel, entanglement likelihood and circumstances, interventions, other devices, personal entanglement accident history, and communications.

Five people were trained to use the interview guide and 103 lobstermen were interviewed at the wharves, in coffee shops, lobster co-ops, storage cabins, and hardware stores. Often this meant arriving at a coffee shop at 5:15 AM to talk with lobstermen before they headed out at daybreak. At other times, the interviews were conducted when the lobstermen were unloading at the wharves at the end of a fishing day. The interviews took place from October 1999 through September 2000. The interviewers obtained consent before proceeding with the interview; some lobstermen declined the interview but none terminated the interview midstream in spite of having been given the option. In most cases, the lobstermen were interviewed privately. Interviewers did not collect any information that could be used to identify participants. The data were entered into spreadsheet software.

RESULTS

Of the 103 lobstermen interviewed only one was female; 93 were captains and 10 were sternmen. Fifty-two percent reported "always" fishing with a sternman, while 25% reported "sometimes" and 22% reported "never" fishing with a sternman.

Of the 103 lobstermen interviewed, 75 (73%) answered "yes" to the question, "Have you even been caught in trap rope where you lost clothing, were pulled to the stern, or pulled overboard." Forty-five (44%) of the 103 lobstermen reported a total of 90 entanglements within the last five years.

Eighty-one percent of the lobstermen interviewed said that entanglement was either "likely" or "very likely" to happen when setting gear. Sixty-eight percent said entanglement was either "likely" or "very likely" while shifting gear. Freeing snarls and picking-up the buoy were described as "not likely" to be settings for an entanglement by 67% and 94%, respectively. (See Figure 1.)

Table 1. Number of lobstermen entanglement events in the last five years.

Number of events	Number reporting	Total events
1	20	20
2	14	28
3	7	21
4 8	2	
5 5	1	
8 8	1	
TOTALS	45	90

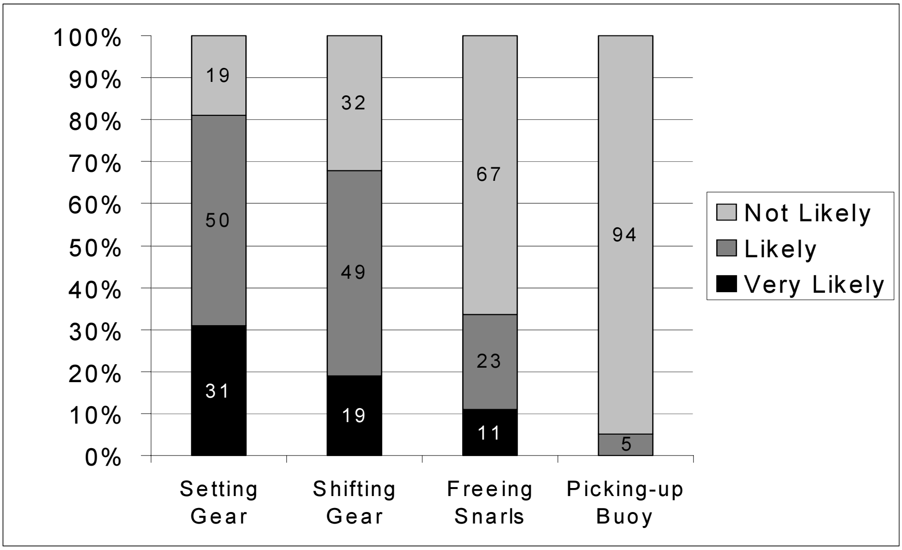

Figure 1: Likelihood of entanglement for each of the four lobstering activities.

Rope often accumulates at the feet of the lobsterman as he is setting traps. When he is ready to set the traps he pushes the first trap overboard and the remainder follow, with the rope paying out over the side or transom of the boat at considerable speed. The setting gear activity is generally more dangerous if the captain (as is the practice) has placed the boat in forward gear.

Interventions suggested by lobstermen that might reduce and presumably prevent entanglement included both work practices and engineering controls, the two categories of interventions typically found in industrial settings. Regarding their work practices, lobstermen mentioned "working slowly", paying close attention, knowing where the rope was at all times, using "common sense," keeping hands and feet away from rope as much as possible, and positioning people carefully during setting and shifting activities.

Table 2 shows the responses given when lobstermen were asked to determine whether eight engineering interventions we listed would be "not useful," "useful," or "very useful" in preventing entanglements or aiding in self-rescue from an entanglement.

Table 2. Percent of respondents specifying perceived usefulness of engineering controls to reduce entanglement risk

Intervention	Not Useful	Useful	Very Useful	Useful or Very Useful
Nonskid mats	5	53	42	95
Washrail above knee	5	38	57	95
High traction deck	15	58	27	85
Rope locker/bin	31	39	31	69
Bucket/pipe as fairlead	49	39	13	51
Temporary abrasive (salt)	61	33	6	39
Safety shut off cord for engine	65	26	9	35
Sensor mat for shutting off engine	70	27	3	30

As shown, lobstermen were clear and largely in agreement that non-skid mats, a washrail above the knee, a high-traction deck surface, and either a rope locker or a rope bin are engineering controls that would be useful in reducing the risk of entanglement.

When asked to make a choice among eight means of escaping from an entanglement, 95% of those interviewed said having a sternman would offer the best hope of escape. The second, third, and fourth choices were wearing a knife (25%), having a knife mounted in the stern (18%), and having a gag line (remote engine shut-off) (15%).

When asked to choose among four means of surviving an overboard incident and being able to re-board the boat, 98% ranked having a sternman as their top choice. Loose clothing (77%), a rope ladder or scuppers for footholds (76%), and a life jacket (60%) were ranked second, third, and fourth.

DISCUSSION

With 73% of the respondents reporting that they had experienced a serious entanglement in trap rope at some time in their fishing career, it is evident that this type of entanglement is common in the lobster fishery. When asked to explain the circumstances, lobstermen reported a variety of circumstances leading to entanglement. One lobsterman fishing alone had the trap rope wrapped around his left wrist and was pulled into the water. He was able to cut the rope, but had no flotation device and only because another lobsterman saw his aimlessly circling boat was he rescued from the water 45 minutes later. He fortunately survived without major injury. One lobsterman told of hailing a passing boat while lying prone on the deck of his boat. Others were fortunate enough to have had a sternman or a knife, or the strength to hold on to the wheel long enough to take the boat out of gear.

This study delineated four major components in the strategy to prevent entanglement and facilitate recovery from the event: 1.) control the environment including the ropes, 2.) stop the force including cutting the engine, 3.) rescue by untangling or cutting the rope, and 4.) re-enter the vessel if pulled overboard.

Rope control can be achieved through "engineering controls" such as installing an under-rail rope bin or an under-deck rope locker or by using a fairlead. Suggestions from lobstermen regarding work practices that can help reduce the risk of entanglement include "work slow," use "common sense," know where the rope is, keep hands and feet away from the rope, and choose positions on deck that reduce contact with rope. Another work practice promoted by some lobstermen was to set traps while drifting rather than while in forward gear.

More than two-thirds of the lobstermen indicated that a rope locker or rope bin would reduce the risk of entanglement. However, during this study, the interviewers only found two lobster boats with these devices. A rope locker (see Photo 1) is a water-tight compartment built under the flooring with openings under the pot-hauler and along the rail so that rope coming off the pot-hauler will drop into the compartment under where the lobsterman stands and will be completely out of his/her way. These lockers are particularly useful for lobstermen who fish ten trap trawls (ten traps on a length of rope between two lobster buoys) because these trawls involve the use of much more rope than fishing a single or double (pair of traps) per set.

Photo by Ann Backus

Photo One: Rope locker (deck platform open) shows rope collecting under the deck away from the fisherman's feet.

Nonskid mats reduce the chance of slipping into the rope pile and increase the chance of retaining or regaining balance when caught in the rope. The deck surface tends not only to become wet, but also slimy when seaweed and algae arrive on board with the rope and traps. For similar reasons, a high traction deck surface is useful. Some lobstermen improve the traction on their entire deck surface by having their decks painted with an abrasive-containing paint. Nonskid mats are often used along with high-traction deck paint.

The rope bin is a simple hinged door device that allows the rope to fall into a compartment under the washrail, but above the deck. The door, as simple as a plywood panel hinged along the deck-side edge, keeps the rope away from the feet of the lobsterman.

A fairlead in the form of a bucket or pipe, set on or mounted through the washrail, was deemed "useful" or "very useful" by 51% of those interviewed.

Illustration by Mediastream.

Figure 3. Rope bin made of plywood with a piano hinge that allows it to drop open and accept trap rope from the pot hauler.

This device controls the rope by guiding it back into the water before it has a chance to run to the stern, and thereby reduces the floor space occupied by rope to a small corner near the pot-hauler. The fairleads in use were in some cases buckets filled with water, and in others were an iron or PVC pipe, or a spaghetti-like bundle of fiberglass rods mounted through the washrail. This last invention had the benefit of being flexible in the event that a person was thrown against it during a sudden shifting of the boat or an entanglement accident.

The importance of the washrail height as a means to reduce entanglement and especially lessen the potential of being pulled over board is well-understood by lobstermen. Ninety-five percent said that a washrail (washboard) above the knee was "useful" or "very useful" in reducing the risk of entanglement. While hauling and setting, lobstermen tend to lean on the washrail. A rail that is high, i.e., above the knee and almost at mid-thigh, provides significantly more support against the loss of balance and provides a better barrier to being pulled overboard.

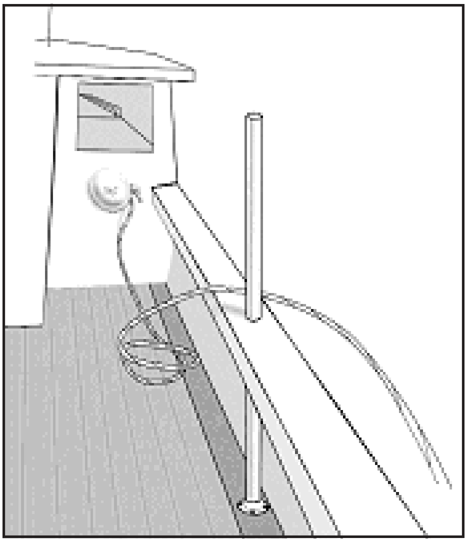

Illustration by Mediastream.

Figure 4. A fairlead made of a steel pipe or a collection of fiberglass rods mounted into the deck that "leads" rope out of the boat and minimizes the area where rope could be a hazard.

Once entangled, either a lobsterman loses a glove or boot, has to struggle to loosen the rope, or has to cut himself free. If there is a second person on board, the situation can usually be resolved quickly; if not, wearing a dive knife in an accessible location, preferably secured upside down on suspenders, is extremely important. A dive knife is made of 100% stainless steel and should have a hard molded sheath that clips the knife in for safety. Of the lobstermen interviewed, 25% answered that wearing a knife was their top choice for escaping from entanglement; 18% thought taping a knife at the stern would be their preference. In actuality, having knives both on person and taped to the transom would provide the best opportunities to escape.

Ability to cut free of the rope is dependent on the access to a very sharp knife, not one that has rusted in its holster on suspenders, or in its leather holder at the stern. Some lobstermen issue new knives after each heavy use; some have a small jack knife in their pants pocket which, even if reachable in an emergency, could not be opened with one hand if the other hand were caught in rope. The suggested placement of a knife is handle down on suspenders such that it is reachable by either hand in one stroke.

Rick Kelly

Photo 2. Wearing a dive knife in an accessible location, preferably secured upside down on suspenders, is extremely important.

Cutting the engine can be done by a competent sternman, but without the presence of a second competent person onboard, an engine gag line or kill switch is essential to get free from an entanglement.

Although only 35% of the lobstermen noted that a safety cord or gag line/kill switch that would provide remote engine shut off would be useful in reducing the risk of entanglement, a means of shutting off the engine is critical to surviving many entanglement accidents. Many lobstermen either don't think it would come to needing to shut down the engine remotely because the sternman would be available to manage the helm, or they think such a device would be a nuisance at non-critical times. For lobstermen fishing alone, it may be the only lifeline in a serious situation. A gag line run under the washrail and across the stern, reachable from two sides of the boat, would in fact be out of the way of normal operations but available to pull-on in the event the lobsterman were pulled to the deck or caught at the transom. Given that most lobstermen set their traps while in forward gear, a means to stop the engine is the only way to gain slack in the rope. The traps are fast sinking and their weight creates a force on the rope that is too great for the average lobsterman to overcome unless he can cut the rope. [8]

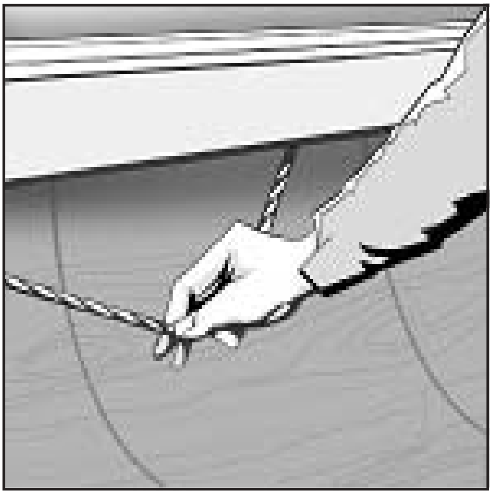

Illustration by Mediastream

Figure 5. Gag line or kill switch for remote engine shut-off.

Captains have the option of taking a sternman with them, and they do so for various reasons. Probably the most frequent reasons given are productivity and efficiency. Many captains would also cite the safety benefit of having an additional person on board. Choosing to fish with a sternman has significant positive safety implications. It reduces considerably the risk of a fatal injury because a second person is available to help. However, the risk is not negligible because some sternmen lack knowledge about the throttle and gears of a boat and could make a mistake that had a fatal outcome if he/she throttled up or didn't take the boat out of forward gear, for example. Although this survey did not contain questions regarding how well sternmen knew the boat and would be able to respond in an emergency, sternmen should be prepared to step to the helm.

In addition, the interviews associated with this study revealed that few lobstermen wear life jackets, inflatable vests, or suspenders. Thus, staying afloat in the water for a length of time is problematic. Observation of lobster boats shows clearly that few boats have fittings that would enable a lobsterman to re-board if thrown overboard. Some boats have steps, knotted ropes, or rope ladders and some have scuppers that are large enough for the toe of a boot, but generally the hand and foot holds on these boats are noticeably absent. It would be simple for lobstermen to make rope ladders to hang off the non-working side, to install a ladder or steps, or to install scuppers that are large enough to serve as footholds and mount handles for easy re-boarding.

CONCLUSIONS

Personal entanglement in trap rope is an experience most lobstermen have had. Setting gear and shifting gear are the lobstering activities that are most likely to result in entanglement. Only a few lobstermen, however, have a planned strategy for reducing the risk of entanglement. The four components any strategy needs are to be able to 1.) control the environment, including the ropes, 2.) stop the pulling force, including cutting the engine, 3.) rescue oneself by untangling or cutting the rope, and 4.) re-enter the vessel if pulled overboard. Careful, intentional work practices, combined with a variety of engineering controls including nonskid mats, high washrails, and rope lockers or bins may reduce the risk of being caught in rope. A remote engine shut-off, strategically placed knives, personal flotation devices, and a means of re-boarding the boat are all approaches that may improve the chances for surviving an entanglement. Additionally, having two people on the boat, each with a thorough knowledge of the operations of the boat, could also improve the ability to survive an entanglement.

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FOOTNOTES

1. Text citation: Schilling RS [1966]. Trawler fishing: an extreme occupation. Proc R Soc Med. *59(5)*:405-410, May, 1966.

2. CFOI [1999]. Census of fatal occupational injuries, 1992-1997.: U.S. Department of Labor, Bureau of labor Statistics. Database. Washington, DC. [stats.bls.gov/oshhome.htm] accessed October 10,1999.

3. NIOSH [2000]. Worker Health Chartbook. Cincinnati, Ohio: U.S. Department of Health and Human Services, Public Health Service, U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2000-127, p. 37.

4. Brochu P [2000]. Personal communication with Division of Maine Resources, State of Maine, Portland: Maine. May 25, 2000.

5. U.S. Coast Guard [1988]. Summary of fatal injuries experienced within the commercial fishing industry of Maine, 1993 through 1997." Portland, Maine:U.S. Coast Guard Marine Safety Office. Unpublished work, based on findings from the Marine Safety Information System (MSIS) Casualty Data Base, U. S. Coast Guard.

6. Office of U. S. Coast Guard, Maine [2000]. Marine Safety Information System (MSIS) Casualty Data Base. Portland, Maine: U.S. Coast Guard Marine Safety Office, Photocopies and notes.

7. Ciampa J [1999]. Personal communication via phone. Portland, Maine: U.S. Coast Guard. September 1999.

8. Olson S [1999]. Kill the engine, save your life. Nat Fisherman, *(99)*11:42.

DEVELOPING THE FOUNDATION FOR AN INTERDISCIPLINARY APPROACH TO IMPROVING FISHING VESSEL SAFETY

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PURPOSE

The purpose of this paper is to report on the initial results of an interdisciplinary program concerned with identifying fishing boat design parameters related to commercial fishing safety and health. The paper will address (1) improving vessel stability and hull integrity, (2) hazards associated with small fishing vessels and (3) relationship between fishery management and safety including better ways to communicate the importance of following stability guidelines. The goal is to improve survivability for fishermen, and profitability for vessel owners.

METHOD

We used an extensive literature search on fishing vessel regulations and documented capsizing events, interviewed owners and captains (including two co-authors), studied various fishing vessel classes and identified hazardous operational procedures.

RESULTS

The paper addresses ways to improve existing and new fishing boat designs with special emphasis on those vessel classes known to have safety problems. We discuss various areas of concern that have had an impact on vessel safety. These areas include: creating and maintaining a watertight envelope including the deckhouse and holds; suggestions on developing an integrated set of intact and damaged stability criteria for fishing vessels of all sizes; methods for more effectively communicating to the crews the safe loading conditions for their vessels; and an improved format for the stability letter. The paper also outlines various conflicts between fishery management practices and vessel safety.

FUTURE WORK

The long-range goal is to create a fishing vessel research program to develop a new set of scalable non-dimensional parameters for designing and building safer fishing vessels.

INTRODUCTION

The IMO voluntary fishing boat safety regulations for vessels under 79 feet (24 m) in length are based on one-size-fits-all criteria derived from computer generated static stability righting-arm curves. The current version is known as the 1993 Torremolinos Protocol and can be found on the IMO web site. [For technical and historical details on its development see USCG NVIC 5-86 (1986), Bird (1986), Cleary (1993), USCG 'Living to Fish, Dying to Fish' (1999), Dyer (2000) and Kobylinski (1994 and 2000)].

The Torremolinos Protocol has been criticized: (1) for lacking "rational criteria" [Kobylinski 1994 and 2000, Umeda 1994, Dahle 1995]; and (2) for promoting capsize resistance at the expense of operational safety conditions on board [Boccadamo 1994 , 2000, Umeda 1999, 2000]. Requiring a relatively large transverse metacentric height (GM_T) to handle various loading conditions frequently causes rapid rolling during fishing operations since the undamped roll period varies inversely with the square root of GM_T [Gillmer 1982]. This in turn increases the frequency of Motion Induced Interruptions (MII) [Boccadamo 2000] which can cause serious injuries to crew members working on deck. Fishermen attempt to compensate for snappy rolling motions by using roll dampening devices such as paravanes, rolling chocks, anti-roll flume tanks, and other similar devices that only change the stability problems a fisherman faces [Bass 1994, 1998, Helmore 2000].

LESSONS LEARNED: STABILITY LETTERS

Implementation of the Torremolinos Protocol generally involves producing a "stability letter" for each fishing vessel, which seems to be of greater interest to insurance companies than to the fishermen themselves. To most captains, the determination of a vessel's stability letter is a lot of black magic by the naval architect/surveyor. After moving some weights on the deck (the only part the crew sees), the naval architect mysteriously determines how large a catch a boat can safely carry. Problems occur when some stability requirements run counter to a captain's "feel" or traditional beliefs on how a vessel should be loaded. For example, some captains prefer to fill ballast tanks under fish holds to stiffen a vessel's ride. While this increases the vessel's initial stability, it may give a false sense of security to the captain and crew because the vessel's freeboard and downflooding angle have been significantly diminished. Crew members will likely not realized this dangerous situation because all they can "feel" onboard is the initial stability. Only complex mathematical calculations or model experiments can show the dangerous effect on overall stability at large angles of heel. This same false and dangerous sense of security occurs with the use of paravanes (flopper stoppers). Paravanes are roll-reducing devices suspended from long outriggers off the vessel's sides. These outriggers, which are longer than the vessel's beam, are lowered to a position just above horizontal when in use. The stability problems they create are twofold. First, by reducing the vessel's rolling motion, the paravanes create a misleading increase in the vessel's stability as felt by the crew, i.e. the vessel appears "stiffer". And secondly, when seas roughen the outriggers can roll into the waves causing the vessel to veer off course (tripping). Unfortunately, the outriggers should not be stowed in the vertical position because that action would raise the vessel's center of gravity, and further reduce the vessel's overall stability at the very time when the vessel needs maximum stability to survive the storm.

An additional problem with crew members understanding of stability is the fact that the stability standards are intended to protect the vessel and its crew in major storms but not necessarily to survive a direct hit by extreme waves, as in the movie *The Perfect Storm*. The rules don't seem to apply to normal weather operations, which can create the false impression that the vessel's stability letter is overly conservative and the vessel can actually carry more cargo. For example, during a fair weather trip, the captain hits the jackpot and fills the hold. The fishing is still good, bills are due, the weather fair, and the vessel feels "safe", so understandably they continue to fish. They do this several times and then start to doubt the catch limits imposed by the stability letter. If their luck changes on a given trip and the weather storms up before they can return to port, the vessel may lack sufficient stability characteristics to survive [USCG 1999].

LESSONS LEARNED: COMMUNICATING FISHING VESSEL STABILITY CONCEPTS TO CREWS

To resolve these conflicts, a simple method of directly showing a captain and crew the effects of such things as cargo loading, tank loading, and use of paravanes (deployed vs. retracted) needs to be developed. Existing booklets and stability trainers have significant negatives that inhibit effective training use in many situations. For example, the USCG's Fishing Vessel Stability Trainer is a sizable, cumbersome unit that requires a trailer for transport and a large tank of water. It is demonstrated primarily at USCG stations, meetings, trade shows and the like. Because it is a generic model of a specific type of fishing vessel (northwest seiner), two additional negatives are present. First, the effect of an individual stability characteristic cannot be easily explored. Second, because the trainer's arrangements may be significantly different than the captain's vessel, the captain and crew will likely believe the demonstration does not apply to their situation.

The training device envisioned by this research is a series of relatively inexpensive, simple 3-D interactive models that captains and crews can literally play with, to visually see the effects of their loading actions on the model's stability. The models (Figures1-3) would be short watertight sections of typical hull forms set in a clear tank that allows the models to heel freely. Hull sections would include fish holds and side and belly tanks. By filling tanks or placing increasing amounts of weights on different models, the effects of deck loading, adding weights high, or free surface in tanks/holds, can be demonstrated for different classes of fishing vessels. And by using side-by-side models, the negative stability effects can be visually demonstrated in a dramatic manner when the training model with the stability defect takes water on deck or capsizes quickly.

Because of the model's simplicity, the participants can perform the tests themselves, thus intuitively learning stability without tedious lectures and theory. It must be remembered, the point of this training activity is not to teach crews how to calculate stability. It is to allow the crews to explore various aspects of stability intuitively, especially those that occur at the severe heel angles the

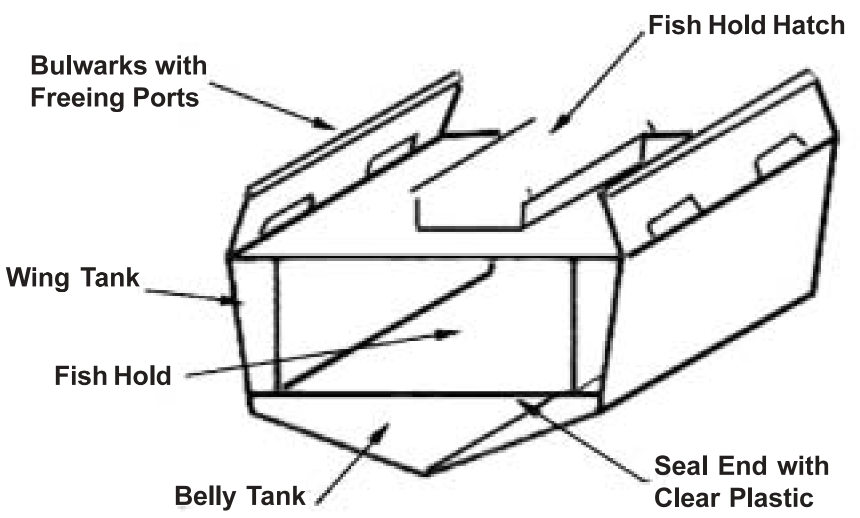
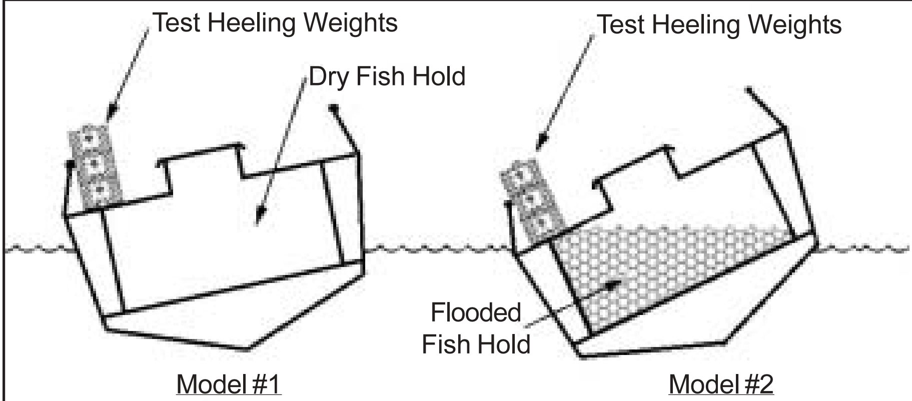


Figure 1: Base model section shown. Additional features such as fish hold pen boards, tank and void vents, outriggers with paravanes, and net reels will be added to individual sets of models to illustrate specific stablity characteristics.



Typical Stability Trainer Hull Model Setup
Effects of Free Surface on Stability

Figure 2: A set of two models are used to illustrate the effect of free surface from partiallly flooed fish hold on stability. Test heeling weights are added one at a time to show each model's relative level of stability. The training model with the stability defect, in this example model 2, will capsize well before the other model.

crews do not regularly experience onboard. This will allow crewmembers to better respect the stability information provided by the naval architect, and to understand the ramifications of their actions on their vessel's stability. The proposed training model achieves this goal by being inexpensive to build, easy to transport, and by its interactive nature effective in demonstrating the mystery of stability. In fact, small versions could be taken dockside for individual training and larger versions can be used at meetings such as fishery mananagment councils.

LESSONS LEARNED: VESSEL OPERATIONS

The next lesson learned deals with another aspect of vessel operations. With the many years of design and operational experience in the U.S. fishing fleet, there exists a vast knowledge of practical tips and areas of concern in vessel design and operation. However, because of the nature of the industry, this information is not readily shared. Current methods such as USCG NIVCs do

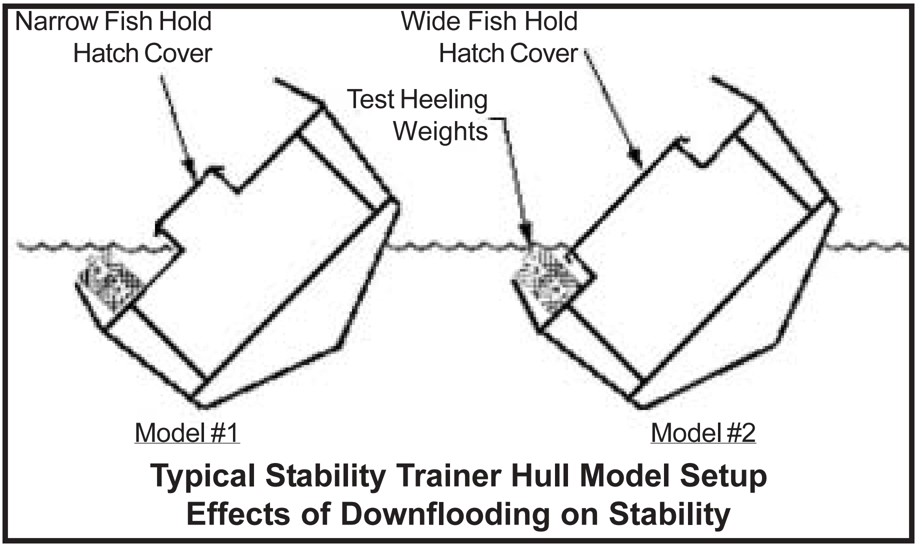


Figure 3: Set of two models are used to illustrate the effect of downflooding from fish hold hatches on stability. Test heeling weights are added one at a time to demonstrate the model's relative level of stability. The training model with the stability effect, in this case model 2, will capsize well before the other one.

not allow for a wide enough a distribution of information and concepts in language understandable to all parties in the fishing fleet. The USCG recently developed booklet, *Best Practices Guide to Vessel Stability*, while written in terms more understandable to the fishermen, uses stability illustrations more akin to a kid's cartoon character. These illustrations with unrealistic hull forms simply erode a crew's ability to believe the lessons given in the booklet. (The USCG has agreed to update this booklet with more realistic illustrations.)

The most important lesson learned is "Keeping the water out"; i.e. creating and maintaining the vessel's watertight envelope and adequate reserve buoyancy. The sea has proven to be merciless and will find a vessel's weak point. Past history has shown the following general areas of major concern: watertight hatches, windows, and doors; rudder and propeller stuffing boxes; sea-cocks and sea connections; ventilation and tank vents; and vessel freeboard and arrangements. The failure modes of these areas are of two types; catastrophic sudden failure and slow progressive flooding.

Slow progressive flooding is generally caused by a small, unnoticed break in the vessel's watertight envelope such as a worn rudder packing gland, cracking in a sea connection, or improperly designed or sealed watertight hatches. Items such as the rudder or shaft packing glands and sea connections are generally located in unmanned compartments or under deck plates in the bilges, making inspection and maintenance difficult and easily forgotten. The watertight hatches, while usually easily inspected, have large sealing surfaces prone to damage when in the open position. Bilge alarms have been installed in some instances to warn the crew of impending flooding, but they suffer the same inspection and maintenance problems because they too are located in hard-to-reach bilge locations [Dyer 2000].

As an example, the Atlantic coast surf clam and ocean quahog fishery lands large volumes of raw shell stock which dictate large fish holds, easily as much as 50 percent of a vessel's hull volume. Because the vessels load the heavy shell stock directly into large containers (cages) that cannot be readily moved by the ship's crew when fully loaded, the top of the fish holds must be able to be completely opened during clamming operations. The majority of the hatch covers currently used cannot be dogged watertight or even held closed and are considered little more than a sun cover by the fishermen [USCG 1999].

The greatest danger arises when vessels return to port fully loaded and have minimal aft freeboard. The hatch covers gradually leak water into the holds, which results in a progressive degradation of the vessel's stability. Because this occurs over a long period of time, it is likely to be undetected by a crew that is tired after a fishing trip or distracted by other problems. Generally, in past sinkings, by the time the crew does realize there is a problem, the vessel's stability has been reduced to the point of being ready to capsize on any boarding wave. The crew, if lucky, only has time to radio a quick mayday and hastily abandon ship [USCG 1999, Dyer 2000]. This situation is another area in which the envisioned stability-training model can be used to impress upon the crew the real dangers of this situation and the need to quickly discover and rectify the flooding problem.

Catastrophic flooding is just as serious, if not more so, than slow flooding [Dyer 2000]. In catastrophic flooding, crew members will very likely have little time to react either to save the ship or themselves. Such flooding generally occurs through the sudden failure of large hatches or the breakage of pilothouse windows under heavy seas. Of all areas onboard a fishing vessel, pilothouse windows are generally the weakest portion in the vessel's watertight envelope. Because they protect the main control station of the vessel, they are also the most important part of the watertight envelope. Loss of the pilothouse windows endangers a vessel's survivability by destroying its stability and restricting the crew's ability to control the vessel and make emergency communications.

One recommendation is to focus on turning fishing vessel pilothouse design from a liability to a stability asset. By the inherent location of a fishing vessel's pilothouse, its enclosed volume can generate a very large righting force at the time of the last chance to save the boat in a capsizing situation. For example, on the USCG's new 47-foot rescue surfboat, the design of the pilot house actually creates a greater righting moment when the vessel is upside down than when floating upright. While this is an extreme example, to integrate this concept into current fishing vessel design would not be costly. The major changes required would be simply upgrading the windows and doors while providing provisions for escape when capsized, and performing some additional stability calculations to obtain credit for the additional reserve buoyancy.

The last lesson learned in "Keeping the Water Out" is in the crew's access to the vessel's internal compartments and bilge systems. Vessel arrangements must allow a crew access throughout the vessel in bad weather to allow the crew to respond to flooding. For example, again we will look at a type of vessel arrangement prevalent in the Atlantic coast surf clam and ocean quahog fishery. Many of these vessels are converted from gulf shrimpers by modifying the fish hold and adding a large pump and engine in the lazarette. This pump primarily supplies high-pressure water to the harvesting dredge, but is also used to flood and pump dry the fish holds. The problem occurs when flooding through the non-tight fish hold hatches discussed above occurs in rough seas. The only access to the fish hold pump is outside across the deck and through a relatively exposed hatchway. Several vessels have been lost when the crew could not access the critical pumps because by the time the problem was discovered, the seas boarding the vessel prevented access aft across the deck [USCG 1999].

LESSONS LEARNED: FISHERIES MANAGEMENT

All parties involved in the fisheries management process must address the potentially negative impact on vessel safety caused by fishing regulations. Unfortunately, with many management schemes in place today, this has not happened. For example, in derby style management with its fixed short openings, the fisherman must go to sea in spite of the weather or the vessel's condition. They simply cannot afford to miss days at sea (lost income) that cannot be made up later. Even with the best boats available, when the weather is bad, vessels simply should not leave the dock. To do so is an unnecessary risk to the crew's safety.

FUTURE WORK

The long range goal is to create a fishing vessel research program to develop a new set of scalable non-dimensional parameters for designing and building safer fishing vessels [Blume 1993, Boccadamo 1994, Buckley 1994]. In order to experimentally determine fishing vessel design parameters that improve survivability in a severe seaway, a new "free-to-broach" towing rig will be developed for the Naval Academy towing tanks. This rig will allow models of a series of existing and proposed new fishing boat designs to be investigated for capsizing resistance while towed under computer control to a region of the tank where computer-generated irregular waves are combined with deterministic steep waves produced by wave energy concentration [Duncan 1987, Takaishi 1994, Buckley 1994, Kriebel 2000]. This technique avoids using radio-controlled models which are difficult to position in capsizing wave conditions, as the book *Lost at Sea: An American Tragedy* [Dillon 1998] discusses. This technique should also be useful for validating attempts to mathematically model the surf-riding phenomenon [Vassalos 1994]. Towing models in quartering seas with and without paravanes extended should shed light on the dynamic stability characteristics of several classes of fishing boats, improving on the zero-speed beam-sea capsize testing previously done at the Naval Academy on sailing yachts [Zseleczky 1988] and the USCG 44-ft and 47-ft Motor Life Boats.

It is expected that the effects of variations in length, beam, draft, freeboard, sheer line, bulwark and deckhouse arrangements, and loading conditions can be correlated with a new set of design parameters for increasing fishing boat safety in a variety of situations [Boccadamo 1994].

REFERENCES

Bass DW, Weng C [1994]. The capsize of the *FV Straits Pride II*: A study in the dynamics of paravanes. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Bass DW [1998]. Roll stabilization for small fishing vessels using paravanes and anti-roll tanks. Marine Tech, *35*(2): 74-84.

Bird H, Morrall A [1986]. Research towards realistic stability criteria. In: Proceedings of the International Conference on the Safeship Project: Ship Stability and Safety, RINA, London 9-10 June 1986.

Blume, P [1993]. On capsize model testing. In: Proceedings of the U. S. Coast Guard Vessel Stability Symposium, New London, CT, March 15-17, 1993.

Boccadamo G, Cassella P, Russo Krauss G, Scamardella A [1994]. Analysis of I.M.O. stability criteria by systematic hull series and by ship disasters. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Boccadamo G, Cassella P, Scamardella A [2000]. Stability, operability and working conditions on board fishing vessels. In: Proceedings of the 7th International Conference on Stability of Ships and Ocean Vehicles (STAB 2000), Launceston, Tasmania, Australia, 7-11 February 2000.

Buckley WH [1994]. Stability criteria: development of a first principles methodology. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Cleary W [1993]. The regulation of ships stability reserve. In: Proceedings of the U. S. Coast Guard Vessel Stability Symposium,New London, CT, March 15-17, 1993.

Dahle EA, Myrhaug D [1995]. Risk analysis applied to capsize of fishing Vessels. Marine Tech *32*(4):245-257.

Dillon P [1998]. Lost at sea: an American tragedy. Dial Press.

Duncan JH, Wallendorf LA, Johnson B [1987]. An experimental investigation of the kinematics of breaking waves. In: Proceedings of the IAWR Seminar on Wave Analysis in Laboratory Basins, 1-4 Sept. 1987, pp. 411-422.

Dyer MG [2000]. Hazard and risk in the New England fishing fleet. Marine Tech *37*(1):30-49.

Gillmer TC, Johnson B [1982]. Introduction to Naval architecture. Annapolis, MD: U. S. Naval Institute Press.

Helmore PJ [2000]. Recent developments in roll stabilization of fishing vessels. In: Proceedings of the 7th International Conference on Stability of Ships and Ocean Vehicles (STAB 2000), Launceston, Tasmania, Australia, 7-11 February 2000.

Kobylinski L [1994]. Methodology of the development of stability criteria on the basis of risk evaluation. In: *Proceedings* of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Kobylinski L [2000]. Stability standards - future outlook. In: Proceedings of the 7th International Conference on Stability of Ships and Ocean Vehicles (STAB 2000), Launceston, Tasmania, Australia, 7-11 February 2000.

Kriebel DL, Alsina MV [2000]. Simulation of extreme waves in a background random sea. In: *Proceedings* of the Tenth International Offshore and Polar Engineering Conference, Seattle, U.S.A., May 28-June2, 2000.

Takaishi Y [1994]. Dangerous encounter wave conditions for ships navigating in following and quartering seas. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A.

Umeda N, Ikeda Y [1994]. Rational examination of stability criteria in the light of capsizing probability. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Umeda N, Matsuda A, Hamamoto M, Suzuki S [1999]. Stability assessment for intact ships in the light of model experiments. J of Marine Science and Tech, SNAJ, Japan, 4:45-57.

Umeda N, Matsuda A [2000]. Broaching in following and quartering seas - theoretical attempts and new prevention devices. In: Proceeding*s* of the 7th International Conference on Stability of Ships and Ocean Vehicles (STAB 2000), Launceston, Tasmania, Australia, 7-11 February 2000.

USCG [1986]. Proposed voluntary stability standards for uninspected commercial fishing vessels. Washington D. C.: Navigation and Vessel Inspection Circular NVIC 5-86.

USCG [1999]. Dying to fish: fishing vessel casualty task force report. Washington, D.C.: U.S. Coast Guard.

Vassalos D, Maimun A [1994]. Broaching-to: thirty Years On. In: Proceedings of the 5th International Conference on Stability of Ships and Ocean Vehicles (STAB 94), Melbourne, Fl. U.S.A..

Zseleczky JJ [1988]. Evolving methods for estimating capsize resistance in breaking waves. Presentation in SNAME NewEngland Sailing Yacht Symposium, New England, March 1988.


Photograph and caption by Earl Dotter

The four to five-hour “haul back” cycle goes night and day. After preparing the fish and storing it in the fish hold, there’s about an hour and a half to two hours down time before the cycle begins again.

SAFETY MANAGEMENT ON BOARD ICELANDIC FISHING VESSELS

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The number of accidents on board Icelandic ships and boats during the period 1984 through 1997 shows that that accidents vary from about 400 per year to about 630 per year. It is fair to say that annually one out of every ten Icelandic seamen at work becomes the victim of an accident.

The number of work-related accidents and other accidents decreases very slowly in Iceland. Research indicates that by far most of the events occur as a result of human error, and the result of the adoption of new technology is frequently a new wave of accidents. This is why there exists a great need for carefully planned internal control in respect of the seamen's safety measures and a need for greatly increased education among seamen on injury prevention measures and safety.

Every year the society's costs from accidents at sea amount to millions of Icelandic crowns. A reduction in the number of accidents is, of course, a matter of great interest, not only to the seamen and their immediate families, but also to the fishing companies and the whole Icelandic population, which shoulders a vast part of the high costs resulting from these events.

This decade has seen great efforts in terms of the collection and registration of data on accidents at sea, their number, causes and consequences. But, more needs to be done. If we want to decrease the number of accidents at sea it is more essential than ever to make good use of such data.

The Icelandic Association for Search and Rescue (ICE-SAR) has proposed the use of a coordinated safety control system on board the Icelandic fishing vessels in order to decrease the number of accidents. We have introduced this concept to the national authorities. Together with ICE-SAR, the organizations of fishing vessel owners and seamen have sent a resolution to the authorities to the effect that they are prepared to cooperate with the authorities on the establishment of a safety control system. Additionally, ICE-SAR has obtained cooperation with the Marine Research Institute of the University of Iceland in formulating such a safety system for seamen. The concept has been well received by everyone. The Ministry of Transport and the National Research Council have agreed to provide financial support for the project.

The objective of the safety system is to set up a certain arrangement regarding security procedures and strategies on board the fishing vessels and boats. This system is intended to meet all provisions of Icelandic laws and regulations pertaining to the safety of seamen, as well as meeting international standards, which the Icelandic authorities have acknowledged. The system is to be based on international safety systems and to increase the internal safety control of the crews and the fishing companies. This is to be a coordinated system with all the same principal rules of procedure applying on board all ships and boats in respect of responsibilities and the division of duties. This facilitates the seamen knowing that even though they change ships, the same safety system applies to it as the previous one. The safety system is to contain descriptions of the procedures of all the main work factors on board every ship and boat, and it will ensure regular and well-organized education and registration within the framework of the safety control measures. The system is also to entail confirmation of the safety rules being honored and that improvements are made when needed. The system will be tried onboard 10-20 ships and boats of different sizes and make. The main objective is, of course, to make seamanship safer and to prevent injuries to the men and damage to property.

This year and last year, a young university student, Ingimundur Valgeirsson, who is studying civil engineering at the University of Iceland, has worked on this project on behalf of ICE-SAR and the University's Marine Research Institute. His Master's thesis will be on safety control systems for seamen. Valgeirsson has collaborated with the crews and owners of a large modern freezer trawler, on the one hand, and a smaller line vessel, on the other hand. Three more vessels have already entered into this cooperation for research purposes.

A decision was made from the very beginning to carry out hazard analysis according to Hazard Analysis Critical Control Points (HACCAP). HACCAP is used for monitoring the quality, hygiene and health of the fish products on board ships; hence the seamen are quite familiar with the system. The seamen write descriptions of all work factors on board, including when a vessel leaves port, procedures during its voyage, during the fishing, which in turn, includes trawl, net, seine and line fishing, fish processing, the arrangement of the catch on board, work in the hold, arrival in port, loading and unloading, etc. A joint assessment is then made of the control points, control frequency and the desirable guidelines.

A detailed study will be made of the high-risk accident points on board the ships. A registration of all work procedures in co-operation with trained researchers and experienced seamen should reveal which points, work procedures and circumstances are hazardous. Accident statistics will also be used in this respect. In addition to finding the hazardous locations on board, other conditions must be studied, including the effects of weather, light, freezing, etc., the objective being to reduce the risk of accidents. A study must also be made of the effects of fatigue, long working hours and even cold weather in regard to the causes of accidents. What is the effect of human relations in this respect? Do misunderstood instructions cause accidents? Under what circumstances? What improvements can be made? What is the impact of the equipment used on board in terms of injury risks? What is the impact of work procedures? This list of questions could easily be extended. Collaboration has taken place with the Icelandic Maritime Administration, the Occupational Safety and Health Administration, and classification societies on the various control factors, control frequency and guidelines. These institutions have already contributed to the preparation of descriptions and guidelines for the control points. According to law, the captain is fully responsible for the safety on board his ship and this does not change, although the implementation of the safety system will systematically distribute the responsibility among all crewmembers, the fishing company and the service parties.

Safety committees will be appointed on board the ships. Their role is to ensure that the system is indeed used and that it works. The safety committee of each ship will receive suggestions by the crew, for example, on risks and control points. The committee will decide who shall carry out the control, when and how frequently. The captain may request the committee to receive a newly recruited crewmember and, in turn, the committee may appoint a special representative, an orientation supervisor, to act in a capacity as the recruit's personal temporary instructor and consultant. The representative will show the new crewmember the ship, the locations of safety equipment and introduce the safety rules on board the ship. The new crewmember will receive a booklet showing the details of the ship, as well as containing work descriptions, information on the safety system and highlighting the main hazards on board. It is highly important that the safety committee enjoys the trust and support of the ship's management. The safety committee will hold meetings with the crew and the owners as often as deemed necessary to discuss the main safety factors on board and to dispatch requests regarding repairs and improvements of the ship. The relevant fishing company and the ship's service parties ashore must take active part in the ship's safety system, which is something the safety committee must follow up on.

The efforts currently taking place are essential basic work, which will certainly be useful to all ships and boats deciding to carry out the safety system. It is quite likely, however, that the system will have to be adjusted to every single vessel. Additionally, it is necessary to computerize the system in order to facilitate improved control and accumulation of data.

The accident statistics of seamen cover a large number of events taking place at harbors in Iceland. ICE-SAR strongly urges for rules being implemented on harbor safety and, needless to say, the safety control system for seamen should apply to all harbors in Iceland.

As previously stated, the objective of this project is for the safety system being adopted and carried out by the entire Icelandic fishing fleet. The IMO already requires commercial vessels to abide by the International Safety Management Code and experience shows that the requirements made of commercial vessels today will sooner or later be made of the fishing vessels. Today, our objective is to structure and implement a safety system for fishing vessels. The system must not only meet all the requirements made of commercial vessels. It must also include a detailed safety control system on board the fishing vessels. Additionally, the safety system will be laid out in such a fashion that it can easily be translated into foreign languages and adjusted for use onboard foreign fishing vessels.

READY FOR SEA: THE SEVENTEENTH COAST GUARD DISTRICT'S SAFETY PROGRAM

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Captain Ed Page is a 1972 graduate of the Coast Guard Academy located in New London, Connecticut. After sailing as a deck officer on the 378 foot Coast Guard Cutter Boutwell out of Boston and later Seattle on Ocean Station and Alaska patrols, he subsequently had assignments in Port Operations and Investigations branches at marine safety offices in Concord, California, San Francisco, California, and Anchorage, Alaska. He also served as Commanding Officer of LORAN Station Iwo Jima, Japan, as deputy Group Commander of Group Ketchikan involved in Search and Rescue and as Chief of Marine Environmental Protection for the 17th Coast Guard District during the Exxon Valdez oil spill response. He served as Commanding Officer of Marine Safety Office/Group Los Angeles-Long Beach from 1994-1997 and as Chief of Marine Safety for the 11th Coast Guard District and Pacific Area in Alameda, California from 1997-1999. During his 28 years as a commissioned Coast Guard officer he has been involved in the coordination of rescues and investigation of numerous fishing vessel accidents on the West Coast of the U.S. As Chief of Marine Safety for the Seventeenth District he led the development and implementation of the "Ready for Sea" program in Alaska. An avid kayaker and outdoorsman, he presently lives in Juneau, Alaska with his wife Barbara and daughters Jessica and Brittany.

Alaska is notorious for its rich and active fisheries as well as for its harsh waters and climate. The extreme weather conditions have led to the sinkings of hundreds of vessels with their crews over the last decade. As reflected in Figures 1 and 2, the added safety equipment required by the Commercial Fishing Industry Vessel Safety Act of 1988 have been effective in reducing the number of lives lost. Despite the improved safety record, fishing continues to be the most dangerous profession in the U.S. and numerous fishermen continue to be lost to Alaska's unforgiving sea each year. At the same time some vessels and their crews are lost at sea, other vessels and crews survive. The difference is the ones that return safely to port ensured their vessel and crew were "Ready for Sea" before getting underway.

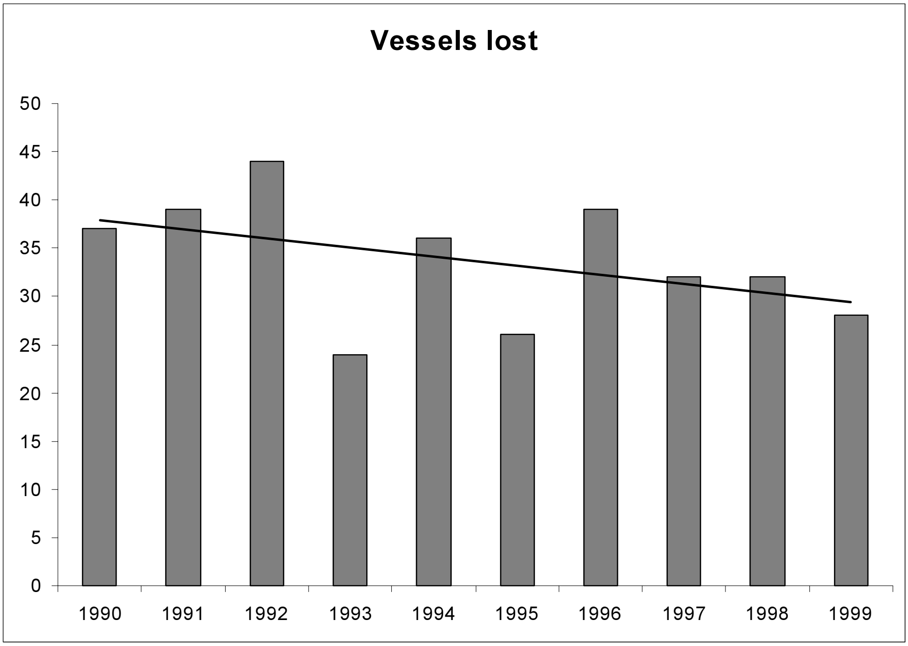

Figure 1: Vessels Lost in Alaska

Figure 2: Lives Lost in Alaska

In an effort to develop and implement a non-regulatory approach to improve fishing vessel safety, the Chief of Marine Safety for the Seventeenth Coast Guard District established a work group comprised of the Coast Guard's fishing vessel examiners, to evaluate past casualties, to identify safety trends and to develop a new approach towards improving fishing vessel safety. Upon reviewing past casualities, the work group identified the factors that made a difference in keeping vessels afloat, and in cases where vessels foundered, the survival and rescue of the crew. This analysis led to development of the Seventeenth District's "Ready for Sea" safety initiative. In developing this program, the work group applied the following Coast Guard "Prevention Through People" principles.

1. Seek Non-Regulatory Solutions: The "Ready for Sea" initiative highlights and communicates "Standards of Care" which prudent mariners practice. It does not add new regulations and in fact, many of the items on the Top 10 safety list are not required by law. It is envisioned a greater awareness of safety issues and adherence to the factors that make a crew and their vessel "Ready for Sea" will significantly reduce the number of casualties.

2. Shared Commitment: The group sought the input of the fishing community and safety associations that share the same goals of improving safety in identifying actions that would improve the safety culture of fishermen.

3. Lessons Learned: Sharing "Lessons Learned" from marine casualties helps fishermen learn from others' accidents as well as safe practices that have prevented the loss of vessels and their crews. These "Lessons Learned" are in many cases success stories where good practices have led to successful rescues. By rapidly identifying the "Lessons Learned" from fishing vessel accidents and sharing them through the timely issuance of flyers distributed via newsletters, mail, postings at harbors and on the Internet, fishermen can become more informed about the risks.

4. Manage Risk:The "Ready for Sea" program focused on managing the risks of fishing in Alaska. The Top 10 safety list reminds fishermen to assess the weather, the skills of their crew, the maintenance of safety equipment, the stability of the vessel and other safety factors to minimize the risks of going to sea.

THE TOP 10 SAFETY LIST FOCUSES ON THE FOLLOWING ISSUES

Weather: Many vessels sink because their crews fail to properly assess the weather conditions as well as the vessel's ability to safely go to sea in the forecasted weather conditions. Evaluating the weather is a risk assessment all mariners should make before setting sail and periodically re-evaluate the weather while at sea.

Crew: An unskilled and/or fatigued crew is a major factor in most fishing vessel casualties. Crews trained in safety practices including the proper deployment and use of lifesaving equipment have a much greater chance of preventing a marine casualty and in cases where the vessel sinks, of surviving.

Stability/Overloading: Loss of stability dramatically reduces a vessel's seaworthiness and has led to numerous sinkings and loss of life in Alaska. Greater awareness of the factors that lead to instability and taking action to preserve stability can reduce vessel capsizings.

EPIRBs/Comms Equipment: A crew's ability to seek help when in distress depends on reliable emergency communications. Properly installed, serviced and operable EPIRBs, VHF and HF communications have saved many lives.

Immersion Suits: Hypothermia has killed many fishermen in Alaska. Many others have survived emergencies because they've carried serviceable and accessible immersion suits and knew how to don them.

Survival Craft: Properly installed and serviced life rafts have saved many lives in Alaska!

PFDs Worn on Deck: Fifty-six fishermen were lost overboard in Alaska during the last ten years. The practice of wearing Personal Floatation Devices (PFDs) while working on deck would have saved many of those mariners, and is a "Standard of Care" vessel crews should adopt.

Damage Control: Quick and effective repair of a vessel can prevent a vessel's loss and the need to abandon ship. Crew training in how to use damage control tools can ensure a crew's safe return.

Fire Fighting: Uncontrolled fire at sea has led to the loss of many vessels. Carrying proper firefighting equipment on board and ensuring the crew is trained in its use can prevent a vessel's loss.

Third Party Exam of Vessel: A third party safety audit by a marine surveyor, classification society or by a Coast Guard fishing vessel safety examiner can identify potentially unsafe conditions.

A Top 10 "Ready for Sea" check off list was developed to address these issues and is provided as an appendix to this report.

As mentioned earlier, another element of the "Ready for Sea" program is the sharing of "Lessons Learned" from other maritime casualties. The communication of these "Lessons Learned" can be an effective way of raising the safety awareness of fishermen and prevent them from making the same mistakes or taking similar actions that have led to the safe rescue of other mariners in distress. A copy of a "Lessons Learned" is attached as an appendis to this report.

Lastly, the Coast Guard's fishing vessel safety program in Alaska modified the Coast Guard's vessel at-sea boarding program to focus on the safety factors that make a vessel "Ready for Sea". Emphasis of Coast Guard boardings was shifted from law enforcement to increasing the safety awareness and culture of a fishing vessel's crew during the course of the boarding.

In summary, the Coast Guard's "Ready for Sea" program is a new approach towards improving fishing vessel safety. The program outlines the factors that help fishermen ensure their vessel and crew are "Ready for Sea" before casting off all lines.

APPENDIX A: COAST GUARD READY FOR SEA SAMPLE CHECKLIST

READY FOR SEA

- [ ] Weather: Evaluated weather forecast. Vessel and crew can handle safely! Can monitor weather reports at sea.
- [ ] Crew: Trained and drilled in operation of vessel and safety equipment.
- [ ] Work schedule minimizes fatigue.
- [ ] Stability: Scuppers and freeing ports clear. Gear, catch and hatches secured. Limit accumulation of ice.
- [ ] EPIRB and Communications: Equipment tested. EPIRB armed and stowed properly. Carry back-up comms.
- [ ] Immersion Suits: Crew donned suits. Ensured proper fit and good condition. Suits accessible and lights attached.
- [ ] Survival Craft: Capacity for entire crew. Serviced, properly installed and crew trained to launch.
- [ ] PFDs Worn on Deck: PFDs/flotation worn on deck by crew. Operable lights attached.
- [ ] Damage Control: Bilge pumps work. Damage control equipment on board and crew trained in use.
- [ ] Fire Fighting: Adequate number of serviced fire extinguishers on board and crew trained in fire fighting.
- [ ] Safety Exam: I conducted “Ready for Sea” deck walk/safety inspection and determined vessel safe to sail.

APPENDIX TWO: SAFETY ALERT SAMPLE

SAFETY ALERT 02-99

SINKING OF FISHING VESSEL WITH ONE LIFE LOST

FAIRWEATHER GROUNDS, SOUTHEAST ALASKA

Background: The Seventeenth Coast Guard District Fishing Vessel Safety Alert program provides timely safety-related information to fishermen of "Lessons Learned" from marine casualties.

Incident: A 54-ft longliner capsized and sank approximately 50 miles offshore off the Fairweather Grounds just before midnight on November 12. The vessel was fishing for halibut in heavy weather and while sailing for port was hit broadside by 20 ft waves, shifting the halibut catch and deck gear, and causing the vessel to list 30 degrees and take on water. The operator tried calling the Coast Guard (CG) on VHF Channel 16 with no response (too far offshore) but did not call on SSB radio that is monitored for offshore emergencies. The operator also activated the EPIRB and threw it over the side as the crew donned immersion suits then tried to reach the life raft that washed overboard. As the life raft painter was not secured to the vessel it did not inflate. A crewmember tied off a rope to his waist and then to the vessel and dove in after the raft. The vessel sank a short time later and he was not seen again. The CG received the registered 406 EPIRB alert and contacted the vessel owner to gather information and verify the alert. Although weather conditions were beyond safe parameters to launch the CG helicopter, the aircraft deployed due to the high confidence of the vessel's distress. The crew was found less than an hour later within 100 yards of the EPIRB. When the helicopter arrived on scene one crewmember turned on the light on his immersion suit and the helicopter crew was able to spot them immediately. Three crewmembers were rescued.

Lessons Learned: While the cause of the casualty is unknown, there are several lessons learned.

1. Before getting underway mariners should assess the current and forecast weather and assess the vessel's condition to determine if the voyage can be safely conducted or should be delayed.

2. The proper securing of cargo and deck gear is critical for maintaining stability during heavy weather conditions. The shifting of fish or gear can quickly lead to disaster. The best time to ensure a vessel is properly "secured for sea" is before encountering heavy weather.

3. As evidenced by this case, a properly serviced and installed EPIRB and properly fitting and serviced immersion suits save lives. The crew attributed their AMSEA safety training with their familiarity with this equipment and their survival. Positive action to activate and deploy an EPIRB better ensures it sends a distress signal and is not caught up in the vessel's rigging.

4. Operable personal marker lights on immersion suits greatly aid night searches.

5. Life rafts should be properly attached to a secure point on the vessel in accordance with manufacturer's directions.

6. The vessel did not have a current CG dockside exam. The last exam was performed more than three years ago. These free exams, performed at the dock, help identify safety deficiencies that can lead to loss of vessels and/ or the crew.

USING DOCKSIDE ENFORCEMENT TO COMPEL COMPLIANCE AND IMPROVE SAFETY

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Charlie Medlicott served in the Coast Guard as a Boatswains Mate 1st Class, working on two cutters and a small boat station, performing SAR duties as well as fisheries law enforcement in Alaska and Oregon. He has commercially fished in Southeast Alaska a bit for halibut and salmon. Charlie has been working as the Commercial Fishing Vessel Safety program coordinator for Marine Safety Office Anchorage since 1993. Charlie is responsible for administering the Dock Side Exam program in western Alaska, helping with investigations, and providing safety training for both fishermen as well as active duty Coast Guardsman.

INTRODUCTION

Effective enforcement is a key component in any regulatory regime. "Enforcement problems arise in virtually every arena of human interaction. Such rules usually provide little or no social benefit unless they are effectively enforced. If deliberate violation of a rule can rarely be detected under an enforcement scheme, or if the punishment for violation is negligible, the rule no longer serves its purpose. Effective enforcement is therefore as important as the rule itself." [Burke et al 1975].

The U.S. Coast Guard is the primary agency responsible for the enforcement of commercial fishing vessel safety in the State of Alaska. Traditionally, the Coast Guard has used a two pronged approach to ensure commercial fishing vessels are in compliance with existing safety regulations: a voluntary dockside examination (VDE) program, and at-sea boarding enforcement program. Despite significant efforts aimed at improving compliance with commercial fishing vessel safety regulations, the existing programs have suffered from many impediments to their success. This paper will evaluate the existing enforcement regime for commercial fishing vessels in the State of Alaska, identify areas of improvement, and explore how developing dockside enforcement can effectively compel compliance and improve safety in the Alaskan fishing fleet.

VOLUNTARY DOCKSIDE EXAM PROGRAM

The major focus of the Coast Guard's fishing vessel safety efforts is the VDE program. Law or regulation does not require VDEs. Under the Commercial Fishing Industry Vessel Safety Act of 1988, fishing vessels do not require inspection by the Coast Guard. During a VDE, vessels are examined for compliance with all applicable federal regulations. VDEs are designed to be educational in nature and provide fishermen an opportunity to bring their vessels into compliance without the threat of civil penalties. Those vessels, which are found to be in compliance, receive a Commercial Fishing Industry Vessel Dockside Exam Decal.

There are several problems with the existing VDE program: vessels that have undergone a VDE may not get into or stay in compliance, relatively few vessels participate in the program, and those vessels that do participate are often not in high risk fisheries. The first problem is that a vessel can have a current exam decal, but slip out of compliance after the decal is issued. Decals are issued for a period of two years. During this two-year period equipment can be removed, fail or expire, and the vessel becomes noncompliant. Consequently, a vessel can have a VDE decal and still be out of compliance. Another area of concern is that because it is a voluntary program, vessels may have numerous safety violations, and there is no established policy to bring them into compliance. Enforcement action resulting from a VDE is forbidden under current Coast Guard policy.

Examining the results of a large number of dockside exams highlights a second problem. In 1999 USCG Marine Safety Office Anchorage analyzed 100 randomly selected fishing vessels that were voluntarily examined at the dock. Discrepancies were grouped as follows:

Big Five: primary life saving equipment and required drills and training;

Navigation Safety: Charts, publications, running lights, ground tackle, sound producing devices, communication equipment;

Administration: CG licenses vessel documentation, EPIRB registration, certificates, and proof of first aid and CPR training, logs;

Pollution: Spills, containment, fixed piping for waste oil, response equipment, oily waste book; and

Marpol: Logs, and marine sanitation devices.

Several concerns are raised from these exam results. The first is that one-third of the vessels examined were not in compliance with primary lifesaving equipment requirements. The second is that the data shows 51 percent of vessels getting exams don't complete the process or don't bring their vessels into compliance. Based upon this random analysis, one can assume that less than half of the vessels participating in the VDE program actually bring their vessels into compliance with safety regulations.

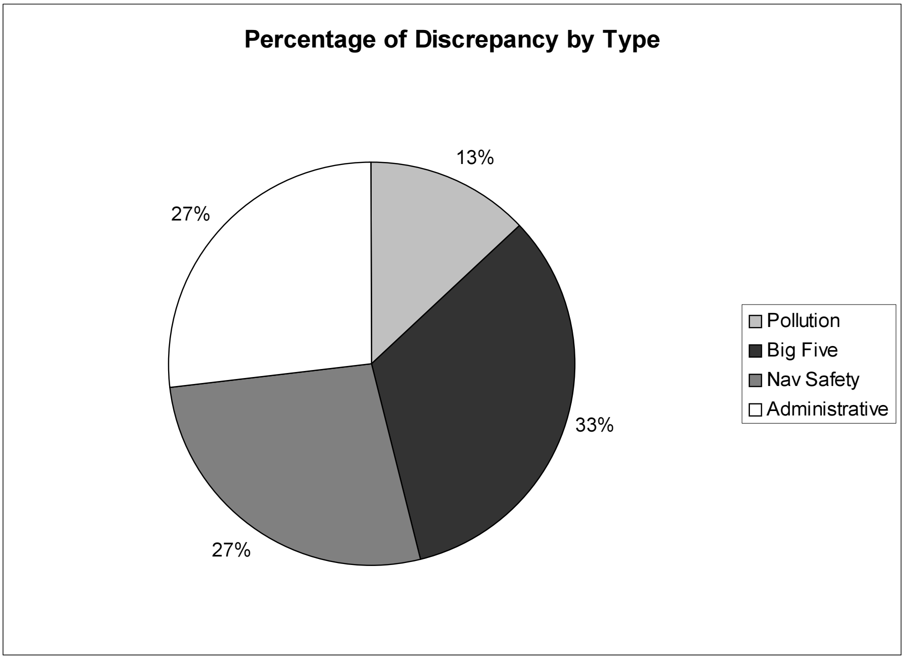

Figure 1: Fishing Vessel Safety Regulation Discrepancies on 100 Vessels receiving Dock-Side Exams in Alaska in 1999.

The second major problem with the voluntary dockside exam program is that very few vessel operators participate with the program. (See Table 1.) Based upon national statistics collected over a six-year period, only seven percent to eight percent of commercial fishing vessels nationwide have participated in the VDE program. In Alaska, the number of vessels participating has ranged from 5 to 9.5 percent and is probably closer to 12 percent. The percentage of the fleet encountered in the exam program is not significant enough to have an effect on overall compliance.

Table 1: VDEs conducted in Alaska

YEAR	1993	1994	1995	1996	1997	1998	1999
Total Vsls in Alaska	n/a	13500	13500	11559	13744	11968	11913
# VDE's	n/a	1243	1177	1093	769	1064	955
% Examined	n/a	9.2%	8.7%	9.4%	5.5%	8.89%	8%

The final problem with the voluntary dockside exam program is that units have tended to target fishing fleets where participation is high and exams are relatively easy to obtain. These fleets tend to have common gear types, are comprised of vessels that have above average material condition, and have a good overall safety record [USCG 1998b]. Marine Safety Office Anchorage, as an example, targets the Bristol Bay fleet heavily for the large number of examinations that can be attained. Coast Guard headquarters still equates program success with the amount of VDEs conducted. In 1999, 62 percent of the unit's 565 total dockside exams came from this single fishing fleet, and the cost of the activity consumed 43 percent of the unit's total fishing vessel safety budget. This effort occurs despite the fact that the fleet historically has an extremely low number of fatalities and the nature of the fishery is such that a vessel with an at-sea emergency could be assisted in a matter of minutes due to a tremendous concentration of fishing vessels.

Conversely, marine safety offices in various regions of the country have observed that vessels appearing to be most in need of safety education outreach are not willing to participate in the dockside exam program [NRC 1991, USCG 1998b]. Due to the difficulties and costs associated with promoting a voluntary dockside exam program to vessel owners and operators who are not very interested, it is not effective, in terms of maximizing exams, to expend the effort to reach these fleets. This strategy has led to an accident prevention paradox [USCG 1998b], where the fleets with higher levels of compliance tend to receive most dockside exam effort, and fleets with low levels of compliance receive less effort.

AT SEA BOARDING PROGRAM

The U. S. Coast Guard (17th District) uses at sea boardings of commercial fishing vessels to enforce federal fisheries regulations. While at sea enforcement is traditionally an effective way of compelling compliance, there are many obstacles in place, which currently limit the effectiveness of the Coast Guard's at-sea enforcement of fishing vessel safety regulations. At sea exams are limited in scope. The fleets are not targeted based upon risk, but based upon availability. The number of boardings has been declining for years, thus reducing transparency, and finally, when and if violations are even detected. (See Figure 2.)

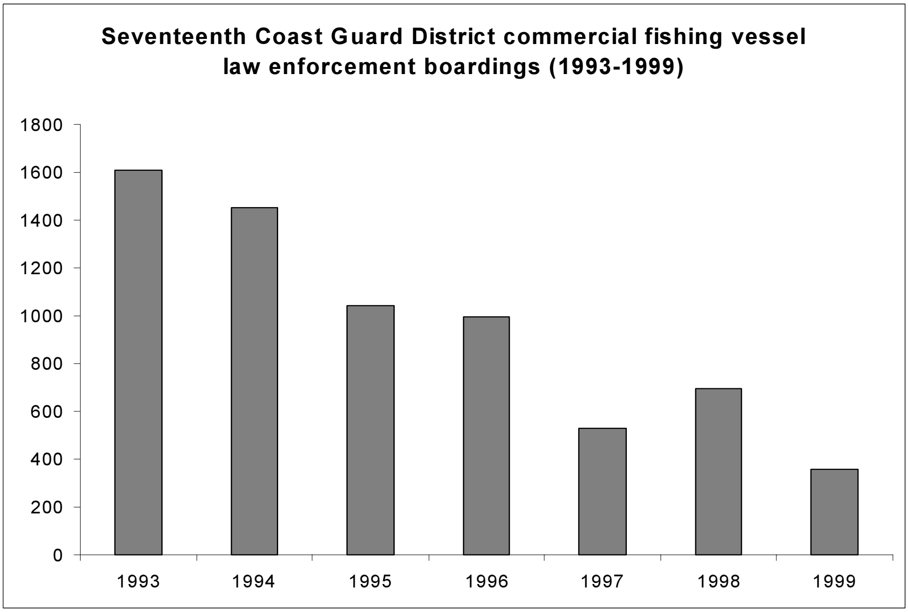

Figure 2: Seventeenth Coast Guard Unit Commercial Fishing Vessel Law Enforcment Boardings

Current Coast Guard policy places heavy limitations upon the degree that commercial fishing vessels can be examined for compliance with commercial fishing industry vessel safety regulations. Coast Guard boarding teams are limited by the following policies:

"The safety equipment examination on a vessel which displays a current decal will normally consist of no more than a spot check…" [COMDTINST 16711.13b].

"Fishing vessel safety boardings are normally conducted in conjunction with Search and Rescue (SAR) and Law Enforcement (LE). No planned patrols/ sorties are permitted for the sole purpose of safety equipment enforcement." [COMDTINST 16711.13b].

While the first policy limits the scope of an at sea boarding to mere spot checks of safety equipment, the second limitation creates more significant problems because it essentially limits safety examinations to only those fisheries that the Coast Guard enforces fishery management regulations on (such as halibut, pollock, and other groundfish): and does not allow the Coast Guard to board what are considered to be high risk fisheries (such as crab, herring, and salmon fisheries). A result of these policies is that the same low risk fleets are often targeted for boardings, and the high-risk fleets are never boarded at all. Compounding this problem is that the at sea boardings for the past ten years have declined in Alaska due to mandated multi-mission requirements, budget constraints, and lack of surface assets.

The limited number of boardings reduces transparency with in the fleet, therefore, it is extremely important that when violations are detected that the Coast Guard use its leverage to compel compliance. In the past, at sea boardings where violations were discovered typically resulted in very small fines or "warnings" in lieu of fines. This practice does not compel compliance nor modify behavior. In response to this problem many Coast Guard districts have established a "fix it" program. The "fix it" program relies on sending the violator a letter stating that maximum penalty will be assessed unless the operator contacts their local Marine Safety Office (usually within thirty days) and arranges to complete a CFVS exam. In Alaska, 90 percent of the operators (found in violation) receiving a "fix it" letter successfully complete the exam process. It's cheaper to comply than pay the fines, because the maximum fines are large. This approach has significant potential to address the non-compliance problem. Conceptually the "fix it" program is a good idea, but ways to make it apply to more vessels should be pursued. However, due to the limited contact the Coast Guard has with the Alaskan fishing fleet, the percentage of vessel operators brought into compliance via this method is insignificant when compared to the total size of the Alaskan fleet.

Given the scope of the compliance problem the Coast Guard faces with both the VDE program and at-sea law enforcement, new approaches need to be developed to improve compliance with fishing vessel safety regulations. Under the current practices, the Coast Guard is missing an opportunity to effect prevention, as well as compel compliance *before* fishing vessels put to sea.

AUTHORITY FOR DOCKSIDE ENFORCEMENT

Dockside enforcement solves most problems the Coast Guard faces with compelling compliance in the U.S. fishing fleet. High-risk fisheries and vessels can be targeted, sanctions are immediate, more vessels can be boarded safely, effectively, and economically than can be boarded at sea. Under the Ports and Waterway Safety Act, the designated Coast Guard Captain of the Port (COTP) has authority, delegated by the Secretary of Transportation, to control the movement of any vessel in his/her zone that is a risk to the environment, impedes commerce or poses a threat to human life and safety. The threat to human life and safety is, of course, the Coast Guard Marine Safety program's highest priority.

The tool used to carry out this authority is the Captain of the Port Order (COTP). Once a vessel has been identified with a clear safety problem, a COTP order is issued requiring the vessel to remain in port until the safety problem is resolved to the COTP satisfaction. This has two immediate effects: strong incentive to bring the vessel into compliance through the instant economic sanction of not being allowed to sail, and intervention prior to the vessel sailing, which is a great preventative action.

Traditionally the Coast Guard has not exercised its authority to enforce safety regulations at the dock as fishing vessels prepare to go fishing. Marine Safety Office Anchorage's efforts in Dutch Harbor are the first comprehensive dockside enforcement efforts aimed at a high risk fishing fleet.

IMPLEMENTATION

Beginning October 1999, the 13th and 17th Coast Guard District fishing vessel safety staff developed a comprehensive at the dock boarding program to identify and correct safety hazards known to exist in the Bering Sea crab fisheries. These fisheries were chosen because the National Institute of Occupational Safety and Health ranks them near the top of the most hazardous occupations in the United States. Economic factors as well fishery resource management issues all combine to create an unsafe environment for these types of vessels [Woodley 1999]. It has been established that the leading cause of fatalities in these winter crab fisheries is the sudden loss of a vessel due to stability problems, followed by man overboard events (MOB). (See Figure 3.)

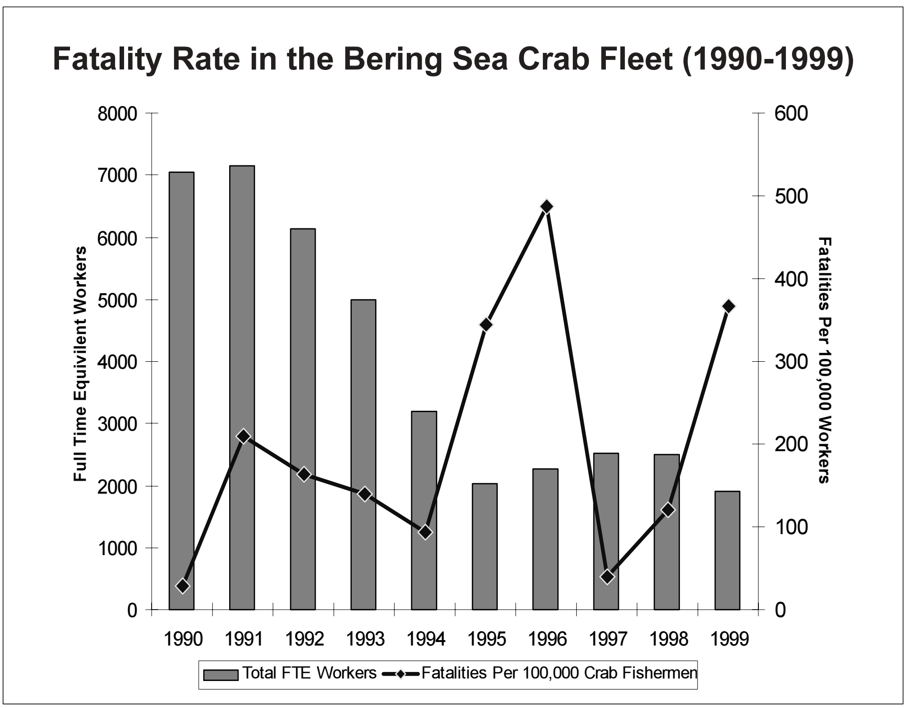

Figure 3: Summary of BSAI Crab Fishery Fatalities

The goal of this at-the-dock-boarding program was to examine a large number of vessels within the fleet prior to the fishery opening. The at-the-dock boarding used qualified marine safety enforcement personnel to board vessels and examine stability instructions, and to ensure vessels were loaded in accordance with the onboard stability criteria. During the examination of the vessels loading practices, enforcement personnel also examined other aspects of the vessels safety system, such as adherence to requirements for drills and instruction, primary life saving equipment, and observed overall material condition of the vessel. Because these boardings were not VDEs, enforcement was possible in the form of a COTP order detaining the vessel until the discrepancy is corrected. What works so well in the Alaskan crab fisheries is that the consequences of the COTP order (not be able to fish) is widely understood, so simply the threat of issuance is enough to compel immediate compliance. Only six COTP orders were actually issued in 1999-2000 and compliance with stability criteria in all cases was immediate.

The following is a brief summary of the three dockside enforcement efforts in 1999-2000:

- Boarded 70 percent of the crab fleet in three four day periods.
- Discussed stability and fishery related issues with over 210 vessel masters.
- Had vessel masters demonstrate knowledge of stability reports.
- Gathered large amount of safety data on fleet regarding MOB and prevention.
- Detected six overloaded vessels, intervened and compelled them to come into compliance.
- Accomplished all of the above with minimal use of personnel, resources and tax dollars.
- Identified problems with primary lifesaving equipment on one-third of vessels boarded.
- Corrected all deficiencies prior to any vessels leaving port.

A total of eight marine safety personnel were utilized and the cost of this enforcement effort totaled less than U.S. $20,000. Compared to what it would have cost to conduct a similar enforcement effort while at sea, this activity gives an extreme "bang" for the buck, and has accomplished every thing the current Coast Guard Marine Safety Business Plan has directed.

SUMMARY

For law enforcement to be successful and compel compliance, an enforcement system must provide surveillance, detection, and credible sanctions. In addition, the population regulated should also expect the presence of law enforcement personnel on a regular basis. Under the existing two pronged approach of VDEs and at-sea boardings, this is not being successfully accomplished. With VDEs there is no method to compel compliance, an insufficient number of exams are conducted, and high-risk fleets are not targeted in order to maximize the effect of exams. With at sea enforcement boardings, the compliance checks are abbreviated, high-risk fleets are not boarded, and the overall number of boardings has declined substantially. Dockside enforcement efforts can accomplish all of the above four primary goals and more.

Currently there is wide spread support in the industry for the Coast Guard to better enforce existing laws and standards. Coast Guard Headquarters and the Commercial Fishing Industry Vessel Advisory Committee are working together in the development of several regulatory and policy initiatives. Many of these initiatives will require extensive time lines for implementation because of the need for additional legislative authority. The use of dockside enforcement efforts that target fishing vessels involved in high risk fisheries can be implemented now. Fishing Vessel Safety personnel in the Coast Guard can target and tailor variations of this approach to suit regional needs. No additional legislative authority is needed, no additional personnel or funding is needed.

REFERENCES

Alaska Department of Fish and Game [1999]. Annual management report for the Shellfish fisheries of the westward region, 1998. State of Alaska, Department of Fish and Game: Regional Information Rep. No. 4K99-49.

Burke W T, Legatski R, Woodhead WW [1975]. National and international law enforcement in the ocean. Seattle: University of Washington Press.

Coast Guard Act. U.S. Code. 1949. Vol. 14, sec. 89.

Commercial Fishing Industry Vessel Safety Act of 1988. Statutes at large. 102, part 2,1585.

Commandant Instruction 16711.13b Implementation of the Commercial Fishing Industry Vessel Regulations.

Fukuyama K et al [1994]. Systematic Policy Development to Ensure Compliance to Environmental Regulations. IEEE Transactions on Systems, Man, and Cybernetics, *24*: 9.

Herbert J [2000]. Minutes Summary of the Commercial Fishing Industry Vessel Advisory Committee Meeting August 22-23,2000, 19th Meeting.

Sicks G [1992]. SCG voluntary dockside examinations. In :Proceedings of the National Fishing Industry Safety and Health Workshop October 9-11, 1992, Anchorage Alaska.Cincinatti, Ohio: U.S. Department of Health and Human Services, Public Health Service, U.S. Public Health Service, Centers for Disease Control and Prevention, Natonal Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-109.

USCG Fishing Vessels Safety Task Force Report [1999]. "Living to Fish, Dying to Fish." Washington D. C.: U.S. Coast Guard.

Woodley C [1999]. Survey for the 1999 Bristol Bay Red King Crab Season Dutch Harbor, Alaska 13th Coast Guard District.

Woodley C [2000]. Developing Regional Strategies in Fishing Vessel Safety: Integrating Fishing Vessel Safety and Fishery Resource Management.

Wednesday, October 25, 2000

HAZARD ANALYSIS AND INJURY SURVEILLANCE

Photograph and caption
by Earl Dotter

After days of “hauling back” with short periods of sleep in between, exhaustion sets in. (Despite their fatigue) every night, one of the crew must relieve the captain on watch.

A COMMERCIAL FISHING VESSEL RISK ASSESSMENT AND REMEDIATION MODEL

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Lieutenant Commander Mike Germinario has over twenty years of operational and engineering experience in the U. S. Coast Guard. He received a Bachelors Degree in Civil Engineering from the Coast Guard Academy in 1984 and holds Masters Degree in Civil Engineering from the University of Illinois and is a registered Professional Engineer in Virginia. In between Coast Guard facility planning and construction projects, he had three separate assignments operating Coast Guard cutters off the Atlantic seaboard, conducting counter narcotics and immigration operations in the Caribbean and most recently fishery law enforcement and rescue operations in the mid-Atlantic and New England offshore waters.

Currently as Deputy Chief of Law Enforcement in the Atlantic Area, he oversees the Coast Guard's operational efforts in their fisheries mission along the Atlantic seaboard. He is also the senior Coast Guard advisor on law enforcement and safety to the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fishery Commission.

BACKGROUND

Commercial fishing continues to rank as one of the most hazardous occupations in America. Eleven fatalities from four fishing vessel sinkings over a three-week period off the mid-Atlantic coast in January 1999 and the findings of the Fishing Vessel Casualty Task Force in April 1999, led the Coast Guard's Atlantic Area Commander, Vice Admiral John E. Shkor, to make the reduction of fishing vessel losses and fatalities his highest safety priority. Taking command of the Atlantic Area in September 1999, he remarked, "…Last winter saw an unusually high number of fatal accidents among our commercial fishermen…I do know another winter is coming and may well see a repeat of last year's tragedies. I intend that the cognizant commands in Atlantic Area focus on those elements of the industry most at risk and with our current limited authorities…Do as much as is possible to mitigate that possibility." Operation Safe Catch was developed to respond to this significant safety threat facing tens of thousands of commercial fishermen. For the first time, commercial fishing vessels in Atlantic Area's zone of responsibility were evaluated and visited using an innovative and extremely effective risk assessment and hazard remediation methodology that focused limited Coast Guard resources on those vessels most at risk.

DEVELOPMENT PROCESS

Operation Safe Catch was a cohesive operational effort involving hundreds of Coast Guard at-sea boarding officers and dockside examiners. The development and successful deployment of Safe Catch was a direct result of an integrated team of staff and field level components from both the Coast Guard Law Enforcement Operations and Marine Safety programs. Organizationally, up until Safe Catch, these programs would often work separate of each other, despite mission overlap in the area of commercial fishing vessel safety. Safe Catch was designed to bring these programs together to improve effectiveness by requiring frequent communication, consistent application of policy and cross-program training, throughout the Atlantic Area (East Coast, Gulf Coast and Great Lakes). Prior to Safe Catch, on the fishing grounds or at the docks, commercial fishermen would often see two distinct components of the Coast Guard; Operations personnel or Boarding Officers conducting safety and fisheries law enforcement inspections at-sea and Marine Safety personnel performing voluntary safety exams dockside. Despite having similar safety objectives, communications between these two entities was minimal. Through the framework of Safe Catch, each program shared common training tools, frequently worked side-by-side, and effectively exchanged information. Consolidated monthly reports with clear measures of effectiveness further encouraged teamwork between the programs. Operation Safe Catch invigorated the commercial fishing safety program by efficiently teaming all Coast Guard resources to focus their efforts on high risk fishing vessels.

Design of the Operation required teamwork from each of Atlantic Area's five regional Districts located in Boston, Massachusetts; Portsmouth, Virginia; Miami, Florida; New Orleans, Louisiana; and Cleveland, Ohio. Many factors were balanced by the Team to develop an operation that could be quickly implemented and effectively carried out throughout the entire Atlantic Area. These factors included regional differences in fishing fleets, seasonal weather, coastline geographies, training and availability of Coast Guard field personnel, policy and regulatory barriers, implementation of the operation before the onset of winter, public awareness, and consistent execution throughout the Atlantic Area. The Team's cross-organizational membership ensured that the operational tasking was in accordance with Coast Guard policy and was capable of being carried out by the field units. Remarkably, Safe Catch was successfully piloted in one District and then fully implemented in all five Districts in only six weeks.

An excellent example of the teamwork required to develop this Operation was realistically defining the scope of the Operation with the constraints of time and regulatory authority. The Team found that although each District had some regional safety program, the risk assessment criteria were inconsistent. The Team overcame this problem by establishing new objective criteria and a measurement system that could be used to gauge the quality and level of effort applied throughout the various regions within Atlantic Area. The Team worked diligently to narrow the high risk definition, devise new training standards and create methodologies to partner between the two programs. The Team was successful at meeting this critical balance. Results from the Operation indicate an unprecedented level of teamwork at every level of our organization that has had a measurable impact on the safety of commercial fishing.

PROBLEM SOLVING

In an effort to move quickly to provide guidance and direction to the field units before the onset of winter, the Team realized that a large information gap between the Operations and Marine Safety programs would have to be narrowed. In addition, there was little familiarity between these programs because of only sporadic contact at both staff and field levels. Accordingly, a conference was held and regional representatives participated in the creation of an operational order that tasked all Atlantic Area commands. The Safe Catch tasking provided clear risk assessment standards and lines of communication between the programs. The Team identified training as the key method to bring the programs together. Accordingly, a comprehensive training guidance document was established providing the necessary criteria for consistent risk assessment and hazard identification throughout Atlantic Area. The training document was based on assessment of all existing programs as well as the new criteria established by Safe Catch. The first phase of the Operation provided 30 days of field inter-program training using this document.

Those training sessions opened the critical lines of communications between the programs at the field level. The delivered training was extremely effective resulting in each program equally identifying approximately one-half of the high risk vessels noted during the Operation.

With nearly 80,000 commercial fishing vessels in Atlantic Area, the Safe Catch Team quickly identified that the management of risk assessment information on specific vessels was a potential problem area for the Operation. The Team innovatively used the assessment standards and the field training as tools to keep the data at a manageable level. The very narrow definition and associated training on high risk conditions as developed by the Team drove the field personnel to identify only the most hazardous vessels within the large commercial fishing fleet. During Safe Catch field personnel interacted with over 4,300 vessels both dockside and at sea and in some areas nearly 100 percent of the fishing fleet was contacted. However, this extremely focused high risk definition served as an effective screen, resulting in only 900 of those vessels being identified as high risk. Beyond simply identifying high risk vessels, follow-up interaction and remediation of those at-risk was a stated goal of the Operation. The narrow focused definition, which kept the total number of high risk vessels low, subsequently provided the field personnel adequate time to interact with those vessels identified as high risk resulting in over 600 of those 900 vessels moving into compliance through follow-up interaction by the Coast Guard.

CUSTOMER FOCUS

The Safe Catch Team realized that in order for the operation to be effective, the Coast Guard would need to work closely with the commercial fishing vessel owners and operators, our primary customer. Their support and ultimately their willingness to work with our Coast Guard field personnel would be critical to success of this operation. The Team launched a massive public affairs campaign that was designed to encourage support from the fishermen by explaining the importance of properly operating safety equipment and a seaworthy vessel. The campaign, which included press releases, local and national TV (CNN), newspaper, magazine, radio promotions, and many local town/fleet public meetings was tremendously effective. In fact, most fishermen knew of and supported our efforts prior to the Coast Guard interacting with them at-sea or at the dock. We received frequent feedback from the fishing communities about the safety “wake-up call” aspect of the campaign. The

Team's customer focus through the public affairs campaign likely resulted in many fishermen simply checking their own safety gear and vessels. These self-assessments helped us reach the thousands of fishing vessels that we will never be able to visit.

The Team recognized that Safe Catch's public sector customer, the fishermen, and our internal customer, the Coast Guard field personnel, would benefit from a consistent and simple way for both the fishermen and the field personnel to assess fishing vessel risk. For the Operation to be a success, this information would need to be developed and disseminated before the Operation began. The Coast Guard had an obligation to ensure a Safe Catch inspection in New England was the same as an inspection in the Carolinas. This was accomplished through a comprehensive 30-day training program delivered to Coast Guard field personnel from Maine to Texas and the Great Lakes. The training program was effectively developed and delivered by the Team. Using the response of the commercial fishing community as our gauge, on several occasions fishermen made the effort to praise the consistent work of the Coast Guard field units. Remarking on a recent boarding conducted during Operation Safe Catch, Capt. James Ruhle from the fishing vessel *Daranar R* stated, "If all boardings during this operation are conducted in this manner, I think that the industry and the U. S. Coast Guard will suffer no damage to the working relationship we are trying to build." The training program developed by the Safe Catch is currently being adapted and will be included as a core element in future training for Coast Guard boarding personnel, ultimately making the program a lasting element of Safe Catch that will continue to save fishermen's lives well into the future.

CREATIVE AND INNOVATIVE TECHNIQUES

Operation Safe Catch was the first ever Atlantic Area effort to employ a highly focused operational risk management regimen to a major commercial vessel population. In contrast to a prevention/enforcement strategy that was previously used, the Safe Catch Team created a risk assessment/remediation strategy. Prior to Safe Catch, safety exams and prevention activities were random and often at the request of vessels already substantially in compliance. Because the exams were voluntary, the Coast Guard would rarely find themselves invited aboard those vessels most at risk of a marine casualty or fatality. Safe Catch used an aggressive strategy of identifying high risk fisheries and high risk fishing vessels and concentrating Coast Guard shore side and at-sea resources to actively engage those commercial fishing vessels most likely to have a marine casualty. Newly developed inspection standards, critical risk definitions and remediation tactics formed the core of the operation. At-sea boardings and voluntary dockside examinations sought to identify high risk vessels, checking safety items including immersion suits, life rafts, safety gear stowage, distress signals, emergency position indicating radio beacons, fire extinguishers and high water alarms. In addition, unique to Safe Catch, the material condition of each vessel was inspected. Those items included the vessel's watertight integrity, hoses, stability and loading. For vessels identified as high risk, Coast Guard personnel shore side would engage the owners, forming a partnership with the owners to reduce the risk on those vessels in an effort to bring them substantially into compliance with current safety standards. The results of this innovative approach and the strong partnerships that followed had a measurable result in that over 80 percent of those vessels identified as high risk willingly partnered with the Coast Guard to improve the condition of their vessel.

A major challenge for the Team was to quickly provide the field units with a simple method of managing the fishing vessel inspection data and simultaneously linking that data directly into the measures of effectiveness for the Operation. In response, the Team developed a uniformly formatted spreadsheet for data entry at the field unit level. The system included data fields and discrepancy coding which enabled the spreadsheet to be used by Coast Guard field inspectors as a daily worklist to assist in their follow-up visits to high risk fishing vessels. Given the short five-month duration of the Operation, the measurement system was developed to be near real-time, providing the senior operational commanders the "dash board gauges" needed to monitor the effectiveness and efficiency of their units and make adjustments to their tactics and efforts. The measures of effectiveness could be easily extracted for the spreadsheet and the simplified monthly reporting requirements required only that the spreadsheet be electronically forwarded from the field to the staff levels. The shared reporting and accountability necessary between the Operations and Marine Safety programs to support the spreadsheet and suite of measures powerfully reinforced that renewed partnership between the programs, resulting in rarely seen levels of collaboration between the two programs' resources. The utility and demonstrated success of this unique measurement system provides a highly effective model for use by the Coast Guard in the future.

RESULTS ACHIEVED

Coast Guard Atlantic Area's Operation Safe Catch significantly increased fishing vessel safety awareness and contributed to a reduction in fishermen's lives lost during the 1999-2000 winter. Remarkably, during Operation Safe Catch the number of lives lost was only about one-third the number that would have been expected based on the previous two winters and the number of vessels that fell victim to sinking or fires. During Safe Catch, 37 fishing vessels were lost, however, only 13 lives were lost. Although there were many factors that contributed to this, the Team's focus on the highest risk vessels and their safety equipment played a big part in this reduction.

The Safe Catch results that measured the level of risk assessment and remediation interaction by the Coast Guard with the commercial fishing community and greatly contributed to the reduction in lives lost at sea are remarkable. During the five-month winter period of Operation Safe Catch, 4,352 fishing vessels were inspected by the Coast Guard, in contrast to approximately 2200 inspected the previous year. Of those, 912 vessels were identified as high risk; and 80 percent of those vessels agreed to partner with the Coast Guard to improve the condition their vessels. By the end of the Operation, 613 of the 912 (67 percent) improved their compliance with the safety standards and are no longer operating in a high risk condition. The Operation relied on the precept that "reducing risk would save lives" and that is indeed what happened with Safe Catch.

The Team recommended to Coast Guard Headquarters a series of key Coast Guard-wide policy changes based on the lessons learned during Safe Catch including changes to commercial fishing vessel safety inspections, associated service-wide training needs and methods to foster the benefits of the Operations and Marine Safety partnership.

The Operation Safe Catch risk assessment and remediation strategy has been permanently adopted by Atlantic Area, creating a lasting fundamental change to Atlantic Area's approach to improving commercial fishing vessel safety. The renewed partnership between the Operations and Marine Safety resources will more effectively use Coast Guard resources, eliminate redundancies and encourage teamwork at all levels. The newly developed and embedded commercial fishing vessel safety training criteria will result in better trained Coast Guard boarding officers and dockside examiners, ultimately leading to continued reduction in loss of life at-sea. Finally, Safe Catch provides the necessary data to support the envisioned long-term Coast Guard Headquarters regulatory policy changes to improve commercial fishing vessel safety.

SAFETY ENGINEERING IN THE COMMERCIAL FISHING VESSEL INDUSTRY

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The commercial fishing industry is one of the most dangerous professions in the U.S. Fishermen suffer from serious accidents such as vessel capsizing and acute injury to crew members working on deck. Investigations of causal factors leading to these events indicate that engineering design modifications and a heightened sense of safety engineering could have prevented many of these casualties.

This paper summarizes the engineering design analysis on commercial fishing vessel casualties that has been conducted at the U.S. Coast Guard Academy. This work has been conducted as part of the Mechanical Engineering curriculum at the Academy and at the University of Michigan, Department of Naval Architecture and Marine Engineering. In these studies, students have investigated failures to discover the engineering failure sequence. Four case studies are presented: steering failures on a lobster boat, equipment handling considerations on a scallop boat, propeller support failure on a whale watching boat, and an analysis of the naval architecture and equipment design on the Northeastern Scallop fleet. Overall, these case studies document how the safety of the commercial fishing industry can be improved by treating the vessel and its handling equipment as a composite machine that includes both the fisheries equipment and the hull form.

INTRODUCTION

The U.S. Coast Guard Academy is the Coast Guard's principal source for career officers. Graduates of the Academy's four-year undergraduate program receive a Bachelor of Science degree in one of six technical majors (Electrical, Civil, Mechanical or Marine Engineering, Operations Research, Marine Science) or two non-technical majors (Government, Management). In addition to the degree, graduates also receive commissions as Ensigns in the U.S. Coast Guard Academy. The average size of the cadet corps is 875, with approximately 200 cadets graduating each year.

Since these graduates assume leadership positions in all of the Coast Guard's missions, including Maritime Safety and Environmental Protection, it is appropriate that these missions be incorporated into their education and training. As such, the Academy's Mechanical Engineering section has been incorporating safety engineering topics within the curriculum by integrating fishing vessel safety topics into existing courses in the curriculum.

One method for doing so has been directed study projects. A group of cadets may investigate the artifacts of a marine casualty and search for the engineering causes of the event. Typically, a group of cadets will work for the entire semester on one casualty, and receive academic credit for their work. Marine casualties have also been used in existing courses in the Mechanical Engineering curriculum as projects in Mechanical Engineering design courses.

An investigation hypothesis technique has been developed to guide most inquiries. The typical scenario for a cadet investigation begins with a U.S. Coast Guard Marine Safety Office delivering artifacts of a casualty and a case history file to the Academy. From there, the cadet team examines the material to understand the circumstances surrounding the casualty. An initial hypothesis for failure is then proposed by the cadet team, and the investigation explores the validity of this hypothesis using a macro-to-micro examination sequence. On the macro scale, the team studies the case history (which include photos and statements) and the artifacts themselves. Mechanical analysis of the system is conducted to understand the forces acting on the object. Magnification of components provides a more detailed view, followed by mounting, chemical etching and higher magnification to see more intricate structures. Additionally, chemical analysis of the failed components is conducted to determine the material's chemical composition [Nutt 1976].

The results of these examination levels are then combined to determine if the initial hypothesis for failure was correct. If needed, a new hypothesis is generated, and the examination results applied to that hypothesis. To complete the education component of the investigations, lessons learned and suggestions on how to avoid similar casualties are prepared and returned to the Marine Safety Office.

The purposes of this work are dual: it introduces an important Coast Guard mission area to cadets and it serves as a research tool for the Coast Guard's Marine Safety community. While the casualties are real, the work of the cadets is for educational purposes only, and is not used as part of official Coast Guard investigations. In each case study, the names of the vessels have been changed to a fictional name. In this paper four case studies are presented to document this work and solicit feedback from fishing vessel safety professionals.

CASE STUDY ONE: LOBSTER BOAT STEERING FAILURES

Two casualties of lobster boat steering have been examined and illustrate a potential class problem for these vessels. Two brief summaries are presented: the motor vessel *Mr. Morgan* and the motor vessel *King of Calm*.

The *Mr. Morgan* was a 65 ft lobster boat used in northern U.S. waters for lobster fishing in the summer and urchin fishing in the winter. The original engine in this vessel was replaced with a 350 horsepower engine, in part to enable the boat to be competitive in summer time lobster boat races. During urchin fishing, it was not uncommon for the vessel to ground itself as it worked the tidal zone areas for urchin.

Over a period of time, the master experienced the following sequence of events: with the vessel fully loaded, the rudder would be hard over, the throttle placed ahead-full, followed by a loud crack from the stern. After placing the vessel in a tide crib, the stainless steel rubber post was found to have failed along the weld that connected the post to the rudder. On its final voyage, the scenario repeated itself and a loss of steering was encountered as the vessel made its way back to harbor. After taking a tow and removing the crew, the vessel capsized and sank in 60 feet of water.

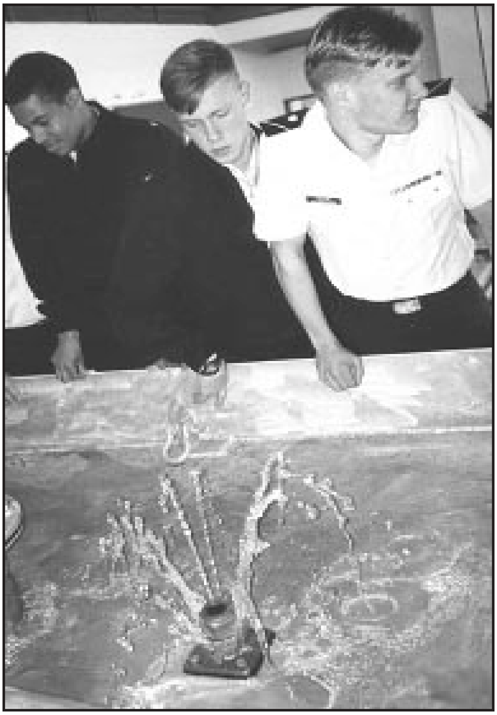
The vessel was recovered, and was examined by a Coast Guard inspector. The inspector found that the rudder post housing was cracked into four pieces. This failure led to the loss of steering, and allowed sea water to freely enter the aft steering compartment. The three pieces of the housing were removed from the damaged vessel, and sent to the Academy.

Examination by a team of cadets discovered that the rudder post housing failure was not a catastrophic failure, but rather a progressive failure that occurred over a period of time. Macro and micro examination of the failed components illustrated that the cracks originated from high stresses placed on the rudder housing from the vessel groundings, and that these cracks propagated due to high loads placed on the vessel while getting underway from a dead

Photo 1: A Failed Rudder Post Housing

stop, rudder hard over condition. The chemical composition of the material indicated that the original component was indeed adequate for the initial design, but not for the additional load that resulted when the engine size was increased. It was hypothesized that the majority of cracks in the rudder post housing existed for a long period of time, and could have been readily detected by an examination of the vessel steering system.

In addition to the written report of their findings, the cadet team documented their investigation for the Marine Safety Office with an educational video that detailed the failure sequence and promoted regular inspections of the vessel's engineering systems by vessel owners. Also, the failure was replicated on a mobile damage control trainer used by the Marine Safety Officer to illustrate the volume of water that can result from cracks in the rudder post housing.



U.S. Coast Guard Academy

Photo 2: A Cadet Investigation Team at Work

This case study was duplicated in another that examined the loss of steering on the *King of Calm*. The original rudder post bearing on the vessel's keel was replaced from a brass bearing to a Teflon block by the owner to allow for quieter steering. A bearing mount was machined into this Teflon block, and the rudder post was placed in this new bearing. Over time, the captain of the *King of Calm* noticed a slow degradation of steering that eventually resulted in a complete loss of steering.

Upon examination by a CG inspector, the rudder post was found to be sitting on top of the Teflon block. It had worn a new bearing hole into the block. As with the *Mr. Morgan*, the rudder post housing was also found to be cracked in four locations and the mounting holes of the housing were worn into oval shapes. The case history and the failed rudder post housing were delivered to the USCGA Mechanical Engineering section for analysis. In this case, a group of cadets examined the components as a project in their Machine Design course and examined the failure with respect to specific topics covered in this course.

Examination by the cadet team led to the hypothesis that the alignment of the Teflon bearing block was not correct and that this misalignment had forced the rudder to jump out of the machined bearing hole. While resting on the Teflon block, the rudder post slowly wore a new bearing hole into the Teflon, with the shape of this hole being oblong as well. By analyzing the forces on the rudder, the cadet team determined that the unbalanced load on the misaligned rudder caused the cracks in the rudder post housing.

Here too, vessel alterations were the cause of the progressive failure of the rudder post housing. Regular inspections of the vessel's operating system would have detected the cracks in the rudder post housing and allowed the master to correct the problem before it manifested itself as the more dangerous loss of steering condition.

CASE STUDY TWO: SCALLOP EQUIPMENT HANDLING

Two cadets studied the Northeast Scallop Fishing fleet as a directed studies project to examine how safety in this industry could be increased. Working with MSO Portland, Maine and the vessel classifications established by MSO inspector Mr. Jeff Ciampa, the cadets focused on studying the Washington County rig for scallop fishing [Ciampa 2000].

In this rig, fishermen work directly below the boom head and drag net while its contents are emptied on a sorting table. With a combined weight of nearly 5,000 lbs supported by a single connection point (cable and pulley), there is great potential for severe injury if the cable or support fails.

After spending time on-board scallop vessels, talking with vessel examiners and fishermen, the cadet team developed possible solutions to increase safety should components fail. The team documented their design alternatives with a series of models that were used to illustrate their ideas and solicit feedback from scallop fishermen. Based on the community feedback principle, input from the fishermen was essential for the cadet team to further develop their ideas [Backus 2000].

To improve safety in this industry, the cadets designed a secondary support mechanism for the net as well as a set of operating procedures to help reduce injuries. Of special note is that the cadet research on this work received first place in the national student paper competition sponsored by the American Society of Mechanical Engineers Safety Engineering and Risk Analysis Division and the National Institute for Occupational Safety and Health [Plumley and Pisares 1998].

CASE STUDY THREE: PROPELLER SUPPORT

A 100-ft whale-watching vessel was the subject of a forensic engineering investigation of a failed propeller shaft strut. This structural member, which supported a 3-foot run of a 3-inch diameter shaft, cracked along its weld to the hull. The case history reported the operators hearing a loud noise, followed by severe vibrations as the suspended strut rotated on the spinning shaft.

The cadet investigation for this case was notable since the work was conducted as a project in a course on Finite Element Analysis. The strut was modeled using finite element methods and the model was then examined to see which of a series of loads and vibrations yielded a stress concentration field that matched the failed component. This analysis ruled out shaft misalignment as the cause, and indicated that a stress concentration started at the leading section of the strut and then propagated to the rear of the vessel, most likely from ingesting a submerged line that then wrapped itself around the spinning shaft.

Photo 3: Hull damage

HULL FORM AND EQUIPMENT HANDLING IMPACT ON STABILITY

Upon graduation, cadets become Ensigns and are assigned to floating Coast Guard units for their first tour of duty. Specialization in a Coast Guard mission area follows that initial tour, with graduate school in engineering as one option for officers working as engineering specialists. In one example, a USCGA graduate conducted master's level research in the field of fishing vessel safety, thereby demonstrating the applicability of this area to graduate work as well.

Working with MSO Portland, Maine and faculty at the University of Michigan Department of Naval Architecture and Marine Engineering, a former cadet examined the influence of operations on scallop vessel stability. In this case, the vessel and the equipment were treated as a composite system, and the reserve stability was calculated for the vessel in each operating condition. Correlating with the industry's casualty occurrence rate, the greatest decrease in stability was demonstrated to occur on the single point side rig vessels during haul back.

SUMMARY

These case studies illustrate how the topic of fishing vessel safety can be integrated into the undergraduate and graduate engineering curriculum. In each case, engineering analysis was applied to investigate the vessel's condition and identify unsafe operating procedures. This method has been quite successful not only as a tool to engage future Coast Guard officers in an important mission area, but also to serve as a research arm of the Coast Guard Marine Safety Offices. In each project, safety was found to be a function of not just the separate components, but rather the integrated system of components and hull form.

ACKNOWLEDGMENTS

The contributions of MSO Portland, ME, and especially the assistance of Mr. Jeff Ciampa, are appreciated and valued. The work reported in this paper reflects the contributions of many members of the USCGA Department of Engineering and its Mechanical Engineering Section. This work was also supported by the Harvard University Visiting Scholars Program in Occupational and Environmental Health.

REFERENCES

1. Nutt MC [1976]. Metallurgy and Plastics for Engineers. Phoenix, AZ:Associated Lithographers.

2. Ciampa J et al [2000]. The New England Fishing Fleet. Presentation at International Fishing Vessel Safety and Health Conference, Woods Hole, MA.

3. Backus AS [2000]. Entanglement of Lobstermen, Work Practices, and Entanglement Prevention Devices in Maine Lobster Fishery: A Preliminary Study. Presentation at International Fishing Vessel Safety and Health Conference, Woods Hole, MA.

4. Plumley M, Pisares C [1998]. Scallop Fishing Vessel Safety. Submission to 1997/1998 National Student Safety Engineering Design Contest, The Safety Engineering and Risk Analysis Division of the American Society of Mechanical Engineering and The National Institute for Occupational Safety and Health.

5. Newton TJ [1999]. Stability Analysis of the New England In-Shore Scalloping Industry, 1999 [Thesis]. Michigan: University of Michigan, Department of Naval Architecture and Marine Engineering.

MEASURING RISK OF CUMULATIVE MUSCULOSKELETAL TRAUMA IN FISHING VESSELS

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Scott Fulmer began researching health issues among fishermen in his hometown, Gloucester, Massachusetts, in 1992 while earning an M.S. in Ergonomics from UMass-Lowell. He worked for five years as a fellow and staff at the Center for Community Responsive Care in Dorchester, Massachusetts, a Preventive Medicine/Public Health Residency Fellowship. Mr. Fulmer investigated fishing vessel ergonomics for two years through a grant from Northeast Center for Agricultural and Occupational Health, as well as ergonomics of fruit harvesting among migrant workers in the Northeast U.S. He is presently the Ergonomics Project Manager of the Construction Occupational Health Program at UMass-Lowell, since fall of 1999, researching ergonomics hazards and solutions in highway construction on a grant from the Center to Protect Workers' Rights.

INTRODUCTION

Fishing has long been recognized as a dangerous occupation, consistently ranking at or near the top of all occupations in fatalities in states where the industry employs a significant population. Between 1992 and 1996, the fatality rate for fishing was 140/100,000 workers: eight percent of the fatalities were from the Massachusetts' fleet [Drudi1998]. Systematic measures of response to fishing vessel emergencies implemented in the last ten years may have resulted in declining rates of lives lost at sea. Measures of prevention of injuries or vessel emergencies have not been as widely adopted, nor have rates of non-fatal injuries or rates of vessel emergencies been shown to be decreasing [Lincoln 1997, BLS 1990-1997]. Literature continues to grow which link certain occupational risk factors to the incidence of injury and illness. Specifically, repetitive motions, forceful exertions, awkward or static postures, cold temperatures and vibration contribute to cumulative musculoskeletal disorders. By reducing these risk factors through ergonomic measures, a corresponding reduction in injuries would be expected. For example, Törner

[1988] showed that hull redesign could reduce knee bending and contact stress to the knee among fishermen in Sweden.

This study characterized the work processes involved in different types of fishing in Massachusetts. Specifically, observations were made to qualify and quantify risk factors that may be reducible by applying ergonomic principles to the design of the work environment in fishing vessels. Many different methods of harvesting fish are used throughout the various fisheries of Massachusetts. Fishing boats are classified by their gear type. The boats investigated in this study were two lobster boats, a gillnetter and an otter trawler. The three gear types observed in this study make up about 70 percent of all fishing boats licensed in Massachusetts.

METHODS

Two of the four boats observed were lobstering operations, one was a gillnetter and the other was a trawler. Each had a crew of two – one captain and one sternman – except the trawler, which had an extra sternman for a crew of three. The boats were out of Gloucester, Rockport, and Fairhaven, Massachusetts, and selected by convenience.

Each crew voluntarily completed a health assessment questionnaire. The questionnaire was composed of questions regarding occupational experience, health history, and health treatment.

Direct observations of the four boats were made during their regular operations in order to quantify risk factors for musculoskeletal disorders, acute injury, and noise-induced hearing loss. Video recordings were made of the operations, which helped in analyzing the elements of the required tasks. In addition, still photography was employed to document hazardous conditions.

An ergonomic job analysis in which the observed risk factors for musculoskeletal disorders that were described was completed for each boat [Keyserling 1991]. The risks were identified after reducing the work description to an elemental level, then associating those elements with postural risk factors. Categories for postural risk factors were derived from the PATH (Posture, Activity, Tools and Handling) method, a work sampling-based approach for collecting ergonomic hazard data in non-routine jobs [Buchholz et al 1996]. The duration of the various routine cycles of work were measured and used to determine the overall workload and percent of time an individual would be exposed to a particular risk factor. Noise was measured using an audio dosimeter (model MK3, DuPont) clipped to the observer. The condition of tools (sharpness of knives, integrity of handles, rust, etc.) and estimated weights were noted when possible.

RESULTS AND DISCUSSION

The three kinds of fish harvesting observed involved gear designed for that particular fishery. Lobstering and gillnetting are classified as stationary gear, while otter trawling is classified as mobile gear. Each of the gear types is designed to trap and remove fish or shellfish from their natural environment. Successful production in commercial fishing is simply a matter of volume, with limits on species regulated by state and federal governing bodies. Crews try to haul in as much fish or shellfish as possible, clean and prepare it for storage as needed, and stow it into some kind of holding area. Beyond regulations on gear size, harvesting equipment is not standardized.

The major risk factors to musculoskeletal disorder are related to materials handling. The frequent hauling of traps requires some awkward posturing, frequent and sometimes forceful lifts. Handling bait and removing catch did not usually require great force, but was repetitive and required both speed and precision.

The movement of the fishing boats at sea was significant, yet was not fully predictable. Although these were less than ideal working conditions, experienced individuals had some skills in compensating, as the work demanded smoother handling practices that fully utilized mechanical advantages. The sternmen on the lobster boats were able to use the rising boat to create inertia when lifting the traps.

Work stress resulted from the condition and management of the fisheries. One captain pointed to concerns he had for the “big picture”. He was most concerned about over-fishing. In particular, he felt that the government has not taken adequate measures to manage fishery resources, and will be forced to react too forcefully to what will be an unavoidable need for emergency protection. When this happens, competitive forces will make economic survival more of a challenge than it is presently. These forces, or the mere perception of these forces, present an increased risk for poor health outcomes in multiple ways. Primarily, they put pressure on the observed vessels to put more time at sea to compensate for the decrease in the fishery resource. More time at sea increases the exposure to the known risk factors. Secondly, but no less significantly, there is additional systemic stress to fish harvesters who may perceive that the work that they are doing is not truly a path to economic well-being. Although they may have felt that the work is not worth the risk, they were bound and committed to it by virtue of being boat owners or experienced hands who had no immediately viable alternatives. Karasek and Theorell [1990] have demonstrated risk for undesirable health outcomes in any work environment where such a high job demand is exacerbated by low decision latitude.

LOBSTERING

Lobstering has the most repetitive haul and set cycle of the three types of operations observed. On the day they were observed, one crew handled 240 traps, the other 290. Both captains commented that they commonly handle 300 traps on most days.

The two operations observed are interesting in comparison because their techniques differed in three major ways that affect health and safety. One boat set traps individually attached to buoys, known as singles, the other set groups of ten or twenty traps attached to buoys, know as trawls. The crew of the boat setting and hauling trawls did so for 45 percent of the day, whereas hauling and setting strings of singles required about 70 percent of the day. Lifting and pulling the trap onto the boat was necessary only ten percent of the time on the trawling set than on the singles set. Awkward postures of the back and upper extremities and high force were associated with this lifting and pulling. The captain, who was the one who performed the lift, of the boat setting and hauling singles was exposed to ten times the number of these awkward lifts than the captain of the trawl set. The rate of repetition in either boat is strictly under the control of the captain, who operates the boat.

The second effect of the trawl set regarded the lines. The lines used to connect the traps to each other in the trawl set were piled on the deck at the feet of the crew, and were a risk for entanglement and loss of life from drowning. In contrast, the lines connected to the single strings were immediately placed on top of the trap at waist height once the trap was hauled in, which decreased the risk of entanglement.

The third difference in technique was not related to the traps, but to the bait loading. One boat ran a spike through the bait-fish's eye sockets and then down a string attached to the trap. The other loaded bait-fish into onion bags and tied the bag into the trap with a drawstring. Neither sternman reported pain associated with this task, but significant differences in wrist posture were noted. The associated repetition and postures would make this task an area of concern for reducing risk for MSD.

The technique of hauling and setting the traps was otherwise similar between the two lobster boats. Captains were exposed to the awkward trunk and upper extremity postures, high force, and repetition of pulling in the trap. Additionally, sternmen were exposed to repetition, high force and awkward posture of handling traps in their back and shoulders, as well as to repetition and awkward postures associated with gauging and banding the lobster.

Noise levels were close to OSHA's standard of 90 dBA for eight hours on one boat, but much less on the other. Both captains attributed the noise level differences to the differences in engine manufacturers.

OTTER TRAWLING

Otter trawling is a method of dragging named for the large doors that hold open the mobile gear (the net) while it is dragged either through mid-water or across the bottom. When the doors shimmy through the water, they look like otters swimming. The opening of the net is very large, and narrows to a "cod end" where the catch gets trapped.

Otter trawling is a less repetitive process than lobstering, and among all types of gear, it has been known as "gentlemen's work". On the observed day, the crew set and hauled back the net three times. They were idle while the net was dragging.

The large otter doors required forceful exertions to guide them as they were hoisted from their secure slot into the water to begin the haul, and, in the reverse process, to secure the door into its slot after hauling back the net. Static force was required to hold a bar against the cable in order to guide and prevent tangling when the cable was wrapped around a large spool during haul back. The crew sorted the fish into baskets after the net was hauled back and the catch emptied onto the deck of the boat after dragging for about two hours. The work surface was below the feet, and required severe forward trunk flexion and/or kneeling for extended periods. Once in baskets, the catch was loaded into the hold without mechanical aids. The captain estimated that full baskets weighed up to 80 lbs, and were passed from above deck by one man to below deck to another. The second man's arms had to be fully extended above his head to grab the basket from above deck. An extremely forceful pull was required to haul in the "bird", a 200 lb winged iron weight on each side of the boat set out during dragging to dampen the movement of the hull of the vessel. High force may be required for irregular lifts of any large objects dragged off the ocean floor, such as oil cans, boulders, or broken and discarded fishing equipment.

GILLNETTING

Gillnetting is another form of stationary gear. An extremely long and practically invisible net (monofilament fiber) is set vertically like a fence in mid-water or near the floor and hauled back after about 12 hours. Fish swim unaware into the net and are entangled. The haul back is slow, and the fish were untangled and removed from the net one at a time by the crew.

Though gillnetting was similar to dragging by being completed in a few reiterations, one iteration of removing all of the fish from the gillnet involved highly repetitive motions of the arms, often forceful and jerking motions, with the elbows above shoulder height. This high degree of repetition did not have predictable cycles, in contrast to the cycles of handling lobster traps. The lobstermen's routine had shorter cycles, allowing for one to three minutes of idle time between about 12 minutes of intense materials handling. Gillnetters responded to each fish as the net was slowly hauled back by the lifter. So, when fish close together in the net got hauled in, a flurry of work would continue until the net happened to be empty for a few feet. Conceivably, the repetition could last for the entire haul back, which lasted about an hour for each net.

Two brief lifts were particularly forceful: when the "stone" – a large piece of iron used to weight one end of the net to the bottom – was thrown overboard, and when the anchor was hauled in to the bow. On longer trips, the catch would need to be iced below deck. Removing the iced catch required forceful shoveling in very awkward positions.

GENERALIZABLE RISK FACTORS

Repetition was an important risk factor for injury in each of the fisheries. The volume of catch was a major determinant in how much repetition, except in handling lobster traps (where each trap had to be hauled, new bait set, and then reset in the water regardless of the trap's contents). The captains determined the rate of the repetition, and they had to judge whether increased rate of repetition actually resulted in increased volume of catch (the ultimate goal).

Forceful lifts in awkward posture were seen on each boat. In lobstering, and less consistently in gillnetting, these were accompanied by the risk factor of repetition when handling the gear. Forceful exertions of the hand and wrist were also seen in handling of the catch in lobstering and gillnetting. Given existing technologies, these tasks would be required on any boat of the respective gear type.

Additional strain due to force of muscles needed to maintain balance as the boats move somewhat unpredictably is more prevalent in the smaller boats. None of the boats observed were big enough to dampen the effects of the waves moving the boat, even on calm days. Decks, gear, and catch were always wet, a factor that also tends to increase the strain on the musculoskeletal system: grip forces need to be higher and footing needs to be securer than with similar circumstances under dry conditions.

Irregular tasks also put the worker at higher risk. In lobstering, the high force and awkward wrist angle during line repair was only observed once in 20 hours of work. In otter trawling, high force and awkward posture was required to move an old and full lobster trap that got hauled in by the net.

These operations were observed for one fishing trip each. Crews commented that the long workdays and sleep deprivation accompanied by overnight trips does contribute to stress. This work stress is compounded, as mentioned before, by the economic issues facing the entire industry. Engine noise has a negative effect on work stress, too. Heat and sun in the summer and cold temperatures in the winter also are factors.

INTERVENTIONS GENERALIZABLE TO INDUSTRY

Available workspace determined posture for some of the repetitive tasks, such as stacking traps in lobstering, icing fish in gillnetting, and sorting fish in otter trawling. In ergonomic intervention of any kind, attention should be given to ensuring that maximum utility of the limited space is achieved and that the work processes require as little unnecessary lifting as possible. Bigger boats ease some of this pressure on efficiency.

However, the biggest boat observed, the otter trawler, could improve the biomechanical aspects of the job by putting a workstation in the hold of the boat. The described process of sorting fish while kneeling could be eliminated if the catch were lowered onto a sorting table under the deck. The catch could be sorted and iced by sliding the fish, and the work height would be near waist level. The forceful and repetitive lifting of the baskets would be eliminated also. In the wintertime, it would be warmer below deck. However, the noise may increase.

In lobstering, a hoist that engages the trap buoy overboard and hauls the trap or trawl of traps up to and then onto the boat would eliminate a very large proportion of highly forceful and highly repetitive lifts done in awkward postures. Some of the stress to hands and wrists could be eliminated by changing the banding tool and gauging tool handles to reduce the need for non-neutral postures.

The subjects in this study were creative problem solvers. The nature of the industry seems to challenge one's basic survival and creative energy. Certainly, fishermen would make excellent ergonomists if given useful training and information. Ergonomic training in the fishing industry should include an understanding of what the risk factors for musculoskeletal injuries are and how they relate to the work they do. Vessel stability is a specialized science that must be taken into account with respect to any alteration of a boat.

ACKNOWLEDGEMENT

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REFERENCES

Bureau of Labor Statistics. Occupational injuries and illnesses: industry data. 1990-1997.

Buchholz B, Paquet V, Punnett L, Lee D, Moir S [1996]. PATH: A work sampling-based approach to ergonomic job analysis for construction and other non-repetitive work. App Ergon *27*:177-187.

Drudi D [1998]. Fishing for a living is dangerous work. Comp and Wking Cond *summer*: 3-7.

Karasek R, Theorell T [1990]. Healthy Work, Stress, Productivity and the Reconstruction of Working Life. Basic Books.

Keyserling W, Armstong T, Punnett L [1991]. Ergonomic job analysis: a structured approach for identifying risk factors associated with overexertion injuires and disorders. App Ergon *6*: 353-63.

Lincoln J [1997]. Epidemiology of vessel casualities and commercial fishing fatalities in Alaska. In:Proceedings of the 2nd National Fishing Industry Safety and Health Workshop.

Törner M, Blide G, Eriksson H, Kadefors R, Karlsson R, Petersen I [1988]. Workload and ergonomic measures in Swedish professional fishing. App Ergon *19*: 202-12.

Photograph and caption by Earl Dotter

A woman sorts the urchin catch at the culling table in frigid 20 knot gusts with a wind chill of minus nine degrees Fahrenheit. Should cables or the headgear above her fall, the violent release of energy could send wire cable whipping.

SURVEILLANCE FOR NONFATAL WORK-RELATED INJURIES IN THE ALASKA FISHING INDUSTRY

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INTRODUCTION

Information for injury surveillance can come from many different data sources. Fatality information is generally gathered from death certificates, which are a clearly defined endpoint. However, information for nonfatal injuries can be a little more difficult to define and locate. This point can be more clearly portrayed by looking at injuries in the commercial fishing industry. Recent injury surveillance has shown that work-related fatal injuries in the Alaska commercial fishing industry are more commonly a result of the loss of a vessel resulting in the loss of fishermen's lives [NIOSH 1997] .When nonfatal injuries occur in the commercial fishing industry it is more commonly a result of machinery or falls that occur while working on deck. This paper will focus on hospitalized nonfatal injuries in the Alaska commercial fishing industry using injury surveillance data from the Alaska Trauma Registry (ATR).

METHODS

The ATR is used as a tool for hospital quality assurance for the care of patients with traumatic injuries. It is also used extensively for injury surveillance in Alaska. Data are collected and maintained by the Alaska State Department of Health and Social Services, Division of Public Health, Section of Community Health and Emergency Medical Services in Juneau, Alaska.

There are many unique aspects regarding the use of the ATR for injury surveillance. One of these is the fact that all 24 acute care hospitals in Alaska contribute data to the registry. Also there are very few hospitals located across the Alaska border. The result is that few people who are injured in Alaska will be seen at a hospital outside of the state before being seen in an emergency department (ED) at a hospital in Alaska. These points make the ATR a useful population-based data source for injury surveillance.

The ATR only has information for patients admitted to a hospital in Alaska. To be included in the ATR a patient has to sustain a traumatic injury defined by an ICD 9 CM discharge diagnosis code ranging from 800.00 through 995.99. The patient also has to be either admitted to a hospital in Alaska; transferred to a hospital with a higher level of care after being admitted to a hospital or seen in an ED in Alaska; or declared dead in the hospital emergency department or after being admitted.

Cause of injury information is taken from the ICD 9 CM "E code." Nature of injury and body region injured are extracted from the ICD 9 CM "N code" given to the primary discharge diagnosis. The ATR has a narrative "injury description" field where additional information on the cause and circumstances of injury can be obtained. Hospital costs are taken from hospital discharge information.

RESULTS

Currently, the ATR contains complete data for the years 1991 through 1998. During this time period there were 34,306 injuries recorded in the ATR. Ten percent (3,582) of these injuries were work-related with 587 occurring to workers in the commercial fishing industry. For the years 1991 through 1997 the commercial fishing industry had the highest number of work-related injuries in the ATR [Husberg 1998]. With the inclusion of the 1998 data, the construction industry had the highest number of injuries for the eight-year period. Annual trends show a decreasing number of commercial fishing injuries where the construction industry has a gradually increasing trend.

When looking at injury rates by industry, commercial fishing ranks third, with four hospitalized injuries per 1,000 workers. The industries with the highest hospitalized injury rates in Alaska were logging (18/1,000) and construction (6/1,000).

Bradley Husberg

Photo 1: Pot being positioned on pot launcher by crane

Bradley Husberg

Photo 2: Pot launcher in up position launching a pot over the side of the boat

Leading causes of injuries in the commercial fishing industry include machinery (187), falls (149), and being struck by an object (98). The E code system does not have a further breakdown for the machinery injuries. However, after reviewing the injury description field in the ATR, it became obvious that most of these injuries were caused by crab pot launchers (CPL) and cranes. The injuries caused by falls can be broken down further using the E code. Most of the falls were from slips or tripping (37) followed by falls from a structure (7). The injury description field in the ATR shows that most of the objects striking workers were crab pots and fish nets.

The nature of injury listed most commonly included a fractured bone (279), open wound (73), and burn (29). Body regions most commonly injured include the upper extremities (184), lower extremities (171), and the spine (35).

Hospital costs ranged from U.S. $219 to U.S. $165,324. The average hospital cost was U.S. $2,063.

CONCLUSION

From review of the causes we find that many of the injuries occur in the crab fishery. The initial approach to the machinery injuries was to look at the CPL in depth. The CPL is a platform, approximately 7ft. by 7 ft. square made of steel pipe. One side of the platform is permanently attached to the gunwale of the boat by hinges, the other side is free to raise and lower by hydraulic power. When a crab pot is ready to be placed in the water the hydraulic ram raises the free end of the CPL platform where the crab pot can slide into the sea. The free end rests on the deck except when it is raised to deploy a crab pot. An empty crab pot in the larger crab fisheries measures 7x7x3 feet and weighs approximately 700 pounds, empty.

Many of the injuries, caused by the CPL, identified by the ATR were crushing injuries to the lower extremities and feet. Possible injury prevention measures could be to weld two steel blocks (~4x4x4 inches) on the bottom of the free end of the CPL where it rests on the deck. This would reduce the contact surface with the deck and minimizing the area where feet and toes could be crushed. Another measure to prevent injuries working around the CPL is to paint a yellow boundary around area the CPL covers on the deck. This would increase fisherman's awareness of areas to avoid when the CPL is in operation. Finally, on some vessels the controls to the hydraulics for the CPL are located far away from the CPL itself making it difficult for the operator to have a clear view of the work (the controls for the CPL are usually located with the controls for cranes, and power blocks). Locating the CPL controls closer to the CPL or with a good view of the working area could help decrease these injuries. Another possibility is to locate an emergency shut off switch near the CPL to be used if someone was caught under the CPL platform.

The ATR has been very useful in identifying hazardous work practices and injury prevention measures in the commercial fishing industry. With information from the ATR, injury prevention programs focusing on machinery injuries in crab fisheries fishermen are underway.

REFERENCES

NIOSH [1997]. Current Intelligence Bulletin 58: Commercial fishing fatalities in Alaska; risk factors and prevention strategies, in NIOSH. Cincinnati, Ohio: U.S. Department of Health and Human Services, Public Health Service, U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-163.

Husberg BJ, et al [1998]. Surveillance for nonfatal work-related injuries in Alaska, 1991-1995. Am J of Ind Med *34*:493-498.

AUDIT OF THE USE OF ACCIDENT AND EMERGENCY DEPARTMENTS BY FISHERMEN WORKING IN THE CATCHING SECTOR OF THE SCOTTISH FISHING INDUSTRY.

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INTRODUCTION AND BACKGROUND

This study was conducted as part of a wider programme of research that began in October 1999, looking at health issues affecting fishermen working in the catching sector of the Scottish fishing industry. The research program was facilitated by the Fishing Industry Safety and Health (FISH) consortium, which was formed to address health issues affecting fishermen.

To gain a more accurate impression of the health issues currently affecting this population group, multiple data collection sources were used. The audit itself was designed to describe the types and frequency of injuries and illnesses arising both on shore and at sea. Data was collected by recording emergency admissions to accident and emergency departments in the North East of Scotland, Orkney, and Shetland.

This paper will briefly set out the aims and objectives of this study, describe the methodology used, and present some of the preliminary findings from the study.

AIMS AND OBJECTIVES

The overall aim of the research programme is to identify health issues affecting fishermen working in the Scottish catching sector. Key objectives of the audit are: to illustrate the nature and frequency of injuries and illnesses affecting fishermen; and to determine the nature and frequency of medical emergencies that arise among this population group.

METHODOLOGY

SITES

Accident and emergency departments and minor injury units of hospitals around the coast of Scotland, near major fishing ports, were initially identified and contacted to see if they would be interested in participating in the study. It was decided however, only to include those in the North East of Scotland, Orkney and Shetland, as this is where the majority of fishing activity occurs. This selection would also facilitate regular site visits by the researcher to participating sites.

DATA COLLECTION

Data collection took place on a prospective basis over six months from March to the end of August at eight accident and emergency departments. This period was considerably longer than initially anticipated but given that hospital staff were keen to participate and a longer data collection period would be more valuable, the period was extended.

DATA COLLECTION TOOL

Data was collected using a structured data collection form and was completed by the attending nurse or doctor. The form was relatively short with mostly close-ended questions, to make the forms as user-friendly as possible. Instructions for completion were given in each form. Data was collected on the patient's occupation on a fishing boat, method of arrival at the department, frequency of visits to accident and emergency departments and whether the patient was currently registered with a general practitioner. Medical details on the presenting complaint, final diagnosis, date, time and place of occurrence, treatment, and outcome of the visit were also gathered. Forms were completed exclusively for fishermen and only new presenting conditions were recorded. If follow-up treatment was advised then both this and the type of treatment required would be indicated on the form. Patient confidentiality was stressed.

PILOT STUDY

A pilot study was conducted over one month (February 2000) with five of the participating departments. Hospital staff were consulted as to the structure, content and method of data collection. Their input was vital to the success of the audit. Introductory meetings were held with members of staff where any queries or concerns could be discussed. A gatekeeper was established and this individual acted as the main point of contact between the researcher and hospital staff.

SITE SUPPORT

Regular site visits were made to maintain contact and interest in the audit amongst staff. Reminders were issued to staff at each participating department at regular intervals, again to maintain interest. Patient information leaflets and posters were also used to raise awareness of the audit amongst the patients themselves.

Introductory meetings were held with members of staff at the relevant departments before launching the pilot study in March with the remaining sites. These meetings acted as a vehicle for information dissemination and feedback. A gatekeeper was established and this or these individual/s acted as the main point of contact between the researcher and hospital staff.

DATA ANALYSIS

Data were entered and stored in a database (SPSS) for analysis. Simple descriptive statistics were used and some cross tabulations. Chi square tests were run to determine the statistical significance of results. However, given the relatively small number of cases, the statistical power was reduced.

PRELIMINARY RESULTS

BACKGROUND AND DEMOGRAPHICS

There were 164 recorded instances of fishermen attending accident and emergency departments over a six month period, from March to the end of August 2000, at the eight participating sites, as shown in Figure 1. The greatest number of attendances, 29 percent (n=47), were recorded at the Gilbert Bain Hospital, Shetland. Peterhead and Fraserburgh had a similar number of recorded attendances, 22 percent (n=36) and 19 percent (n=31) respectively. Chalmers Hospital, Banff recorded 15 percent (n=24), Aberdeen Royal Infirmary 9 percent (n=14), Dr. Gray's, Elgin 4 percent (n=7) and Seafield Hospital, Buckie, recorded 3 percent (n=5) attendances. Balfour Hospital, Orkney, did not record any attendances of fishermen over the six-month period.

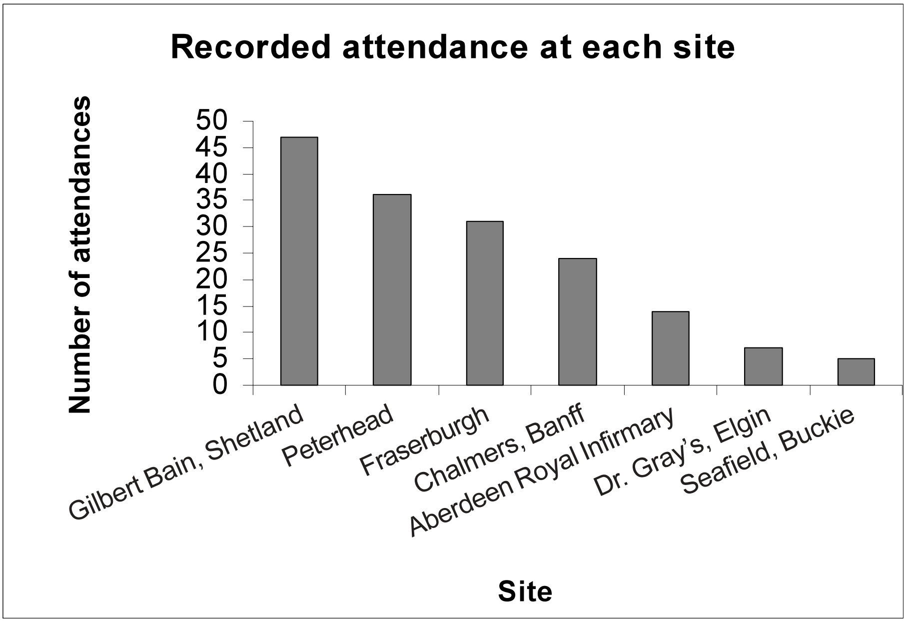

Figure 1: Recorded attendance at each site

SITE DETAILS AND ATTENDANCE

There was a steady decline in the total number of attendances each month over the study period, illustrated by Figure 2. During the first month, 29 percent (n=48) of the all attendances in the study were recorded, compared to 11 percent (n=18) in August.

Attendance across each of the sites was evenly distributed over the course of the week and time of day, with no definite pattern in attendance. However, there were fewer overall attendances at the weekend

CASUALTY DEMOGRAPHICS

All respondents were male. Twenty-three percent (n=38) participants were 15 to 25 years of age, 35 percent (n=57) were aged 26 to 35 years, 18 percent (n=29) were aged 36 to 45 years. The remainder, 20 percent (n=32) were over 46 years of age.

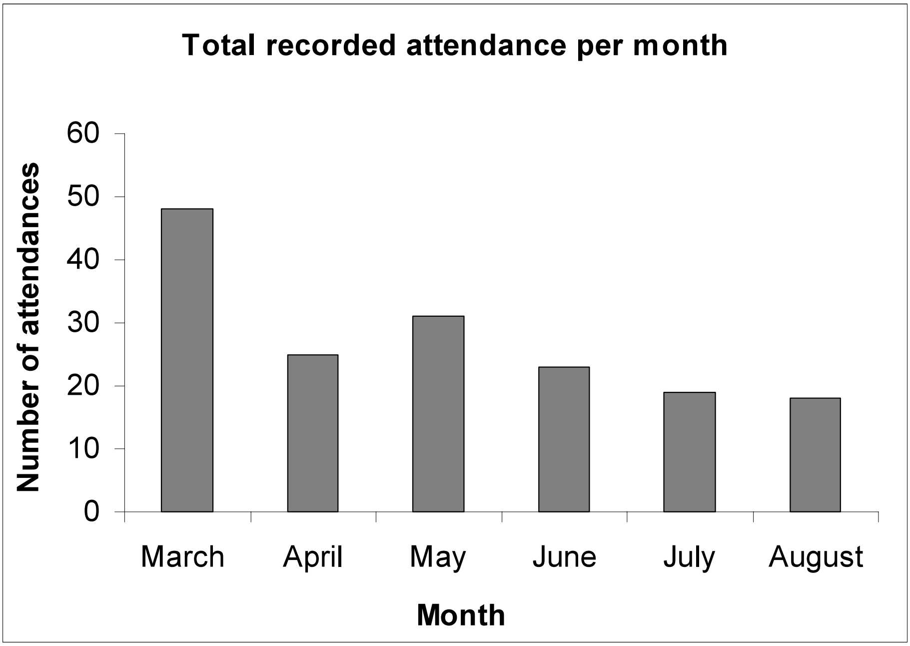

Figure 2: Months of Attendance

OCCUPATION DETAILS

Ninety-three percent (n= 153) of participants worked on a full-time basis, 4 percent (n=6) on a part-time basis, with 0.6 percent (1) retired. One of the fishermen (0.6 percent) worked on an 'other' basis which was not stated. Three respondents (1.8 percent) did not answer this question. The majority of participants, 45 percent (n=73) worked most often on a trawler greater than 24 m, 31 percent (n=50) on a trawler less than 24 m, 9 percent (n=15) on a seine netter, 6 percent on a shellfish boat. Other boats, of which there were 4 percent (n=6), included multi-purpose vessels. (Ten respondents, or 6 percent did not answer this question). The type of boat is displayed in Figure 3.

The majority of participants reported working as crewmen (44 percent, n=72), 29 percent (n=47) as mates and 9 percent (n=15) as skippers, as shown in Figure 4.

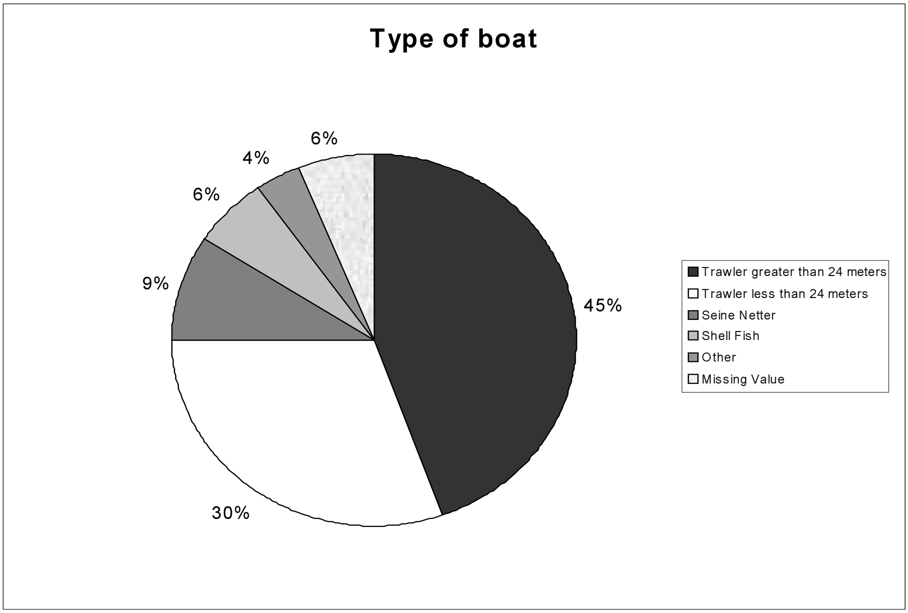

Figure 3: Type of Boat

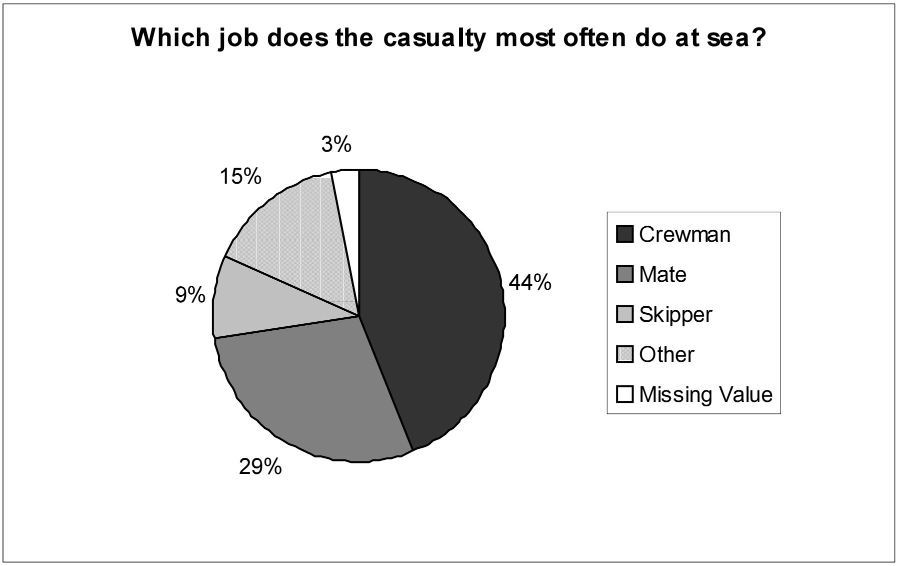

Figure 4: Job Title of Person Injured at Sea

MEDICAL DETAILS

Figure 5 illustrates the number of injuries and illnesses presented. Eighty-one percent (n= 133) of participants presented injuries, 12 percent (n=19) presented illnesses. Four percent (n=6) of cases could not be identified as either injuries or illnesses. (Four percent, n=6, did not answer this question).

Figure 6 illustrates the location where symptoms were reported as first arising. Respondents were also asked when they were next traveling to sea. The majority reported that they were going to sea within seven days.The types of injury presented were predominantly lacerations (28%, n=46) and soft tissue injuries (24%, n=39). The remainder included fractures (9 percent, n=14), foreign bodies (7 percent, n=12) and burns, including sunburn (2 percent, n=3). Twelve percent (n=19) could not be identified. Figure 7 shows the part of the body most susceptible to injury. This was the hand, wrist and finger (28 percent, n=46) and the head, face and throat though other body parts were also prone to injury.

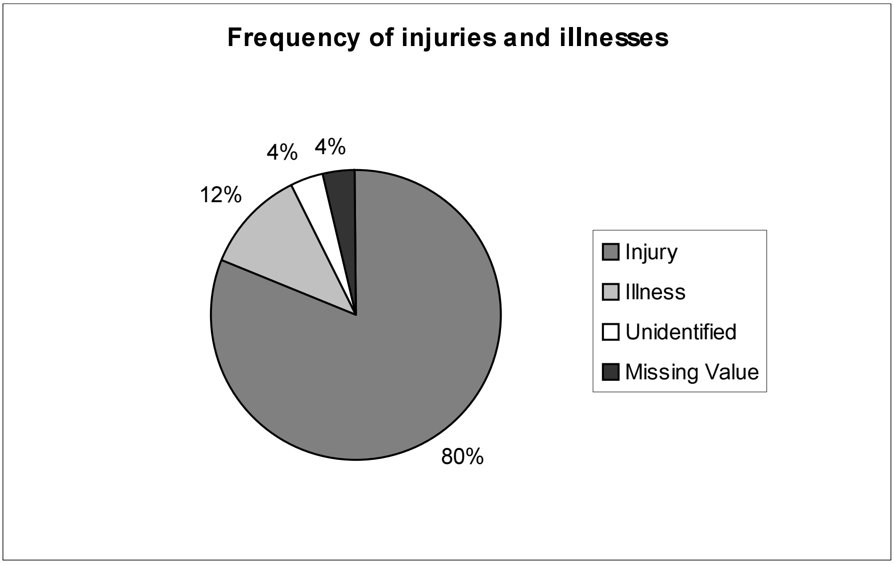

Figure 5: Distribution of Injuries and Illnesses

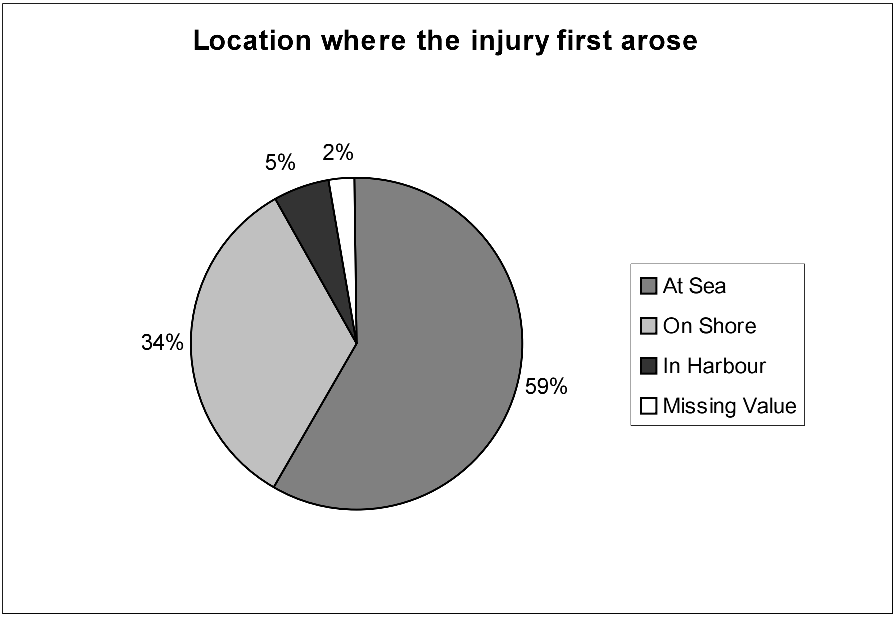

Figure 6: Location where the injury or illness first arose

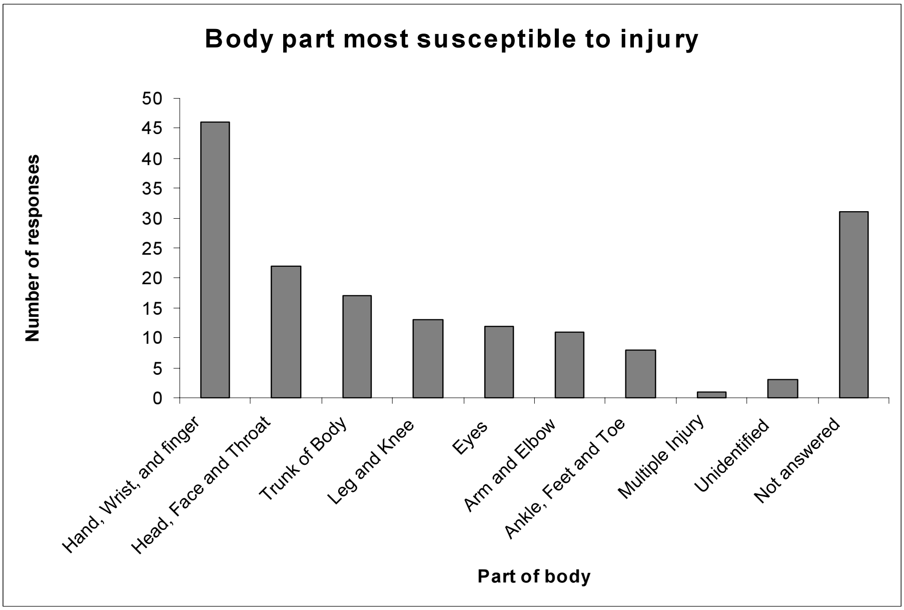

Figure 7: Body Parts Injured

GENERAL MEDICAL PRACTITIONER REGISTRATION AND SOURCES OF ADVICE

Sixty-nine percent (n= 113) of participants reported being registered with a local general practitioner at the time of attendance. Twenty-three percent (n=37) were registered with a general practitioner outwith the area in which the site was located. Less than one percent (n=1) were not registered with a general practitioner. Five percent (n=8) were of an overseas nationality. Three percent (n=5) did not answer. Fishermen were asked if they had sought advice from another source. Almost three quarters had not. The general practitioner was the most common source of advice (12 percent) and others included other hospitals, district nurses' health centers, first aid responders or skipper on board and radio-medical advice.

PREVIOUS ATTENDANCE AT ACCIDENT AND EMERGENCY DEPARTMENTS

The majority of participants (62 percent, n=102) had never been treated in *any* accident and emergency department. Twenty percent (n=32) had been treated once before, 13 percent (n=21) had been treated between 2 and 3 times. In two percent (n=4) of cases this information was not known and in three percent (n=5) of cases there was a non- response.

OUTCOME OF THE VISIT

The majority of participants (61 percent, n=100) were discharged home after their visit. Eleven percent (n=18) were referred to a general practitioner, 7 percent (n=11) were admitted to a ward on site, 2 percent (n=4) were referred to an outpatient clinic, 2 percent (n=4) were admitted to a ward in another hospital, 2 percent (n=3) were admitted to another hospital's accident and emergency department, 1 percent (n=2) discharged themselves against medical advice, 1 percent (n=2) were deceased, 1 percent (n=2) had a different outcome from their visit. There was an 11 percent (n=18) non-response to this question.

FOLLOW-UP TREATMENT

The majority of fishermen in this study (78 percent, n=128) were advised that they did not require any follow-up treatment and 22 percent (n=36) were advised to seek follow-up treatment.

SEEKING ALTERNATIVE MEDICAL ADVICE- INJURIES AND ILLNESSES FIRST ARISING AT SEA

Seventy-four percent (n=62) of participants with injuries that had first arisen at sea had not sought alternative medical advice prior to attending the accident and emergency department. Twenty-six percent (n=22) had however sought alternative advice (14 percent, n=12) from another source; and 12 percent (n=10) from a general practitioner. Of all fishermen with illnesses that first arose at sea, 57 percent (n=4) had not sought alternative medical advice. Twenty-seven percent (n=2) sought advice from another source, 14 percent (n=1) had sought advice from a general practitioner. In the four cases where the condition could not be identified as either illness or injury, 75 percent (n=3) of participants had not sought alternative advice, and one fisherman had sought advice from an other source and none from a general practitioner. In 73 percent (n=69) of all conditions first arising at sea, fishermen had not sought alternative advice, 16 percent (n=15) sought advice from another source and 12 percent (n=11) from a general practitioner.

Of the injuries and illnesses that first arose on shore, 91 percent (n=38) of participants did not seek alternative advice for injuries, 7 percent (n=3) sought advice for injuries from another source and 2 percent (n=1) sought advice from another source. Of the illnesses that arose on shore 55 (n=6) did not seek alternative advice, 9 percent (n=1) sought advice from another source and 36 percent (n=4) from a local general practitioner. Of the two presenting conditions that could not be determined as injuries or illnesses, one sought advice from another source and one from a local general practitioner. In total, for injuries and illnesses first occurring on shore, 80 percent (n=44) did not seek alternative advice, 9 percent (n=5) sought advice from another source and 11 percent (n=6) sought advice from a local general practitioner.

STATISTICAL RELATIONSHIPS WITH LOCATION (ON SHORE AND AT SEA)

In total there were 95 fishermen presenting symptoms that had arisen whilst they were at sea. Of these, 84 were injuries, 7 were illnesses and in 4 cases could not be determined. Of the conditions that first arose on shore, 42 were injuries and 11 were illnesses, another two presenting symptoms could not be determined as being either injury or illness.

Illnesses were significantly more likely to arise on shore and injuries at sea (Chi-squared, p=0.017). However, there was no statistically significant relationship between injuries and illnesses which first arose on shore and at sea and: the age of the participant; the type of vessel that the participant most often worked on; and the occupation of the participant at sea.

DISCUSSION
LIMITATIONS

There were a number of limitations to this study. The main limitation was the time period. Six months did not allow seasonal variations in attendance to be taken into consideration. Ideally, the study would have been conducted over a 12-month period. Furthermore, data collection was heavily reliant on members of staff completing the forms and under pressure they may not have time to complete the form, or may simply forget to do so. In addition to this, only five of the eight participating departments record occupation, along with other personal patient details. There was the risk that in cases where the accident or illness was not directly work related or did not happen at sea, that the attending member of staff may not be able to identify whether that person was a fisherman. However, the sites where this information was not automatically recorded were small community hospitals with close social networks. Therefore most of the staff knew who the patients were and what they do. These limitations highlight some of the main points for discussion and further work: there are difficulties in accessing reliable data; there is not a uniform method of collecting patient information between treatment centers; occupation is not always recorded; and non-computerized registration systems can hinder data collection.

PREVIOUS RESEARCH

There has been little previous research into health issues affecting fishermen. However, other research conducted in the United Kingdom indicates that injuries are more prevalent than illnesses [Grainger 1992; Reilly 1988; Richardson 1981; Schilling 1971; Moore 1969/1] in this occupation group. This supports the findings of the present study.

The preliminary results of this study highlight a number of key findings: the majority of symptoms presented were injuries; illnesses were statistically more likely to arise on shore and injuries at sea; the body parts most greatly affected by injury were hand, wrist and fingers, followed by head, face and throat; and the most frequent type of injuries presented were lacerations and soft tissue injuries.

SUMMARY

From these findings, a number of recommendations can be made. Firstly, the need to emphasize the importance of first aid at sea for fishermen and the use and knowledge of medicines at sea amongst this occupation group. Secondly, the frequency and nature of injuries occurring at sea should be addressed. These results will contribute to the overall findings of the research program and will be used to inform future health care service provisions and training programs for fishermen who work in the catching sector of the industry.

ACKNOWLEDGEMENTS

This project has been funded by the Maritime and Coastguard Agency, Seafish Industry Authority, and PESCA European funding. The research is supported by FISH (Fishing Industry Safety and Health) Ltd, a Scottish charity set up by the Scottish Fishermen's Federation and the Scottish White Fish Producers Association. The researchers would like to thank these bodies for their ongoing support.

REFERENCES

Grainger CR[1992]. Some mortality data for Grimsby 'Lumpers' and fishermen. Bull Inst Trop Med Gydinia *41*(1-4): 51-55.

Moore SRW [1969]. The mortality and morbidity of deep sea fishermen sailing from Grimbsy in one year. Brit J Industr Med 1969/1;*26*:25-46.

Reilly MSJ [1988]. Epidemiological and geographical sspects of the occupational safety and emergency survival of United Kingdom fishermen, 1961- 85 [Ph.D. thesis]. Dundee, Scotland, United Kingdom: University of Dundee.

Richardson WT [1981]. Losses at sea of deep- sea fishermen from Hull, 1970- 1977. In: Adam JM(ed) Hypothermia Ashore and Afloat: Proceedings of the Third International Action for Disaster Conference Aberdeen. Scotland, United Kingdom: Aberdeen University Press, pps.119-124.

Schilling RSF [1971]. Hazards of deep sea fishing. Brit J Industr Med *28*:27-35.

Wednesday, October 25, 2000

SAFETY TRAINING FOR FISHERMEN

Photograph and caption by Earl Dotter

A commercial fisherman demonstrates the correct way to enter the water during a survival suit drill at a local quarry swimming hole in Vinalhaven, Maine, U.S.A.

A PORT-BASED FISHING SAFETY INSTRUCTOR NETWORK, AND THE SECOND FOLLOW-UP STUDY OF ITS EFFECTS ON FISHING FATALTIES (1995-1999) IN ALASKA

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BACKGROUND

Alaska is a land of superlatives: spectacular wilderness, rich wildlife and bountiful fisheries. If Alaska were a separate nation, it would rank as one of the world's top ten fisheries in terms of value, worth over a billion U.S. dollars a year. Unfortunately, these superlatives also apply to Alaska's extreme weather, great distance from rescue, frigid water and high fishing fatality rate.

The Alaska Marine Safety Education Association (AMSEA) was formed as a non-profit organization in the early 1980s in response to the great number of marine related fatalities in the state. It was a grass roots effort, started in Kodiak and Sitka, collaborating with fishermen's organizations such as fishermen's wives, as well as state and federal agencies such as Alaska Sea Grant, Alaska Vocational Technical Center, the U.S. Coast Guard (USCG), Alaska Observers Center, and the National Institute for Occupational Safety & Health (NIOSH).

AMSEA's first priority was to create and maintain a port-based Marine Safety Instructor-Training (MSIT) network that could deliver relevant hands-on marine safety training to Alaska's far flung fishing communities. These port-based

MSITs have experience in local fisheries and have credibility and contacts within the local fleet to conduct and facilitate training.

MSIT training began with a pilot project in 1983 and since that time almost forty of these week long courses have been held, which have trained over 500 Marine Safety Instructors (MSIs) on most coasts of the U.S.. These MSIs, who work for a diverse group of private and public entities, have in turn trained over 100,000 people in various marine safety courses in Alaska, the U.S. and overseas. The people they in turn train include fishermen, agency personnel, school children and professional mariners. AMSEA's next priority has been to maintain the MSIT network with updated cold water related curriculum, educational productions, and training supplies.

In 1991, the USCG required that monthly drills in emergency procedures be conducted on many documented fishing vessels. There are approximately 30,000 of these documented vessels in the U.S. The USCG also required that by 1994, the person conducting these drills be formally trained in the contingencies required during drills.

In 1991, AMSEA developed an 18-hour Drill Instructor (DI) course that was USCG approved and also follows the International Maritime Organization's (IMO) Personal Survival Module. The DI class focuses on the use of survival equipment and proper procedures to use during vessel casualties. It is a hands-on, skills based course. AMSEA then used its MSIT network to deliver the DI course to fishermen's home ports. Most of the participants in the DI course were fishermen who could deliver the monthly drills to their own crews.

Since 1991, over 4,000 people have been certified by AMSEA to be Drill Instructors in over 370 courses. Most of these DIs reside in Alaska. This group represents more than one drill instructor for every two documented boats in Alaska. This is probably the largest single group of trained Alaskan DIs. Important to this study is the fact that AMSEA maintains a database of names and addresses of those trained in this course. Therefore names of survivors and fatalities can be matched to casualty databases. Other AMSEA trained MSIs in other parts of the nation have developed their own USCG approved courses and are not part of our database of trained DIs.

From the period of 1991 to 1999, fishing vessel fatalities in Alaska have demonstrated a downward trend, even though the number of vessel losses stayed roughly the same. The latter half of the 1990s saw a consistent 50 percent drop in fatalities over the first half of the 1990s [Lincoln and Conway 1999]. During the 1990s, however, not only were fishing training requirements established, but survival equipment requirements were also established. The Pacific Northwest has also seen the greatest compliance with safety training and several organizations still offer this training on the Washington and Oregon coasts.

The question remains however: has safety training been effective in reducing fatalities?

What role if any has safety training played in reducing fatalities? Were people who had safety training at lower risk to be involved in a fatality? What effect has time had between initial training and the time of a casualty on survivability? How could a study answering some of these questions be replicated for others to use? There are many anecdotal stories of fishermen who were helped in an emergency by the knowledge or skills obtained in training. Additionally, it has been observed that there are many fewer vessels lost with all crewmembers, which implies that people are learning how to survive vessel losses. But can this be quantified?

INITIAL PERKINS STUDY

Since a database exists for those trained by AMSEA, and the U.S. Coast Guard maintains a database of commercial fishing casualties (including fatalities and some survivors,) these databases were compared to distinguish fatality rates in trained and untrained groups of fishermen. The USCG originally funded a study in 1995 to examine just this issue in Alaska. This study looked at the 1,518 AMSEA DI trainees between 1991 and 1994, as well as the 159 vessel incidents within that same time frame. Of the 114 fatalities resulting from those incidents, none of the fatalities were AMSEA trained. Of the 343 survivors, 10 were AMSEA DIs from eight different vessel losses. Eight of the 86 vessels that had at least one survivor and none of the 64 vessels with at least one death had an AMSEA DI onboard. The percentage of this happening by coincidence was just two percent [Perkins 1995]. This gave a strong indication that training was having some influence on survivability.

CURRENT STUDY

Five years have passed since the initial study, and it was felt that with the greater number of people trained and the longer time span it would be worthwhile to once again try to quantify the effect safety training was having on fatality rates from the years 1991 to 1999. It is the goal of this study to conduct an ongoing periodic mechanism by which the effectiveness of safety training can be reproduced every four to five years.

In the first study, the criteria of who counted as a “save” was based on a victim basis, not an incident basis. Using a victim basis would not take into account the fact that having one trained DI onboard could have influenced the survival of the other people onboard. Therefore, data was analyzed on an incident basis, and the entire nine-year period from 1991 was examined. The results follow:

From 1991-1999 there were 234 fishing vessel incidents in Alaska investigated by the USCG in which all of the people involved were known.

There were 66 fatal incidents. Eleven of these incidents had at least one AMSEA trained DI onboard. There were 168 non-fatal incidents. Forty-four of these incidents has at least one AMSEA trained DI onboard. This fact alone demonstrates that one would be 1.7 times more likely to survive an incident if there was an AMSEA DI onboard. However, these results are not statistically significant. Further analysis will stratify by time since training occurred to see if this demonstrates significance, and to also determine optimal times for refresher training courses.

In this initial study, we looked at the difference in time between when training took place and the incident occurred. In the Perkins study, this time interval was only 9.6 months. When we looked at data for the whole decade, we found that the average time between AMSEA DI training and a fatal event was 46.8 months. The average time between AMSEA DI training and a non-fatal event was 36.8 months. It is well understood that knowledge and skills deteriorate over time. It is also widely observed that monthly drills are probably not being conducted on a majority of fishing vessels, even if they have DIs onboard.

Currently, there is no refresher training required for DIs, and voluntary refresher training efforts have been disappointing. A lifetime once-only course may be sufficient if survival equipment technology and procedures do not change, but even since 1991 there has been some change in this area. Also, if in fact, as seems to be the case, the majority of DIs are not conducting monthly drills, [Cullenberg 2000] it is likely that there is knowledge and skills deterioration. These would both speak to a need for DI refresher training. From the data on the average time span between training and a fatal incident, it seems that refresher training every five years would be appropriate. This also corresponds very closely to what exit interviews with newly trained AMSEA DIs have noted as being the most recommended time for refresher training.

Since observations have noted that monthly drills are not being conducted on most vessels, there may also be an argument for all persons working on fishing vessels to be required to take a survival course. In this way, emergency procedures and survival equipment use would be familiar to all who work in the industry. More analysis of this data needs to take place before further conclusions are drawn. A known denominator of Full Time Equivalent positions would also give a major boost to analysis. However, it can be stated with certainty that the fatality rate has been significantly reduced in Alaska for a sustained period. Since 1995, the number of fatalities in Alaska has fallen below that of the state's recreational boaters [Hargis 2000]. A replicable methodology has been developed to further research on the effects of safety training.

FOOTNOTES

Cullenberg P [2000]. "Fisheries Observers: Researchers and Guests: Strategies for the Safety of Visitors on Board." Draft of paper presented at IFISH Conference, Woods Hole, Massachusetts,U.S.A. Oct.23-25, 2000.

Hargis S [2000]. Alaska Recreational Boating Fatal Accident Statistics 1987-1999. Alaska: U.S. Coast Guard, 17th District.

Lincoln JM, Conway GA [1999]. Preventing commercial fishing deaths in Alaska. Occup Environ Med *56*:691-695

Perkins R [1995]. Evaluation of an Alaskan marine safety program. Pub Health Rprts, *10:* 110

FISHERY OBSERVERS, RESEARCHERS AND GUESTS: STRATEGIES FOR THE SAFETY OF VISITORS ON BOARD

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INTRODUCTION

Every year, approximately 350 observers spend over 35,000 days at sea in fisheries in Alaska's Exclusive Economic Zone. Observers are contracted biologists who live and work alongside fishermen on a variety of vessels, such as 75-foot scallop vessels, 80-foot bottom trawlers, 125-foot freezer-longliners, or 375-foot factory trawlers. The vast majority of fishery observers are from outside of Alaska. Most have never been to sea before, and many have had little contact with the fishing industry.

The National Marine Fisheries Service (NMFS), the Alaska Department of Fish and Game, the Coast Guard (USCG), the North Pacific Fisheries Observer Training Center (OTC) and private observer contractors all play a part in the reducing the risk to observers working at sea. The protocols and standards that have been developed may serve as a model to observer programs in other parts of the world, or in other instances when individuals unfamiliar with a vessel or the industry must go to sea.

BACKGROUND

Alaska's commercial fisheries are best described in superlatives - highest volume of catch in the world, most valuable fisheries in the world, carried out in the most inhospitable of conditions. In 1999, Dutch Harbor, Alaska became, for the twelfth year in a row, the port with the highest volume and greatest dollar value of fish landings in the United States. Kodiak, Alaska consistently is in the top five ports in the nation. Over 16,000 vessels ranging in size from 16 feet to 688 feet in length overall participate in Alaska's commercial fisheries each year.

The groundfish and shellfish observer programs in Alaska are some of the most extensive in the world. Approximately 300 groundfish observers spend over 32,000 days at sea each year working on catcher boats, catcher/ processors, processor vessels, and shore plants. Observers spend about 90 days at sea, collecting biological and compliance related data mandated by the National Marine Fisheries Service. In a smaller program operated by the State of Alaska, about 50 observers spend over 4,000 days a year observing crab and scallop fisheries in the Bering Sea.

The observer programs in Alaska are also unique in being completely funded by industry through regulation. All vessels greater than 60 feet and fishing in the EEZ must provide observer coverage either 30% or 100% of the time. Vessels pay private observer contractors on a daily basis to provide them with observers. Each year, the industry spends approximately $12 million to cover observer salaries, travel, and insurance.

High risk and mortality also characterize Alaska's fishing industry. Until recently, Alaska had the highest commercial fishery-related drowning deaths in the nation. In the last 10 years, ending in 1999, 120 individuals died in commercial fishing related incidents in Alaska.

Unfamiliar with the job, the weather conditions, and fishing in general, fisheries observers are uniquely at risk. Most are young, recent college graduates, primarily from outside of Alaska. Of 118 new groundfish and shellfish observers trained at the Observer Training Center in 1999, 89% were not residents of Alaska, 60% ranged in age from 20-25 and 68% had graduated with a bachelor's degree in the last 12 months. In many cases, observing is a first career-linked job after school. For example, it would not be uncommon for a

22 year old from Iowa to come to the OTC for two weeks of crab observer training and then board an 82 foot snow crab boat in January, having never been to sea or to Alaska before.

Once onboard, observers work long and erratic hours, seven days a week. Observers are expected to work as the vessel fishes, day or night. On many vessels, sampling takes place in a below-deck factory; on other vessels an observer works on the deck in a semi-exposed environment. Turnover in Alaska's observer programs is high. Approximately one-third of the annual observer population in Alaska is replaced each year.

In the twenty-three year history of the observer programs in Alaska, there has been one observer lost at sea. Robert McCord, from Englewood, Colorado died, along with eight others from a crew of 31, when the Aleutian Enterprise went down on March 22, 1990.

Observers and the personnel on vessels carrying them have different concerns regarding observer safety. Observers need to feel safe doing the job, have confidence that they can get off the boat if it is not safe, and the assurance that there is some recourse for them in the event of injuries.

Fishermen carrying observers want to prevent an accident to an inexperienced observer. They want to be able to protect themselves if an observer is injured. They want assurance that they can seek recourse if an observer feels that their boat is unsafe. And they want to continue to do their job with the observer on board with the least amount of interference.

The stakeholders in the observer programs in Alaska have each contributed a part in developing a system that attempts to make working as an observer safer. The components of this system include **prevention, emergency preparation, and protection** if an accident or injury occurs. Protocols for training, vessel safety inspection and insurance coverage have evolved in an attempt to create a risk-reduced environment for observers.

TRAINING

Safety training for observers in Alaska is done by certified safety trainers either at the University of Alaska's North Pacific Fisheries Observer Training Center in Anchorage or the National Marine

Fisheries Service in Seattle. It lasts one full day, and is hands-on and skill-based in nature.

General onboard safety practices, emergency preparation and response, and survival at sea are covered. New observers learn about common accidents onboard, proper boarding and transfer between vessels, hypothermia, cold water near drowning, man overboard response, maydays, and the seven steps to survival. The lecture portion of the class is followed by a hands-on skills session in a pool or protected open water that includes donning immersion suits and PFDs, entering the water, and boarding a life raft. Trainers complete a five-day Instructor class with the Alaska Marine Safety Education Association before offering the class.

VESSEL SAFETY INSPECTION

Following the passage of the Commercial Fishing Industry Vessel Safety Act of 1988 (P.L. 100-424), vessels have the opportunity to obtain a Voluntary Dockside Examination (VDE) by the Coast Guard or Coast Guard Auxiliary. If they pass the inspection they are issued a Vessel Safety Inspection Decal, valid for two years.

Since a VDE is currently voluntary, the North Pacific Fishery Management Council initiated a regulation in 1998 that made the VDE or some other documentation of compliance with Coast Guard regulations mandatory for all vessels carrying observers. 50 CFR Sec. 600.746 applies to "any fishing vessel required to carry an observer as part of a mandatory observer program or carrying an observer as part of a voluntary observer program under the Magnuson-Stevens Act, MMPA, the ACTA or any other US law." It states "a vessel is inadequate or unsafe for purposes of carrying an observer if…it has not passed a USCG safety examination or inspection."

In November 1999, a groundfish observer noticed that the Voluntary Dockside Examination Decal on his vessel had expired two years earlier. The vessel was allowed to continue to fish only after a Vessel Safety Examination was completed. As a result of this incident, groundfish observers are now required to check that the Vessel Safety Inspection is current upon boarding a vessel.

Observers are also "encouraged to briefly walk through the vessel's major spaces to ensure that no obviously hazardous conditions exist," and to spot check major safety items such as the presence/absence of life rafts, EPIRBS, and life rings. If an observer feels that he/she would be boarding an unsafe vessel, the observer is instructed to contact their contractor and NMFS. The USCG responds to these situations by coming aboard and working with the vessel to correct problems.

INSURANCE

In Alaska, the vast majority of observers are employed by private contractors who are paid by individual vessel owners or fishing companies. Minimum observer insurance coverage levels were standardized in "observer contractor certification requirements" by NMFS regulations in 1996.

The intent of the current coverage is to reduce the need for both the vessel and the contractor to insure the observer. Observer contractors must provide NMFS with "certificates of insurance" that verify coverage including Alaska Workers Compensation with U.S. Longshore and Harbor Workers and Maritime Employer's Liability attachments to cover "seaman's claims under the Jones Act and General Maritime Law" as well as Commercial General Liability coverage. Worker's Compensation with the maritime provisions covers an observer whether he or she files a maritime or Alaska worker's compensation claim. Commercial General Liability provides contractors with protection against liability and may include a portion that indemnifies the vessel owner from claims.

This level of insurance coverage is substantial compared to that provided to crewmembers in most cases. The industry pays close to $1 million in insurance payments per year. Part of the basis for this wide coverage includes the observer contractor/industry system. Another part is due to a lack of determination whether an observer can be considered a "seaman" for liability cases.

RESULTS

Analysis of whether observers face significant safety problems can be evaluated by looking at an observer's experience after his or her contract is complete. Observers are required to complete a Vessel Survey after each contract that includes questions related to sampling techniques, vessel activities, accommodations, and safety conditions.

An analysis of more than 1,000 Vessel Survey reports from last quarter of 1998 through the first half of 1999 indicated that a large majority of observers experienced no safety problems or accidents. Approximately 18% of the observers reported some safety problems.

Safety problems reported by those groundfish observers covered an assortment of emergency situations including man overboard, collision, flooding, loss of steering, loss of electricity, gas leak, cables parting or other. Figure 1 delineates the categories of safety problems reported by observers. “Other” problems were those not listed on the survey and included such incidents as vessel icing, sanitation problems, sleeping at the wheel and unsafe sampling on deck.

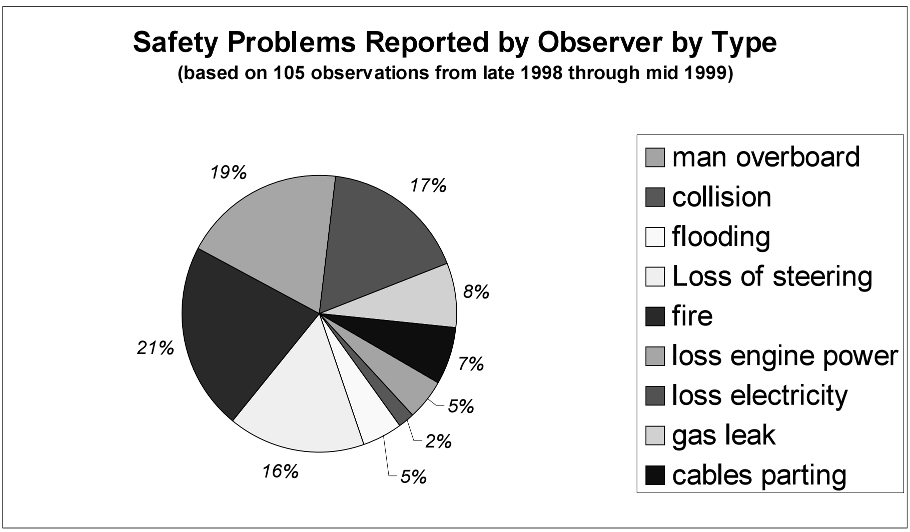

Figure 1: Safety Observations, by Type

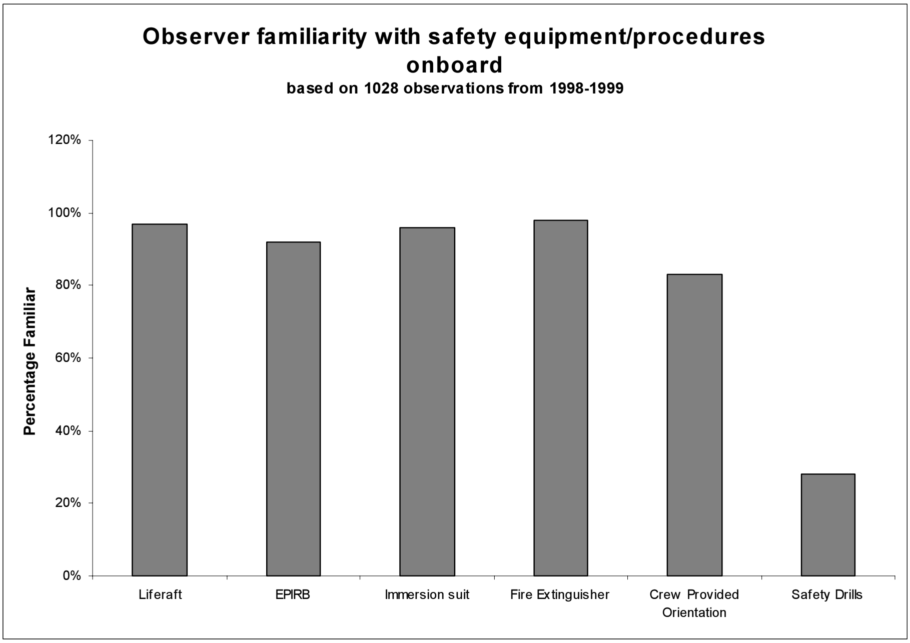

Figure 2: Observer Knowledge

The survey reports found that most observers were familiar with the location of basic emergency equipment onboard their vessels. (See Figure Two) Most reported being given a safety orientation by vessel personnel, although "orientation" ranged from a brief tour of the vessel to a more extensive overview. Of concern, however, were the number of responders who reported that they did not participate in safety drills. Less than 300 out of 1,028 reported that they were given the opportunity to practice emergency skills onboard their vessels.

NMFS Enforcement handles groundfish observer safety problems that are serious enough to warrant investigation. Through 1999 and the first half of 2000, 23 affidavits related to observer safety were completed by observers. (Overall, more than 500 enforcement related affidavits were filed). Approximately one-third of the affidavits related to a vessel having either an expired Vessel Safety Decal or no decal at all. All were pursued by enforcement and were usually fined $500.00. The other affidavits related to a variety of issues such as freon/ammonia leaks, unsafe transfers at sea, stability concerns, asleep at the wheel etc. and in general, were referred to the Coast Guard.

RECOMMENDATIONS

The extensiveness of observer coverage, the high rate of turnover and Alaska's harsh working environment create the potential for a significant number of observer injuries or emergency situations. The safety protocols in place for fisheries observers in Alaska are likely more comprehensive than other programs in the world given the variety and size of the observer programs. Indications from the observers themselves are that most are able to perform their jobs safely and experience minimal safety-related problems.

However, examining the completeness of the protocols in providing prevention, emergency response and support, led to three conclusions. First, observers, many of whom have little background on vessels, are asked to be the judge of their safety. How can an observer be expected to "feel safe" when he/she does not really know what a safe situation is? Do we provide adequate training for observers to make those judgments? Is the VDE the best or only tool that should be used by observers upon boarding a vessel?

Observers, by not participating in drills or a defined "orientation" do not necessarily get the preventative training or emergency response background that they need on a particular vessel.

Second, the emphasis in training and in vessel requirements is weighted toward post-event situations. A small portion of Alaska's fleet is mandated to provide safe sampling stations for observers. Most vessels are not, leaving observers to work in a variety of corners of the deck or factory.

The following recommendations to the current practices may reduce risk to observers further.

Work with industry to improve sampling stations for observers. A small component of Alaska's groundfish fleet are required, by regulation, to provide a designated observer sampling station with proper lighting, enough room to work, and tables at correct height, among other things. Observer programs should continue to work with industry to provide safely designed observer sampling stations in more fisheries.

Ensure that training focuses on pre-event as well as post-event activities. In the last year, training has encompassed prevention more extensively, such as avoiding sleep deprivation and back injuries. This prevention aspect of training should be incorporated more fully in the future, based on observer reports of injury and other sources about safe fishing practices.

Require refresher safety classes for experienced observers. Once an observer has completed his or her initial observer training, no further skills-based refresher training is required or available through the programs. Safety is mentioned in annual refresher short classes required of groundfish observers, but no pool or practical lessons are included. Shellfish observers are not required to complete any annual reviews and do not receive any refresher training in safety skills.

The majority of observers do not participate in safety drills while onboard the vessel. As a result, very few observers have the opportunity to perform the skills needed in an emergency situation beyond their initial training class. Many federal and state employees who work at sea on an infrequent basis are required to participate in annual or biannual skills-based safety classes. Observers could also be required to maintain an annual or biannual "safety at sea" certification.

Require observers to enter safety check documentation in their logbook. Observers are trained to check for current documentation of a vessel's compliance with US Coast Guard safety regulations and are "encouraged" to spot check safety gear themselves. Currently, observers are not required to document their safety check. Observer logbooks could contain an area to record the date that the Vessel Safety Decal expires as well as documentation of a safety-orientation and gear check. This would elevate an observer's safety check to a "required" rather than an "encouraged" activity. Defining the scope of a safety "orientation" for industry members would ensure more consistency for observers.

Work with the Coast Guard to improve compliance of fishing vessels with drill requirements. A safety "orientation" for an observer can vary widely in comprehensiveness. It also does not provide an observer with a sense of the "safety culture" on board that particular vessel. Participation in drills would give observers a chance to familiarize themselves with the dynamics of the crew and the procedures on board.

Observers may be placed on a vessel that has only 30% coverage and thus, has missed a recent drill. On the other hand, safety drills are not held regularly on every vessel, and so, observers as well as crewmembers do not have the opportunity to practice emergency skills. Compliance with safety drill requirements, in itself, may be a measure of the importance of safety on that particular vessel.

Establish the status of an observer for insurance claim purposes. Determination of whether or not an observer is a "seaman" has the potential to save considerable money for industry, as well as simplifying liability claims for observers. That determination may take a judicial or legislative determination.

Demand for observers is growing worldwide. In many cases, observers go to sea on vessels that are not as safety conscious or as well regulated as those in Alaska.

Ensuring a risk-reduced environment for observers and others who are infrequent members of a vessel's complement requires recognition by both the observer and the vessel's crew that inexperience can create unique safety concerns. Focusing on preparation before departure and ensuring that an observer is traveling on a safe vessel are paramount in reducing risk. Supporting observers if an accident or injury does occur is critical in maintaining and valuing a strong observer corps.

ACKNOWLEDGEMENTS

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SAFETY TRAINING FOR ICELAND'S FISHERMEN

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Captain Snorrason was born in Reykjavik in 1957. He started as an AB seaman in the Icelandic merchant fleet in 1973 and finished the Navigation School in Reykjavik in 1978. CAPT Snorrason served as a deck officer on RO/RO, general cargo and pallet carriers and was promoted to Master in 1984 in Icelandic State Shipping. He joined the National Life-saving Association of Iceland (now Icelandic Association of Search and Rescue (ICE-SAR)) in 1991 as a principal and manager for the Maritime Safety and Survival Training Centre and a master of the training vessel Saebjorg. CAPT Snorrason has been in the Icelandic Maritime Accident Investigation Committee since 1996, member of the Safety Education Committee since 1992 and several committees regarding maritime safety related matters. He has been the Vice-Chairman of the International Association for Safety and Survival Training (IASST) since 1999.

Iceland bases its livelihood on fisheries and 95 percent of the total seafarer population in Iceland are fishermen. Naturally, the national authorities are concerned about the working environment of seafarers as well as of the performance of this important industry.

In 1999, the fishing fleet consisted of a total of 2000 vessels, with 1500 under 12 m in length, 220 between 12 and 24 m, 180 between 24 and 45 m and 100 over 45 m. The estimated number of seafarers on those vessels is approximately 9,000.

The accident and mortality rates among seafarers have been very high, as this field of work rates among the most hazardous today. The authorities have found the situation to be unacceptable and in 1985, a parliamentary committee was established with the objective of finding ways to reduce the number of accidents at sea and to increase the safety of seafarers. Following a resolution of the committee, the National Life-Saving Association of Iceland (now Icelandic Association of Search and Rescue, or ICE-SAR), together with interested parties, decided to establish a safety-training center for seafarers with the principal objective of increasing their knowledge on safety issues.

The establishment of the training center, the Maritime Safety and Survival Training Center (MSSTC), marked the beginning of a new chapter in the safety affairs of Icelandic seafarers. Upon its establishment, the authorities proved their support by selling a coast guard vessel to the NLAI for ISK1,000 (approximately $9.70 U.S.) for the new center. The vessel, which was given the name *Saebjorg*, was converted into training vessel. It housed the MSSTC, whose role is to educate seafarers in safety and survival on board ships, as well as provides general education on accident prevention at sea.

A reduction of accidents can been seen in figures showing reported accidents to the Social Security Fund every year. This group contains both minor and major accidents, as well as accidents involving trips from the ship to home and back again. They comprise about ten percent of the total figures.

From its beginning, there has been strong interest in Icelandic seafarers about the Training Center, and from the start its programs have been very well attended. Having a safety-training center on board a ship facilitates bringing the courses to the seafarers in areas outside of the capital city, and contributes to the high attendance rate of the Training Center. Since its establishment, the MSSTC has steadily grown and the number of courses offered has increased. Today, the Center offers 14 different types of courses for seafarers, with the Basic Survival and Fire Fighting Courses being most popular. In collaboration with the College of Navigation in Reykjavik and the University Hospital in Reykjavik, the MSSTC has organized refresher courses in medical care on board ships, according to the Council of Europe's directive no. 19/97.

The Icelandic authorities have always shown much interest in and given much support to the MSSTC. The year 1990 saw the passing of a law on the Training Center, securing its financial foundations by allowing an annual allocation from the national budget. Additionally, the Center has an agreement with the authorities on safety training for all Icelandic maritime schools. In 1994, the authorities decided, through a law amendment, to obligate all Icelandic seafarers who are to be registered for service on Icelandic vessels to undergo safety training before being permitted to work at sea. The act on the registration of seafarers applies to all vessels sized 12 GRT or more. According to the act, all crewmembers must be registered with the authorities before a vessel leaves port. Today, this system is nationally computerized, and is a very effective control system in terms of the seafarers' certificates and their safety training.

In 1998, the Government of Iceland decided to give a ferry, which was to being taken out of service after a construction of an underwater tunnel on the ferry's regular sailing route, to the training center for replacement of the older vessel. The size of the ferry, which was owned by the state, is about 50 percent greater than the old training vessel. The new vessel was handed over to the MSSTC in July 1998. Conversion on the training vessel, which has given the same name as the predecessor *Saebjorg*, was made and the first course started in October 1998. To run a training center for seafarers onboard a ship allows for the possibility to take the training center to the seafarers along the coast. The MSSTC's training vessel has made calls at every seagoing port around Iceland, providing training programs that have made it possible for seafarers and owners to minimize the cost of transport and accommodation for the crews while attending courses.

The input by the Icelandic authorities in promoting safety at sea and finding ways to decrease the number of accidents at sea is invaluable. From the date of its establishment, a total of 15,000 people have attended the various courses of the MSSTC. It is anticipated that around 600 fishermen have not yet attended Basic Survival and Firefighting Course. By the end of March 2001, all Icelandic seafarers should have received safety training. However, many of them received it as far back as 15 years ago. This is why the Icelandic authorities included a provision in the act on the registration of seafarers authorizing the relevant government minister to implement a requirement on seafarers, obliging them to re-train in five-year intervals. It is hoped that this option will soon be exercised.

The ICE-SAR, on behalf of the MSSTC, is a member of the International Association of Safety and Survival Training (IASST). This is a venue in the exchange of expertise and knowledge pertaining to the safety training of seafarers and thereby ensures that the training is in accordance with the most stringent demands. The Icelandic Maritime Safety and Survival Training Center has repeatedly proved its importance as a large number of seafarers have stated that the training they received at the Center saved their lives in hazardous circumstances. The best thing would be, however, for us to be told that nothing happened as they, the seafarers, have received safety and preventive training. For us, good news would be no news.

EFFECTIVE TRAINING PROGRAMS FOR FISHERMEN INVOLVED IN SPILL RESPONSE

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He is currently the Safety and Training Coordinator for Alaska Clean Seas, the organization tasked with spill response and training for the North Slope of Alaska. Prior to joining Alaska Clean Seas, he worked training fishing vessels in emergency response in Prince William Sound as part of the efforts stemming from the Exxon Valdez Oil Spill.

While oil spill incidents have declined over the past decade, increased awareness by regulatory agencies, shippers, facility operators, local, state and federal governments and most importantly, the public, has brought sweeping changes to the response industry. New U.S. regulations such as the Oil Pollution Act of 1990 (OPA 90), which came about largely as a result of the Exxon Valdez oil spill, amended the Federal Water Pollution Act to require tank vessel and facility response plans in order to better prepare the owner of a vessel or facility to respond to an oil or hazardous substance release. OPA 90 required that in addition to identifying response equipment and methods, operators must also provide response training and exercises to both employees and private response personnel.

The National Preparedness for Response Exercise Program (NPREP) was developed to establish guidelines to satisfy the OPA 90 exercise requirements. This program provides general descriptions of the types, frequency, and size of the various training and exercise programs needed to be in compliance with the OPA 90 requirements. It is not a strict guideline, but rather provides minimum standards for ensuring adequate response readiness. Many facility and vessel operators exceed the minimum standards.

In addition to OPA 90 regulations, the Occupational Safety and Health Administration (OSHA) requires that personnel employed in hazardous substance response and clean-up operations be trained to recognize the hazards and understand the protective measures available to them. These regulations are outlined under 29 CFR 1910.120, commonly called the HAZWOPER regulations. Additionally, employers must comply with federal requirements identified in 49 CFR parts 172 and 176, which again provide guidance to employers on the training of employees in handling hazardous materials. All of this adds up to a comprehensive program for fishermen's participation.

These regulations and guidelines apply only to those programs located in the United States. However, in many parts of the world, there are similar programs as governments, industry, and the public recognize the need for regulations to provide measures to ensure that we do everything we can to protect the largest and most delicate ecosystem on the planet; our oceans, rivers, and streams.

Largely as a result of these regulations, many opportunities have arisen where the use of fishing and other vessels to assist with prevention and response to marine spills have become necessary. Some of these efforts did not go well. The partnership between industry and fishermen may have been developed after an incident, when tensions are running high, program priorities are vastly different or the cost of developing a program may have proven prohibitive. Many efforts faltered because industry did not recognize the contribution that fishermen could provide to the response. Issues such as where the oil is going, where isn't it going and why, identification of environmentally sensitive sites such as spawning and fish transit areas, bird nesting sites, clam beds, and the vessels' capabilities, were often overlooked in the response. On many occasions, fishermen have proven the best computer modeling of spill trajectories wrong by simply saying, "Come with me, I'll show you." Response efforts have been shown to be more successful when fishermen had input to the planning process prior to the emergency. Issues such as current modeling, seasonal site sensitivities and availability and capabilities of vessels as well as general local knowledge of the area all have contributed to minimizing the impact of a spill.

Times appear to be changing as more and more vessel programs are being developed. History has shown that the cost of having a program in place prior to an incident is far less expensive than having to put one in place after a spill.

Delays due to lack of resources or knowledge of response issues only add to the confusion. Groups of qualified responders are being formed, and heightened awareness of the benefits of a vessel program have prompted many shippers and petroleum organizations to refine response plans to include fishing vessels as part of their response capabilities.

While fishing vessels comprise the majority of available response vessels, there are a number of uses for other types of vessels of all sizes. From small skiffs to large tour boats and ferries, a marine response will not be effective without the use of a well trained marine fleet. Many operators of marine terminals and pipeline operations located near water have boats in their response inventory. However, they often do not maintain all that would be needed or have enough qualified operators to staff the fleet during an emergency.

The following examples are typical of the types of vessels and the activities for responder participation.

Seiners and their jitneys

Used for deploying and towing oil spill booms in containment, deflection and exclusion booming activities.

Operating a variety of skimming and other recovery systems, transporting small oil recovery barges, and basic work platforms.

Handling oily waste and freight delivery.

Bow Pickers

Deploying and towing containment boom and working in shallow waters to assist beach crews.

Anchoring activities, shuttling light duty equipment such as small pumps, sorbents and other nearshore equipment.

Transporting oily waste bags to larger vessels.

Landing Craft

Used for a wide variety of functions from beach support for shoreline clean up operations, delivery of large amounts of boom and other supplies, fueling the marine fleet, waste handling and general staging platforms.

Fish Tenders

Waste handling, transporting recovered oil tanks, crew and equipment support such as refueling, repairing response equipment, and refrigeration needs.

Skiffs and Small Craft

In many situations, these vessels are the most important of all. Their ability to work in shallow areas allows them to do a variety of tasks.

Beach clean up work, shuttling responders and equipment from larger vessels, wildlife hazing and transport and anchor monitoring are just a few of the tasks they accomplish.

Tour Vessels

Used for command and observation platforms, crew transport, meal and rest stations, and supply vessels.

Ferries

Based upon the size and type, ferries can be utilized for crew berthing, personnel transport, observation platforms or refueling stations.

Car carrier versions can transport equipment and act as accumulation points for both oily waste and other disposal needs

The following are some of the key topics that should be included in a training program for vessels operators and crew.

REGULATORY REQUIRED TRAINING

HAZWOPER training may range from 8 to 48 hours depending on the type of activities the responders will be involved in, the level of work hazards they encounter, and the chemical hazards associated with the spilled product.

Hazardous Materials Transportation and Shipping (HAZMAT) training is required for those responders involved with the packaging and transport of hazardous substances. The U.S. Coast Guard license issues may come into play in certain situations where vessel operators are transporting passengers for hire or operating larger vessels. There are many other situational training requirements that may come into play but these are the primary regulatory requirements.

SAFETY AND HEALTH

Critical issues to review are the safety and health hazards associated with the incident, specifically, the tasks that the fisherman will be performing. Understanding the personal protective equipment, safe work practices, and decontamination procedures that are required ensures that personnel are not exposed to chemical hazards. Issues regarding confined spaces such as fishholds, tanks and temporary storage devices should be reviewed. Temperature related injuries such as heat exhaustion, hypothermia, and frostbite need to be addressed. Excessive noise, eye exposure, respiratory protection, and prevention of slips, trips and falls are always an issue as these are often new activities for fishermen and they may not be as familiar with the safety hazards associated with oil as they are with fishing. Other issues such as vessel stability, lines under tension, crushing hazards and crane safety are more familiar to fishermen, but merit attention.

FATE AND BEHAVIOR OF OIL

Understanding the physical, chemical, biological, and climatic conditions that effect the fate and behavior of oil in the marine environment will give the responder a better understanding of how they effect response priorities and equipment selection. Responders must have the ability to adjust their activities according to how the product changes while in the environment. Persistent oils such as crude oil, bunker oil, and lube oil do not have the evaporation qualities of a gasoline or jet fuel. Spreading and transport factors such as tides, current, sea state, soil make-up, and wind can all dramatically increase the area of the spill. There are many cases where a spill was under control until the wind came up and drove the oil into marshes, onto beaches, or further out in the bay. Suspended sediments in the water can act as binding agents, causing the oil to become heavier and sink below the surface. Oils that come in contact with sandy beaches will form heavy tar balls that stay in the intertidal zone or migrate out into nearshore areas. This presents responders with a new set of challenges as a beach may be contaminated numerous times, requiring a beach clean-up team to re-visit the site.

RESPONSE MANAGEMENT

OPA 90 requires that the responsible party have a management program in place for emergency response. This is often referred to as the Incident Command System or Response Management Plan and involves a prescripted organizational structure for management of all phases of the incident. It can vary from area to area but addresses issues such as the organizational structure, common terminology, manageable span of control, and comprehensive resource management. Understanding how the fishermen and their vessels fit in to the plan, their activities, reporting procedures, their communications responsibilities, what form of contract exists between the responsible party and the vessel owner are all factors that must be identified early on. The Incident Command System is designed to have many of these things in place prior to the incident so that activation is the issue, not education. Knowing ahead of time what your duties are and where you will be performing them reduces the time lost to confusion.

RESPONSE EQUIPMENT

Fishermen are renowned for their ability to improvise in an emergency. After the response is underway is not the time to try and figure out how to operate or deploy response equipment. Much of the equipment is similar to the types of equipment used in their day to day job but may have peculiarities that make it important for fishermen to understand the operations and conditions in which to use the equipment.

Spill containment booms behave very similar to nets while being deployed. They typically come off drums or peel off the deck as the vessel moves forward, they have floatation and ballast, and react much like a net while being towed into position. But like a net, they can suffer catastrophic damage if not handled properly. Understanding how to tow a boom in a certain configuration and what characteristics it has, determines how effective it is in containing oil.

Powerpacks that operate skimmers and other systems are largely like the hydraulics on a vessel and in many cases, the vessel's own system may be utilized. However, if not used properly, they will be ineffective and the recovery of the oil will decrease significantly. A hydraulic system put out of service due to an operator's unfamiliarity with it, means no oil is recovered until it is back in service.

Anchor systems are a critical piece of equipment in spill response. Understanding the method and reasons for setting them in certain patterns or having to set anchors in areas that vessels normally wouldn't anchor in may mean the difference between a successful response and a failure.

The inability to deploy, properly position, and operate response equipment means that oil initially contained may escape containment, creating additional impacts to the environment.

RESPONSE OPTIONS

There are four primary options for response to marine spills: mechanical recovery utilizing containment boom, skimmers, and storage tanks, in-situ burning, dispersants and monitoring. Due to the regulatory atmosphere in the United States, mechanical recovery is the primary response method. In other parts of the world, burning and dispersants play a larger role and monitoring is used when the activitites associated with responding may create greater environmental impacts than if it were left alone. It is important to remember that these responses are all "tools in a tool box."

Certain methods work better in situations than others. Certain areas place higher emphasis on one method over another, and no one solution works in all cases. With mechanical recovery, it is not unusual to have large amounts of resources such as personnel, vessels, and response equipment dedicated to the effort. Vessels involved in burning and dispersant activities have specialized training needs that should be addressed in advance.

RESPONSE OBJECTIVES, STRATEGIES AND TACTICS

Marine responses are essentially grouped into four categories: Open Water, Nearshore, Rivers/Estuary, and Onshore. The methods for responding in these environments share some common issues and equipment, but the environments are different enough that understanding the methods and goals for them must be understood by the responders in advance. Weather, tides, current, amount of oil, and degree of sensitivity are taken into consideration when establishing the response priorities. The responders must have a clear understanding of their assignment prior to deploying equipment. Objectives are like goals, they are broad in nature and do not provide information on the method by which they will accomplish them. Strategies define how we meet our "goals" and tactics describe the method to be used. Fishermen involved in the response work primarily with strategies and tactics. They are in the field, deploying the equipment and working to accomplish the objectives. The objectives, strategies, and tactics should be re-examined regularly as the incident progresses and will often change to reflect conditions in the field. Understanding them ahead of time, being able to anticipate the changes, communicating the situation in the field to the response managers, being familiar with the equipment needs, and the methods for employing them are all critical to the success of the response. Responders must be aware of the various ways in which the vessels they work on, and the tasks assigned to them, are utilized if the response is to be successful.

All of these factors add up to a comprehensive program for fishermen's participation. In many areas around the world, large fleets of fishing and support vessels are actively involved in programs, but more training and exercises are needed. Training and exercises cannot be a one-time experience. Training and exercises must be conducted on a regular basis. New techniques and equipment are coming available all the time and they can only be evaluated by using them in a variety of conditions. Fishermen have both an economic and emotional attachment to the seas. Therefore, they have an enormous stake in the success of response efforts and need to be involved in the process at several levels. From the first step in identification of priority protection sites, through additional steps ensuring that vessels and equipment are properly matched to the task, and insisting on quality training, fishermen are at the core of an effective response program.

Wednesday, October 25, 2000

LATE BREAKING PRESENTATIONS

Photograph and caption by Earl Dotter

The groundfish catch of haddock, pollock, cod, monkfish, hake, and flounder is released from the net after a four to five hour trawl. The First Mate, on the left, controls the winding of the net as the deck hands release the catch.

CHALLENGE AND OPPORTUNITY: OCCUPATIONAL HEALTH AND SAFETY "ON THE EDGE" EVALUATION AND INTERVENTION STRATEGIES FOR FISHING AND FISH PROCESSING

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Andy is a safety consultant with the Acordia insurance brokerage firm in Seattle, Washington. His safety career spans 20 years, and includes service as the first Loss Control Administrator for the Puget Sound Schools Risk Management Pool, as well as consulting work for three major insurance carriers.

Since joining Acordia in 1990, Andy has worked extensively with maritime clients, and has become well known in the industry for his work with fishing vessels and floating seafood processors. He worked as the full-time safety director for a major offshore processing company for over three years, spending several months at sea in remote locations while designing and implementing a comprehensive safety program. He has presented popular seminars at statewide and regional seminars and conventions.

INTRODUCTION

Commercial fishing and offshore fish processing are among the most hazardous occupations in the world. The often adverse environmental factors, and the nature of the work itself combine with the independent spirit of these workers "on the edge" to create a volatile mix that results in thousands of disabling injuries and fatalities every year. Injury and fatality rates in this industry are up to ten times higher than land-based "high risk" occupations.

In Alaska, as in other parts of the word, this work is often performed in hazardous settings; the hours are long, and the work itself physically brutal. Yet from an accident prevention standpoint, this work is not so different from other jobs. Physical laws still apply; people act in safe and unsafe ways; and the working environment intertwines with the human element to create challenges for occupational safety and health professionals. Even this most demanding industry is amenable to the accident prevention techniques that have been successful in other industries.

This paper summarizes my initial experiences as the safety director for a major Alaska based fishing and fish processing company in the early 1990s. Charged with a reduction in accident levels that were threatening the continued existence of the organization, I spent many months at sea in remote locations evaluating the situation, and then designing and implementing a comprehensive safety program.

Loss exposures were evaluated via on-site studies, and injury/fatality data analysis. The overall reportable Incidence Rate (the number of reportable injuries over the course of a year per 100 full-time equivalent employees) was 119; in one division the incidence rate was 245. This meant that each 100 employees were incurring 245 injuries over the course of a year. By way of reference, a "high risk" land based company might have an incidence rate of 10 or 15.

Loss prevention methodologies and intervention strategies were developed based on interviews with line employees and company management, as well as workflow and process analysis. An intervention priority matrix was developed that incorporated weighted frequency and severity factors. This matrix was used to target loss prevention assistance to those facilities with the greatest need of improvement.

Employee and supervisory training modules were developed to address the identified loss exposure areas, including environmental, machinery, and process hazard (ammonia refrigeration). Special attention was devoted to life safety at sea and emergency preparedness/response. Initial orientation was developed for new employees and recruitment efforts were refined with the aim of selecting and retaining most qualified applicants.

The incident rate was reduced from 119 to 55 over a two-year period, and direct workers compensation costs were reduced by 26 percent. Another measure of program success was the effective response of the well-trained crew when a disastrous shipboard fire occurred aboard a floating processor three years into program implementation.

This paper focuses on recognition of common loss exposures, and on development of countermeasures to reduce incident frequency and severity.

The emphasis throughout is on accident factor "theme recognition":

Safety and health are management issues, and they are manageable.

That accidents in the marine environment do not just happen; they have definite causes.

That a properly educated and motivated management staff can prevent these accidents. The key is recognition and correction of the unsafe behaviors and conditions that cause "accidents".

One final point by way of introduction: although the events discussed in this paper took place between six to ten years ago, my work in the fishing and seafood industry has continued. My experiences have led me to conclude that the risk factors are much the same in 2000 as in 1990, and that those risks are still unacceptably high. Unsafe human behaviors in an environment very unforgiving to any error, were the root causes of accidents in 1990, and they are the root causes in 2000.

Progress has been made in some areas, particularly in vessel maintenance and inspection activities (engineering). But the fishing industry still carries a heavy burden of death and injury, and much more work remains to be done, especially in the realm of human behavior.

Thus the challenge, and the opportunity.

COMPANY BACKGROUND AND OPERATIONS

The company was engaged in the harvesting, processing, and wholesale marketing of crab, roundfish, (including salmon, pollock and cod), and flatfish such as sole. Several catcher boats were operated as well as oceangoing or "floating" processors, and shore plants. This was one of the largest American seafood companies, with over 500 employees processing more than 150 million pounds of product per year. The total number of employees averaged between 450 and 550.

The company was in an aggressive growth mode, but profits were being undermined and future growth threatened by mounting workers compensation losses. By 1990, workers compensation and associated costs had skyrocketed to nearly U.S.$2 million per year. It became clear that the loss control service traditionally provided by the insurance industry would no longer meet the needs of the company in this area. A decision was made to hire a safety director on a project basis.

EVALUATION

The first phase of the project was a thorough evaluation of the status of the company's safety program. This process consisted of an examination of current and historical loss data; and the major exposures to loss, and the effectiveness of existing control measures.

An accurate needs assessment was essential to maximize the limited financial and human resources available. In order to establish measurable and realistic goals, we first had to determine a baseline reading of the safety program.

The primary tools for gauging program effectiveness were data analysis, and manager and employee interviews. Anonymous surveys as well as informal conversations were used to develop information. These conversations provided a wealth of information about company and industry attitudes and procedures.

The fishing industry historically has been an occupational safety and health backwater. A "last frontier" mentality has been the norm, and the attitudes engendered by this mentality, combined with a high paced production ethic, have resulted in the high occupational injury and illness rates referenced above. Other contributing factors were the virtual absence of government oversight and the lack of commercial insurance industry assistance.

When I began evaluating these workplaces, colleagues in the safety field had said that I wouldn't be able to imagine the conditions on a floating fish processor until I actually saw them, and they were right. A full exposition of the physical conditions and problems I encountered at each facility is beyond the scope of this paper. Suffice it to say, I was shocked at the condition of vessel "X," and the complete lack of any safety program or procedures. Machinery was unguarded; personal protective equipment either not used or not present at all; safety training, even in the simplest form, was non-existent. And the condition of the vessel itself was appalling. The decks were slick as ice, uneven and corroded due to old fire damage, as well as from poor drainage, surfacing and housekeeping. And from the chipping paint in processing areas, to the gallows humor of the crew, the vessel exuded a forgotten, foreign legion atmosphere.

We learned from interviews that some managers were concerned that incorporating safety into their operations would adversely affect the production ethic of the company. Involving employees in the safety program might open a Pandora's box full of attitude and morale problems. Industry perceptions about "safety" and "production" that had been shaped over many decades would not be changed overnight. For instance, the idea that safety and production are mutually exclusive was central to the mindset of many in the seafood industry. One of my priorities was to educate these managers about the true impacts of accidents upon the organization, the tangible costs of work related injuries. I also tried to illustrate the intangible side of this equation: that the true productive capacity of the company would never be realized until safety was proactively managed.

Workers with whom I spoke broke evenly into two distinct categories. Those who had prior experience in the seafood industry said that the company was about average in its approach to worker safety and health. Those without prior seafood experience were, like me, shocked by the conditions and attitudes present on the vessels.

ACCIDENT AND INJURY DATA ANALYSIS

An evaluation of the data revealed that the *accident types* could be categorized into the following groups, accounting for over 80 percent of all incidents: slips and falls; struck by and against; and overexertion/repetitive motion incidents.

These accidents produced the following *injury types*: strains and sprains; contusions and lacerations; and crushings and amputations.

Most accidents involved workers who were injured individually, although there were several catastrophic claims with more than one injury arising from a single incident.

The remote location of the vessels made each accident a potential disaster. With modern medical facilities many hours and sometimes days away, even “minor” injuries had a major potential. This factor also added significantly to the cost of injury treatment; a medical evacuation flight from the Aleutian Chain to Anchorage could run over U.S.$25,000.

ACCIDENT CAUSATION

Industrial accidents are the result of unsafe human behaviors and unsafe conditions. Most experts agree that more than 85 percent of all accidents result from unsafe human behavior; indeed it can be argued that even those accidents that result from unsafe conditions (e.g. wet or slippery deck, poor weather, etc.) have a human component or interaction that creates or worsens the exposure. A storm in the Bering Sea is not inherently dangerous. It becomes a threat to people only with the addition of people; often in the form of a poorly trained or equipped crew, or in the form of a vessel in the wrong place at the wrong time – the result of poor judgement.

That human behaviors and errors cause accidents is beyond argument. The reasons that people act unsafely are open to question, but my experience leads me to assert three broad categories of causation:

LACK OF KNOWLEDGE

Virtually every accident that I investigated was caused at least in part by a lack of knowledge. Training for new employees and supervisory personnel was therefore the highest priority in our action plan.

IMPROPER ATTITUDES

Sometimes people act unsafely even when they know better. This causes accidents that I group under the “attitude” heading. Examples of this type are employee shortcuts, failure to follow established procedures, etc.

PHYSICAL LIMITATIONS

Humans have physical limits. Nowhere has this been more apparent to me than in the Alaska fishing industry. There, people are regularly pushed to and beyond their limits in the name of production and profitability. The simple physical fatigue that results from working 16 hours per day, day after day is a major factor in most accidents in this environment.

These factors are present to some degree in any industrial setting, but they are distilled and enhanced – and their impact is magnified – in the offshore work environment. This environment is very unforgiving to errors of any type.

The emphasis on human behavior is not meant to minimize or to deny the impact of environment or physical conditions. The physical conditions present in the fishing industry are undeniably harsh and at times seem to conspire against safe work activities. The cold and wet environment, a moving platform, and physical isolation from help in an emergency are a few of these factors. The severe work environment pushed every element – human and mechanical – to the limit.

Finally, as in all other work settings, accidents can be viewed as a symptom of management failures. Frontline supervisors often complained at the relative disparity between their responsibilities and their authority – they said they lacked authority or backing from higher level management to make needed changes.

DEVELOPMENT AND IMPLEMENTATION OF ACTION PLAN

The initial risk control evaluation of the company had revealed several significant areas of weakness that would have to be addressed. I grouped these into two broad categories, administrative and operational. The administrative recommendations dealt with program, personnel, and training elements. Operational elements referred to condition-related recommendations such as machine guarding and chemical safety specific to a particular vessel or location. Since the operational recommendations dealt with vessel-specific physical conditions, only the administrative issues are explored in this paper.

A detailed action plan was developed and submitted to management. This plan included a prioritized implementation timetable.

I have found that troubleshooting an organization and developing an action plan are the easy parts of the job, relatively speaking. *Implementation* of the plan and integration of the elements into production activities are far more difficult. The implementation and integration process takes time, commitment, and a dedication of resources. Viewing safety, like quality assurance, as an integral cycle and an ongoing process makes the inevitable bumps along the road easier to take.

ADMINISTRATIVE

The major administrative recommendations and action steps were:

a.) Demonstrate management commitment to safety. Top management needed to convince both skeptical employees and supervisors that they were serious about safety. This was accomplished in a number of ways. First was in hiring a safety director and making budget resources available. Next was backing the plan that was developed to address shortcomings, including training, upgrading machinery and facilities, etc. A financial incentive plan was approved for line supervisors and employees. And finally, managers needed to "walk the walk": set a good safety example in their own behavior.

b.) Initiate accident prevention training for all company supervisors. Front line supervisors are the most important actors in the organizations' safety program. They are the only people that are in position to observe and correct the unsafe behaviors and conditions that cause accidents before they result in injuries to employees. But they cannot perform their role without knowledge. Hence, training these people in accident factor recognition, and in general management techniques is critical to long-term success. My constant mantra was, and is: The Safety Manager Is Not Responsible for Safety – Company Management *Is*.

c.) Initiate employee training. As noted previously, lack of knowledge is a major factor in most industrial accidents. The corrective action for this is training. Initial orientation and job specific training was developed and delivered to all employees. Employees were trained in the typical industrial areas (lockout/tagout, material handling, accident reporting, etc.,) as well as in areas unique to shipboard life and seafood processing (area evacuation and abandon ship procedures, ammonia emergency response, etc.)

d.) Develop a written safety procedures and operations manual. Standardized policies and procedures were developed that ensured corporate baselines were met while still allowing for management flexibility in meeting goals. This manual also served as a reference guide for the Plant Managers and Safety Coordinators.

e.) Designation of a "Safety Coordinator" for each vessel and location. It became obvious early on that the Plant Managers were overloaded with existing responsibilities. Indeed the entire management structure of the company was very lean. Managers knew they were responsible for safety, but didn't have the time or the resources necessary to do that part of their job. Part of the solution here was a re-ordering of priorities by top management that occurred under paragraph "a" above. The other part was hiring a safety coordinator for each location (or designation of an existing employee as coordinator). The Plant Manager was still responsible for safety results – we made it clear that the Coordinator was a resource person that was there to assist the managers in their safety responsibilities.

f.) Develop improved personnel screening, hiring, and retention procedures. One factor that came up repeatedly in employee interviews was that many employees felt they were not well informed about work and living conditions during the recruitment process. The oft-repeated phrase was " I didn't know what I was getting in to." There was also ample anecdotal evidence that poor morale was a factor in many workers compensation claims.

Therefore improving the information flow to potential applicants and refining employee selection procedures became top priorities. One of our first projects was what I termed our "de-cruitment" video; a realistic portrayal of actual conditions in the plants and living quarters that was shown to each group of prospective applicants. This video, along with other measures, had the desired effect – a dramatic reduction in complaints associated with poor morale and fewer "problem" workers compensation claims.

We also instituted universal pre-placement physical screening. Because of the hard physical nature of the work, this was a very valuable tool for both employer and employee. These exams made it possible to base work area assignments on objective data.

RESULTS

The safety process that was initiated resulted in a significant improvement in the company's risk management and safety profile. There are several different standards available to measure an organizations' safety progress: comparison with shore-based industries, other offshore processors, etc. Perhaps the most meaningful is measuring the company against its past performance. By this standard, great strides were made both in the short term, and over the longer course.

A safety program was developed and implemented literally from the ground up. We were successful in raising the safety consciousness of the top management and supervisors of the company. And we instilled an awareness of safety into the operational and "production" dynamics of the company.

As noted above, the workers compensation Incident Rate (the number of reportable injuries over the course of a year per 100 full-time equivalent employees) was reduced from 119 to 55 over a two-year period, and direct workers compensation costs were reduced by 26 percent over that time. Those figures reflect overall company experience; the reduction at some of the "problem" plants was far more dramatic. One location had an incidence rate drop from 246 to 67 over the same two-year period. Costs were reduced by over 75 percent at that location.

In addition to direct workers compensation savings, the implementation of the safety program produced many collateral benefits. Among these were:

Reduced employee turnover (and reduction in associated costs);

Improved product quality (resulting from more experienced and better trained work force); and

Improved relationships with regulatory agencies.

The bottom line was literally a better bottom line – increased profitability.

CONCLUSION

The progress has been painfully slow at times. It was clear that procedures and attitudes built up over decades were not going to be changed overnight — or even in a decade. Some of the underlying causes of the high injury rate among seafood processors seem destined not to change at all, or at least in the foreseeable future. Things such as the relatively low pay and long hours (up to 18 a day), that make it difficult to attract and retain educated and qualified workers.

In spite of those challenges, I am optimistic about the future. My optimism stems from success stories like those related above, and from others I have been involved with since then. I have seen at first hand the difference that safety training can make.

The defining moment of my 20 year safety career (thus far) came in 1994. A horrific fire broke out on a processing vessel in a remote area of the Gulf of Alaska. Within a short time the fire raged out of control and it became clear that the vessel would have to be abandoned. Although one crewmember was killed fighting the fire, the miracle was that over 200 people were safely evacuated without a single other major injury. The professional response of the crew made that miracle possible. And that response was made possible by training; training that had not existed in prior years. When the smoke had cleared, experts agreed that many more casualties would have resulted were it not for the effective response of the crew.

Rarely is it possible to see the results of a program so clearly. More often, thankfully, the results are less spectacular. But that incident proved to me that in the fishing industry, the results are worth the effort. The safety bar has been raised in the last ten years, to be sure. But much remains to be done.

Thus the challenge, and the opportunity.

NORWEGIAN SEA SAFETY TRAINING FOR FISHERMEN

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INTRODUCTION

"Safety Training for Fishermen" (STF) is a national compulsory program for all fishermen on board Norwegian vessels. STF started as a project in 1981. In 1985, the government decided that the STF should be a permanent arrangement. Since then the administration of this national training program has been an independent department of Tromsø Maritime Academy. The training consists of a 40-hour basic course, and after five to eight years there is a 20-hour repetition course.

BACKGROUND

The STF project started due to the awareness that great numbers of fishermen died or were injured when working. Research in the seventies documented very high accident rates in the Norwegian fishing fleet. In order to reduce the high risk of accident, several safety measures had to be taken. Good safety training was one of the most important measures pointed out by the researchers.

During the project's first year, in 1981, the training consisted of two-day curriculum that emphasized sea rescue and fire protection. Since 1982 the project has grown and it now offers week-long (40-hour) Safety Training courses. In 1985, the project's directing group presented a report that concluded that STF should be institutionalized, and should be given near the fishermen's homes, in a number of fishing ports.

The Norwegian Parliament subsequently decided that STF should be compulsory for all fishermen, and that the State should finance the training.

REGULATIONS

After Parliament ratified the legislation calling for mandated STF, the Maritime Directorate drew up the appropriate regulations. These regulations, developed in 1989, were confirmed by Parliament. The regulations call for all workers on board Norwegian vessels, to have the 40-hour basic course of sea safety training, or safety training for maritime personnel. The regulations require that the fishermen must go through with a 20-hour repetition course within five to eight years after the basic course. For fishermen over the age of 60, the repetition course is voluntary.

The regulations also contain documentation of training. This means that everybody on board Norwegian vessels must have either approved training, or proof of dispensation. Dispensations are normally only provided on a one-time basis, for the first trip at sea, and last no longer than three months.

The regulations also require that a central register be kept of fishermen with approved training , and that the register must be tied to the census of fishermen. The administration of the Sea STF is responsible of keeping these registrations.

FINANCE

The basic Safety Training program is completely financed by the Norwegian government. Beginning in 2000, however, fishermen have to pay a fee of NKr2200 (U.S.$245) when participating in the repetition course. The program budget for year 2000 is NKr20 million (U.S.$2.2 million), of which the government pays NKr15 million . The program's cumulative cost, since its beginning in 1981, was about NKr250 million (U.S.$28 million) by the year 2000.

THE TRAINING PROGRAM

The curriculum provided by the STF program covers the following topics: survival and rescue from accidents at sea; fire protection and fire-fighting; working conditions, hazards and protective measures on fishing vessels; first aid; and laws and regulations concerning the safety of fishermen.

After instructions from the Ministry of Church, Education and Research, researchers at MARINTEK evaluated the STF curriculum in 1989 and 1996. Both times the evaluation concluded that the sea safety training gave the fishermen better knowledge, greater understanding and improved attitude about the importance of workplace safety.

The evaluation pointed out the value of site-based training, near fishing ports and communities, as crucial to the success of the project. Training near the fishermen's homes has contributed to a change of attitude and a greater feeling of safety not only for the fishermen, but also for the people of the communities along the coast. However, the evaluation in 1996 concluded that more of the training could be moved to the stationary safety training centers. The program has opted go for a mixture of ship-based and stationary training centers. Since 1998, the Sea STF has had a roving ship training center, and six stationary safety-training centers located along the coast. In the past few years, 50 percent of training courses have been offered on the program's training vessel.

TEACHING PERSONNEL

Nautical education, experience, and further training in safety-related subjects are required for those who teach at the courses and work on board the training vessel. In addition, instructors must be certified as high school teachers.

MARKETING

Marketing of the courses is mainly done by mailing individuals. Larger Norwegian shipping companies often promote training opportunities, as well. Media outreaches, using national and regional newspaper and magazine ads, are also common approaches. Courses are promoted in cooperation with the fishermen trade unions and the local authorities.

COLLABORATION

The Norwegian Ministry of Church, Education and Research enacted a steering committee to help oversee the STF program. The committee provides advice in questions of trade and management. The committee functions as a board, and represents five organizations: The Directorate of Fisheries; The Council for Labor Supervision on Norwegian Ships; Norwegian Fishermen's Association; The Union of Norwegian Sailors; and a School of Fishery.

STF also collaborates with other institutions: The Ministry of Church, Education and Research, on finance, course distribution, development and administration; The Maritime Directorate, on rules, regulations, subject plans and dispensations; The Ministry of Fisheries, on census of fishermen, coursing and registration; The Main Rescue Co-coordinating center, on the sea rescue exercises; Rescue helicopters, on the "pick up" rescue exercises; The Fishermen's trade unions, on safety issues; SINTEF Fisheries and Aquaculture (previously MARINTEK), on accident statistics, safety projects, teaching aids and evaluation; and producers of rescue material and safety equipment

COURSE PARTICIPATION

There have been approximately 20,000 registered fishermen in Norway since 1980. Work force turnover is about 10 percent. From 1982 to August 2000 about 27,000 people (mainly fishermen, but also a substantial member of school pupils) completed the basic course. The repetition course was initiated in 1996, and about 5,300 fishermen have completed this course.

RESULTS

Before the program started in 1981, the number of fishermen who died from work related accidents were about 30 each year. In the late 80s and early 90s the number of accidents decreased. During the latest four to five years the accident rate in the Norwegian fishing fleet has apparently been substantially reduced. This reduction is partly explained by the large numbers of fishermen who now have completed safety training.

FUTURE PARTICIPATION

The evaluation from 1996 concluded that after year 2000 there would be a need for 1,000 basic course places, and 2,800 repetition course places annually. However, our experience these last years is that the attendance to the repetition course is less than expected, and more than expected to the basic course. The reason to this is probably that there is a greater replacement in the profession now than earlier. Experienced fishermen have often found other occupations after eight years, and they are being replaced by young fishermen who don't need repetition courses, but basic courses. The real needs seem to be 1,400 basic course places, and only 1,000 –1,200 repetition course places each year.

TRAINING

Even if the number of fatal accidents has been considerably reduced over the last years, there are still work-related accidents on board that can lead to great personal injuries. For this reason it is very important that we pay close attention to what kind of accidents actually happens in the fishing fleet, and adjust our subject plans so that they concentrate on situations that actually cause injuries.

FUTURE NEEDS

The main objective of the safety training will remain on reducing the number of fatal or disabling personal injuries to fishermen. How to avoid accidents will have high priority. Increased focus on working conditions and health issues is needed. This may necessitate a differentiation of the courses, to better cover the special conditions of various fisheries and vessel types. Special courses will be considered, for instance on stability and vessel operation of skippers of small and medium sized fishing boats, emergency handling etc. Better Nordic cooperation on safety training and certification is needed, to make the labor markets more open to fishermen from the Nordic countries.

INTERNATIONAL COOPERATION

The International Maritime Organization (IMO) has minimum requirements to everybody working at sea, except for those on fishing vessels. Still there are forms of safety training in different countries. The Norwegian Maritime Directorate approves documented Safety Training from another country for work on Norwegian vessels. We are familiar with that some countries have different types of safety training, also especially for fishermen. But often these courses are attached to other education. As we know, IMO is currently working on STCW-F.

NORDIC COUNTRIES

Norway was the first country in the world to start this systematic training, and the results have attracted attention from other fishing nations.

Iceland, Sweden and Denmark have different types of safety training targeting fishermen. The Farø Islands also have a safety center for fishermen and other Maritime personnel.

Finland and Greenland have yet to implement a comprehensive safety program for fishermen.

CONCLUSIONS

STF has been successful and met the educational standards set by workers and the State, as shown by the reduction in the number of fatal accidents among Norwegian fishermen. STF continuously spreads knowledge and is an important element in increasing the security of those who work on fishing boats.

The organization of STF must, to retain its integrity and independence, have its own board that has the total responsibility for developing the education and running the courses.

There is a need for annual grants from the State of NKr18 million (U.S.$2.1 million), based on the current structure and future needs.

STF must be organized centrally and executed locally to achieve maximum efficiency. International standards for minimum safety training requirements are needed.

THE CHILEAN SAFETY ASSOCIATION AND THE PREVENTION OF RISK IN THE CHILEAN FISHING SECTOR

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THE CHILEAN SAFETY ASSOCIATION

The Chilean Safety Association is a mutual benefit fund, that administers the workmen's compensation act for occupational diseases and accidents. There are currently three Mutual Benefit Funds in Chile, and the Chilean Safety Association is the largest with 53 percent of the market. These Mutual Benefit Funds are private, non-profit corporations managed by a labor dispute board of directors made up of six full members — three representatives from member companies and three worker representatives. These Mutual Benefit Funds provide member workers and companies with the following benefits: risk prevention; medical care; financial benefits: subsidies, compensations and pensions; and rehabilitation.

These Mutual Benefit Funds are funded by means of an obligatory contribution charged to employers, since the latter are still responsible for accidents. There is a basic contribution of 0.95 percent of taxable wages, and an additional contribution of up to 3.4 percent for presumptive risk linked to the activity of the company. The average rate currently stands at 1.8 percent. The fishing sector's rate is 2.55 percent. There is a system of incentives and penalties for employers keyed to their companies' workers risk prevention programs. The lower a company's accident rate, the lower the additional contribution and, if the accident rate climbs, the additional contribution will also be higher. The contingencies that are covered include occupational accidents; accidents en route to work; and occupational diseases.

The Chilean Safety Association has 1,400,000 affiliated workers and 36,000 member companies. It has reduced its accident rate from 35 percent in 1969 to 8.1 percent in 1999. The Association has seven hospitals, 21 clinics, 84 polyclinics and more than 700 hospital beds. It has reduced the average number of days of treatment from 30 days in 1969 to 9.3 days in 1999. It has excellent rehabilitation, which provides for successful job reinsertion: 80 percent of rehabilitated workers return to work, including 99.7 percent of all workers who have suffered a serious injury.

CHILEAN AQUACULTURE AND INDUSTRIAL FISHING SECTOR

FISHING SECTOR

During 1999, there were 474 vessels in Chile. The industrial fleet operating in domestic waters landed a cumulative total of 4,200,000 tons. The main resources landed were pelagic species. The main type of fishing is purse-seining with 64 percent, followed by trawling with 22 percent. A total of 448 processing plants were active in 1990, processing a total of 5,500,000 tons of raw material.

AQUACULTURE SECTOR

Eight hundred and fifty centers operated in 1999 harvesting a total of 310,000 tons, of which 75.5 percent were fish, 14.3 percent mollusks and 10.2 percent algae. The aquaculture sector has evidenced sustained growth, exporting more than U.S.$750 million in 1999.

THE CHILEAN SAFETY ASSOCIATION AND CHILEAN FISHING SECTOR.

In December 1999, 360 fishing companies, with 25,000 workers, were members of the Chilean Safety Association. The accident rate of the fishing sector dropped from 24 percent in 1992 to 14 percent in 1999. The percentage of accidents by area of fishing activity are fishing fleet, 63 percent, and fishmeal plants, 37 percent.

Sea-going personnel suffer the largest percentage of accidents with a greater incidence among the crew of fishing vessels, especially during casting and harvesting activities. The most frequent type of accident is being hit by, or knocking against, material objects used in the maneuvers (especially during rough seas and night work). The main agent causing the accidents are elements used in the maneuvers (cables, ropes, tacking equipment and work surfaces). The body's upper extremities suffer the most injuries with 48 percent of the total.

THE CHILEAN SAFETY ASSOCIATION AND THE FISHING PROGRAM

As part of its policy to constantly evolve and adapt to changes and new requirements of domestic production, for some years now the Chilean Safety Association has implemented an Overall Plan for the Aquaculture and Fishing Sector, which, among other things, seeks to provide this important economic activity of the country with specific advisory services geared towards reducing the sector's accident rate indices.

The fishing program's main goals are to increase risk prevention training, skills development and exchange of experiences among affiliated workers of the Chilean Safety Association nationwide, and to reduce occupational accident rates in the aquaculture and industrial fishing sector.

The activities of the Chilean Safety Association in the Fishing Risk Prevention Program are geared primarily towards accomplishing our two main goals in accordance with our institution's strategic directives. The Chilean Safety Association has set up the following strategic directives for Risk Prevention: to be a leader in risk prevention; to increase loyalty and customer satisfaction; and to strengthen the public image.

The Chilean Safety Association has developed a variety of services and products aimed at different sectors of the aquaculture and fishing sector, with its sphere of action covering the whole Chilean coastline. These services are delivered with technical support from the various Units in existence: Physical Risk Unit, Chemical Risk Unit, Biological Risk Unit, Ergonomics and Fire, among others. Products aimed at the aquaculture and industrial fishing sector include the following:

Fishing Safety

Recognition and evaluation of risks in fishing operations, both on board vessels and in processing plants;

Advisory services to draw up and execute comprehensive risk prevention programs;

Drawing up of work procedures for critical activities in fleet and plant; and

Evaluation of preventive measures in management policy.

Industrial Hygiene

Recognition, evaluation and control of physical, chemical, biological and ergonomic risks affecting fishing workers.

Ergonomics

Physiological evaluation of fishing workers; and

Program of corrective exercises for problems of posture and physical recovery on the job.

Occupational Health

Define and evaluate job profiles (physical, psychological, sensorimotor and technical requirements).

Legal Consultant

Support in operational aspects of the Workmen's Compensation Act for Occupational Diseases and Accidents (Law Number 16,744 and its supplementary decrees).

Statistics

Deliver statistical reports on accident rates of the aquaculture and fishing sector; and

Prepare studies of the sector's accident statistics.

Training

Management training and workshops for plant and fleet supervisors; and

Specific courses for the fishing sector (risks on board, risks in reducing plants, risks of sulphidric acid, survival in the sea, among others).

Publications

Preparation of manuals, booklets and posters to support preventive measures and training;

Participation with technical articles in magazines from the aquaculture and industrial fishing sector; and

Production of aquaculture and fishing risk prevention videos. (The most recent videos produced include "Trolling Safety," "Surviving in the Sea," "Safety in Salmon Processing Plants.")

Agreements

Work, research and cooperation agreements with foreign and domestic institutions.

SCIENTIFIC RESEARCH

The Chilean Safety Association leads the field in scientific research, just as it does in matters of prevention. The recent research into the fishing sector undertaken by our Institution is proof of that. The aim of that piece of research was to become acquainted analytically with the fishing activity, its work conditions and associated risk factors. The study will soon be published in Chile.

FISHING SECTOR: WORK CONDITIONS AND RISK

This section of the paper will describe the Chilean fishing workforce, their injury risk factors and their relationship to work conditions. The significant physical, psychological and social detriment is known to affect directly work, and consequently productivity. Different methods for fishing capture are used in Chile. However, the most relevant one for this study is that known as purse-seine, whose main resource is pelagic fishing: Spanish sardine (Sardinops sagax), anchovy (Engraulis ringens), and jack mackerel (Trachurus murphyii), mostly used in fish meal and oil plants. Work conditions include all of the factors integrating the realization of concrete tasks that decisively have an influence on the workers' health. A descriptive study was designed to define the principal components of the present industrial fishing sector.

For this purpose several instruments were developed and used to measure and collect both qualitative and quantitative information on the dimensions that compose the work conditions of said sector: general personal characteristics and job conditions, workday, free time and contractual situations; general condition of the ships, safety, emergency preparedness, rough work style, level of knowledge, on-board organization, alcohol and drug consumption.

The team was conformed by an engineer expert in safety and risk prevention, a psychologist and a sociologist, whose job was entirely carried out on site in both northern and central southern Chile.

METHODOLOGY

The theoretical methodological approach is of a qualitative and quantitative character and it aims at registering and systematizing any information referring to the work conditions of the fishing sector. Among the strategies employed to collect this information, the following techniques were used:

Direct or participating observation

The normal workday conditions were observed in the job of seining just as they show in its socioenvironmental ambience. For this reason the sociologist had to go aboard for twelve hours in the northern and central southern area of the country.

Interviews to key informants

Thirty exhaustive interviews were made. The people interviewed are representatives of the sector to which they are associated because of their experiences or the positions they have.

Questionnaires

An anonymous instrument for the collection of massive data consisting of a set of printed open and semi-open questions was applied in order to obtain objective indicators of the variables in question. This questionnaire was answered by 681 fleet workers. The size of the sample was determined by a simple random sampling of fishermen who were associated with industry partners of this study. All major seafood industries of Chile participated in the study by providing lists of fishermen who could potentially serve as respondents to the survey.

Focus groups

This technique implies the collection of a determined number of people to discuss, talk and reflect upon one or more themes. The participants give their opinions in an open and free way about themes of interest for the study proposed by the researchers. A total of 10 focus groups were conformed, with 9-14 participants in each group.

RESULTS

Of the relevant themes addressed in the study, the following are highlighted:

As far as the general condition is concerned, the ships have had a significant improvement in terms of habitability and comfort in comparison to those existing a decade ago. This improvement has enabled that the factors considered bothersome, have diminished, though still present in older ships.

The potential risks of accidents are present at every moment, from the moment the crew members go aboard to the fishing task; therefore we consider it essential that every time the crew members require anything dealing with the condition of the equipment and maneuver elements, these should be attended to, welcomed and solved positively by the corporations. Undoubtedly, this will make the job safer and free from accidents to the workers of the sector.

The factors that have affected the fishing sector are, among others, the event of El Niño current and closed seasons. This has required that some labor changes should be made, changes that have affected the workers and the companies. They have to diversify their products and adapt themselves to this new economic situation. Also this situation has passed to the companies related to the sector and to the regional economies. As mentioned, the former has also had a significant impact on the workers as to their work stability is concerned. This has meant that they have to reinsert themselves in other productive areas. Keeping in mind the specificity of the work done by the seamen, in many cases it has meant an important diminution in their living conditions and those of their families.

In relation to the factors that have a bearing on the present problems of fishing, the following were mentioned: lack of governmental policies, overexploitation of the resource associated to the absence of control mechanisms in the regulation of this one by the authorities and the event of El Niño current. According to the interviewees, there is the need of a better planning by the authorities in the regulation of the extraction of the resources, which must incorporate all of the actors involved, government, entrepreneurs, workers and entities related to the sector.

The factors mentioned as determinants for the good work performance in the fishing sector would be as per their importance: psychological aspects, general conditions of equipment of the ship, work stability, personality traits of the skipper, environmental conditions of the job, technical training level of the crews, technical training in the area to work, family situation, capacity for personal development, specificity of the functions and physical capacity of the workers.

Fleet workers say that they experience good relationships with other workers, emphasizing the sense of humor that they share. The workers themselves consider workplace humor a necessary ingredient to keep workplace morale high.

The human relations of the workers with the different sectors of the company fluctuate from bad to excellent, depending on the position of the workers with respect to relationships with safety personnel. We expected, before the study, that we would find that relationships between crew members and safety personnel would be strong, given the interaction between the two groups. However, most of these relationships were judged to be of poor quality by the crew members. The type of relation observed with the fleet or bay bosses is different, relations which were, in general, acknowledged as good.

The attributions that the fishing skipper has give him ample authority, for this reason his leadership style establishes the work condition on board of the ship; in this way, his conducting style marks the different relations for all the crew, becoming a model and example in any situation.

Given the fact that in general there was a moderate existence of drugs in the ships, and asked which one would be the most present, marijuana was mentioned as the highest in percentage in the crews. However, it is important to manifest that drug usage does not constitute the norm according to the workers, although overall use may be higher in San Vicente, Talcahuano, and Iquique.

Considering the survey findings, we regard that with respect to the alcohol and drug consumption habits, a rigorous control by the companies is suggested; this can be done at the moment of selecting the personnel through the application of questionnaires oriented to detecting alcohol and drug consumption, or through permanent workshops in the company. Experienced professionals must conduct these workshops. In the case of carrying out the workshops with contracted personnel, the suggestions by the trade unions can be incorporated, as they usually have some information about the workers presenting difficulties in relation to the theme described.

As to the levels of stress, there is no doubt about the risks that the workers of the fishing sector are exposed to. The climatic factor, the rapidity with which they should act in maneuvering, especially when casting, augment the stress levels. That is why a great psychological strength is required to assume not only the risks pertaining to the job but also the long periods away from home, the irregularity of the workdays, the adaptation to the constant changes of the rhythms of sleep and wakefulness plus the uncertainties of the sector due to occasional factors.

From the focus groups it can be seen that the crews recognize they experience family problems derived from their work routine. These difficulties present themselves at a couple and parent level. In relation to the latter mentioned, the woman must consequently assume roles that are socially shared with her husband, such as the administration of the economic resources, the establishment of norms and limits within the home, the educational support of the children and health care among others.

In relation to the couple, the problems they face and solve are varied, including communication, power relations, infidelity, intimacy, sorrow and frustration issues. These are themes that are difficult to address. It is important to add that for sea people the family constitutes a fundamental solid pillar that they considerably respect, becoming a motivating agent for work performance.

CONCLUSIONS

In the case of industrial fishing, it is important to keep in mind that in the last few years this sector has been a significant national productive area, in spite of the oceanographic problems affecting it lately. Accident rates reached one of the highest indexes over the last year against other economic activities. Nevertheless, these have been gradually decreasing, signifying great advances in the accidents occurring in the sector. The participation of industries, companies, professionals, seamen, and all the entities related to this important economic activity of the country, denote an increasing intention towards preventing risks that cannot be ignored. The technological capacity of the fishing ships has notably developed in order to improve capture and safety efficiency. Modern navigation information systems require that captains, officers, engineers, boatswains, and crew members receive constant training to catch up on the technical knowledge to operate the mechanisms of the ship in a safe and efficient way. The industrial fishing sector has made relevant technological changes in the environmental development to attain harmony between the productive work and the environment, minimizing the impact of industrial wastes.

Finally, it can be said that the crews manifest a deficit or lack in matters of risk prevention in the training that the companies carry out. It is known that there are some norms issued from the Maritime Authority as to the obligation to carry out the OMI Model courses (basic knowledge of medical assistance, sanitary first aid, survival in the sea and in fires), essential requirements before going aboard. To achieve better safety levels for this sector, necessarily implies increasing training actions, which should be oriented to develop a risk prevention culture, with a solid formation in themes such as leadership, team work, self-care, management of stress levels, stress control, and control of the consumption of alcohol and drugs.

The Chilean fishing activity poses enormous challenges to solve. The diminution of debarkations of pelagic species in the northern and central southern areas has meant that the fishing industry has had to reshuffle its operation plan with redistribution and/or a partial stagnation of the fleet, cost diminution and personnel dismissal. Consequently, the fishing sector is going through a period of changes, characterized by low captures, over investments in the fleet and restrictions in the access to the resource. This setting makes it necessary to face it, optimizing the operations, making them safer, allowing the fishing sector workers better and more comfortable work conditions.

POSTER PRESENTATIONS

Photograph and caption by Earl Dotter

The fishermen make quick, deft cuts with razor-sharp gutting knives as they dress haddock. On average, each haul-back of the net yielded about 1500 pounds of fish. The catch must be gutted before it is loaded into the fish hold and packed in layers of crushed ice.

THE INSURANCE SURVEY (C&V) AND ITS IMPACT ON THE SAFETY OF U.S. COMMERCIAL FISHING VESSELS

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Marine surveys are done for buyers, sellers, financial institutions, and insurance underwriters. The Condition & Value (C&V) or Insurance Survey – routinely carried out on Commercial Fishing Vessels for a variety of interests – is subject of this discussion.

Those who perform Condition & Value surveys variously described them as a "visual" examination of the vessel "to determine whether the vessel is an acceptable risk," and to "assist insurance underwriters in making underwriting decisions." There are two purposes of the survey: 1.) identifying the vessel, its equipment, condition and general value, and 2.) identifying defects, damages, or hazardous conditions that pose a potential threat to the safety of the vessel and its crew. C&Vs are not intended to certify that the vessel is built, or conforms to, any standard, nor is there any requirement that the machinery or equipment be tested for proper operation. One Coast Guard Board of Investigation stated, "the surveys (conducted on the subject vessel) were mostly inventories for insurance purposes."[1]

This paper will examine a number of issues regarding C&V surveys, in particular, the performance standard and the legal protections of the disclaimers that are attached to these surveys.

Finally we will explore whether there is a need for a fresh approach to the C&V as it applies to Commercial Fishing Vessels in the 21st Century in order to protect the many interests that rely on them.

INTRODUCTION

The Perfect Storm, in both book and movie form, has rendered readers and viewers alike in awe of the ocean's power and aghast at its dangers. But, for most, that effect is vicarious. For those involved in the marine community the dangers are real. First and foremost, we know the fishermen who set out to sea to earn their living. Second, we know that the sea conditions faced by the crew of the *Andrea Gail*, while dangerous, were not as portrayed in the movie, and that fishing vessels are lost in sea conditions far less extreme. Third, we know that the risks of commercial fishing are manageable, and casualties are preventable, yet they continue at what should be an unacceptably high numbers.

This paper focuses on a document that is a key element of the business of commercial fishing, the Condition and Valuation Survey or "C&V." Insurers and lenders require a vessel owner to provide them with a C&V before issuing a policy of insurance or lending money and using the vessel as collateral, as the case may be. As for any business, the owner's or operator's skill, performance and experience provide the primary basis, apart from the C&V, upon which the business risks can be assessed. In the case of commercial fishing, safety risks take on a dimension far greater than those in any other industry; yet do not receive the necessary attention.

For the reasons we discuss in this paper, we conclude that the C&V survey process as currently conducted not only does not provide an adequate basis for assessing the risks of casualty attendant to a fishing venture, it raises the "comfort level" of those relying on it, particularly a vessel owner, to what should be an unacceptable level. We recommend steps that might be undertaken to remedy this situation.

AN OVERVIEW

To say that the commercial fishing industry is beleaguered at present is to put the situation mildly. Fishing enterprises today are subject to catch restrictions, including days at sea limitations, fisheries available, closed areas, and gear restrictions. Fishermen have to push harder to stay even financially. The risk of casualty remains the highest of any industry. The tort system, which so often drives change in safety regulations, has not improved matters materially. As independent contractors, fishermen cannot form unions, and, therefore, lack the organized presence that could be brought to bear on safety issues. Fishermen remain fiercely independent, willing to say, for example, in reference to a stability letter, "I know better how the vessel should be loaded . . . the more water in the hold, the better she rode – as long as you kept her on an even keel."[2]

Improvement in fishing vessel safety can be built on a substantial, existing fund of knowledge. Mountains of material have been published by government – primarily through the U.S. Coast Guard and NIOSH – academia, classification societies, and fishermen's organizations, on steps that can be taken to improve safety on commercial fishing vessels.[3] Potential sources of economic and political pressure to improve fishing vessel safety are not likely to take strong action. A lender's risk of loss due to casualty is ordinarily covered by insurance, thereby reducing its level of concern. Insurers continue to write coverage leading one to conclude that the fishing vessel insurance business remains profitable even in the face of continuing losses. Congress has declined to regulate beyond the Commercial Fishing Industry Vessel Safety Act of 1988 (P.L. 100-424) by arguing, in short, that additional regulation would be too expensive.

While it is fair to say that there has been a statistically significant decrease in casualties after the implementation of the Act, there are still far too many casualties. Is our society willing to say that the risks are acceptable as long fishermen are willing to take them? Or is there a mechanism to raise the standards for fishing vessel safety at a relatively low cost, without additional regulation?

THE C&V SURVEY

Condition and valuation surveys have long been a component of the commercial fishing matrix. In concept, they are empirical examinations of a commercial fishing vessel conducted to establish its condition and appraise its value at of the time of the survey. C&V surveys are, for the most part, not conducted on a regular schedule. Instead, they are conducted when the vessel owner needs to renew a policy of insurance, or at the request of a lender for the purpose of supporting a new loan or continuing an existing loan facility. In addition, a prospective purchaser of a fishing vessel usually has a surveyor of his choice conduct a C&V on the vessel.

Marine Surveyors are not regulated. Some hold membership in organizations such as the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS), or are certified to conduct surveys on behalf of classification organizations such as the American Bureau of Shipping (ABS). Some surveyors are registered professional engineers. But, in the final analysis, there exists no uniform standard for the performance of or reporting on surveys of commercial fishing vessels. As a consequence, the reliability of a C&V survey as a tool for evaluating the risks a vessel presents to its owner, master, crew, and others having an interest is suspect.

There are two features of C&V surveys that are worthy of particular note. The first is that the surveyor generally characterizes him or herself as "independent." Taken in its ordinary sense, the use of the word "independent" suggests that the surveyor has no affiliation with any party to or beneficiary of the survey, and is conducting it without regard to any specific interest in the vessel. In addition, the surveyor almost without exception uses the words "without prejudice" often in combination with others, to conclude the survey report. When read with the word "independent," that phrase reinforces the proposition that the survey is intended to be as objective as its author can make it.

Second, C&V surveys more often than not include a disclaimer, the impact of which is often hard to divine. As an example, a surveyor used the following language after noting that no stability analysis was done:

"This survey sets forth the condition of the vessel including hull, equipment, machinery, fittings and gear to the best of the surveyors ability. This survey was performed without the removal or opening up to expose ordinarily concealed spaces, without taking borings, ultrasonic or audible soundings to determine thickness or soundness of structures or members; the use of moisture testing equipment to determine moisture content; testing for tightness, trying or testing machinery and/or equipment for proper function ad (sic) operation.

"This survey represents the honest and unbiased opinion of the surveyor, but, in submitting this survey, it is understood by all parties that such a survey is not to be considered a guarantee of its accuracy, nor does it create any liability on the part of the surveyor or its agents arising out of reliance on the information contained herein."

Such language presents two questions. The first is, "Why bother with getting a survey at all?" if the report itself disclaims its accuracy. The answer is that it establishes a paper record of some sort, but it is not valuable for anything else.

The second question is, "What if in fact, someone relies on the survey, takes the vessel to sea and suffers a casualty resulting from some reasonably discoverable condition that the surveyor did not report?"

Generally stated, while courts are reluctant to allow the shipowner to evade or pass off their historic primary duty to furnish a seaworthy vessel, a surveyor is charged with the duties of 1.) detecting all perceptible defects of the vessel during the survey; 2.) using due care in making recommendations; and 3.) notifying the owner thereof. In addition, disclaimers made by surveyors or classification societies in survey reports and documents exculpating them from liability are generally not enforceable.[4]

Accordingly, it is quite clear that C&V surveys of commercial fishing vessels do not provide the depth or quality of reports comparable to those in other industries where businesses retain independent evaluators to audit, evaluate, or troubleshoot the financial, operating, or administrative components of the business. As more fully shown below, they ordinarily do not contain sufficient analysis of factors that are material to the safe prosecution of a fishing voyage.

TODAY'S REPORTS

In the ordinary case, a survey will contain a description of the vessel, describing in general terms the condition of the hull and machinery, list the electronics and safety equipment aboard, and, perhaps report on the skill and competence of the Captain.

The usual C&V survey focuses on the physical condition of the hull, plating, and framing. Recommendations regarding material that needs to be cropped and renewed are prevalent, as are evaluations of the quality of the coatings. In addition, if the vessel is hauled, the survey will report on the condition of stuffing boxes, rudderpost packing, through hull fittings, and other underwater appurtenances.

Machinery will be reviewed for age, general condition, cleanliness, fastening of flanges and couplings, and other tangible or perceptible conditions observed without tearing down any of the equipment. But, there is no documentation that the machinery operates in accordance with manufacturers' specifications. A similar evaluation is done of fishing equipment, including winches, booms, and other equipment for handling fishing gear.

The survey will provide a listing of electronics for navigation and communications. But, again there usually is no determination made as to the proper operation of the equipment.

Importantly, the survey should (but may not) examine the emergency rescue equipment required by 46 CFR Part 28.[5] And, few surveyors make recommendations regarding compliance with the training and familiarization requirements in those regulations.

Further, in many cases a C&V survey will state that a vessel is "fit for its intended service" without ever having described what the intended service is.

It is fair to say, therefore, that the tangible qualities of the vessel are reviewed. However, both through testimony and anecdotal evidence, there are too many circumstances where either (a) a surveyor will prepare a punch list of work that needs to be done on the vessel and makes conclusions about the fitness of the vessel for sea based on the assumption that the work will be carried out; however, there is no follow-up survey,[6] or (b) a surveyor sees a vessel while it is in a shipyard, either hauled or in the water, undergoing repairs and anticipates the completion of the work in a good and satisfactory manner without reporting that the vessel is, in fact, a work in process.[7] In either case, the survey is not valuable for the purposes of assessing the condition of the vessel, or its fitness to go to sea, or as an insurable risk, because there would be no "independent" evaluation of the vessel as completed.

More importantly, the ordinary survey does not deal with issues of stability or structural integrity. In reviewing the laundry list of those matters that are reviewed by the surveyor, one can ascertain from the survey whether the vessel will operate, and if there is a casualty, whether there is equipment aboard designed both to alert others of the casualty and to enable the crew to withstand it, to some extent. The greatest risk to any fishing vessel at sea is water entering the hull thereby impairing its ability to float, and, because the usual marine survey does not address questions of stability or the adequacy of the scantlings of the vessel, one can draw no safe conclusions about the seaworthiness of the vessel from such reports.

There is, therefore, no "seaworthiness" report taking into account all relevant factors, there is only a material condition report upon which very serious personal and business judgments are grounded.

Properly done, each vessel should be evaluated for intact, reserve, special conditions, icing, pumped catch, and other conditions that would impair its stability. The surveyor should conduct a comprehensive review to ascertain that there is sufficient compartmentalization, watertight openings are provided for all compartments, and the vessel itself has sufficient capacity to withstand any number of potential impairments of its stability or seaworthiness. The vessel should be provided with a stability book (instructions) that "provide the master or individual in charge of the vessel with loading constraints and operating restrictions which maintain the vessel in a condition which meets applicable (appropriate) stability requirements."[8]

RECOMMENDATIONS

In considering all of the above it is our recommendation that a Condition & Value (C&V) Survey of a Commercial Fishing Industry Vessel should follow the American Bureau of Shipping (ABS) "Guide for Building and Classing Fishing Vessels" (May 1989), and applicable American Society for Testing and Materials (ASTM) standards: Volume 1.07 "Ships and Marine Technology", Volume 3.03 "Nondestructive Testing" and Volume 3.02 "Wear and Erosion: Metal Corrosion" and other applicable standards.

The survey should pay particular attention to structural integrity, stability, and watertight integrity, and should document the proper operation of all systems, including but not limited to - propulsion, electrical, hydraulic, steering, fuel, water, mechanical, bilge pumping, communications / navigation, alarms (bilge and fire), and fire extinguishing. And the survey should not be considered complete until the vessel is 'ready for sea,' even if that means a 'follow-up' survey to ensure that all recommendations have been completed and all systems are operating properly.

In addition, the survey should document that the vessel is in compliance with all Coast Guard regulations for Commercial Fishing Industry Vessels (46 CFR

Part 28) and other applicable Coast Guard regulations, including but not limited to Pollution Prevention and the Navigation Rules, and pay particular attention to documenting safety training, safety orientation and required drills.

There is no doubt that the cost of this approach will be passed on to the fisherman or vessel owner. But, relative to the risks, the cost is low, and absent governmental regulation, there is no other pressure point to effect change. Once the standard is set, the remedy may "only" be litigation – but it would take only a few cases holding surveyors liable to reshape the surveying process, and the need for improvements in fishing vessel safety would be well served.

FOOTNOTES

1. Marine Casualty Report, Uninspected Fish Processing Vessel, Aleutian Enterprise, Flooding, Capsizing and Sinking in the Bering Sea on March 22, 1990 with nine persons missing and presumed dead. Report dated, November 6, 1991, page 134.

2. Fishing Vessel Task Force Report, at p. 4-5 (1999).

3. For example: U.S. Coast Guard nvic 5-86, 46 CFR Part 28; North Pacific Fishing Vessel Owners Association Vessel Safety Manual; National Cargo Bureau Stability for Fishermen; niosh, Commercial Fishing Fatalities in Alaska, Current Intelligence Bulletin 58, September 1997.

4. See generally, Miller, Liability of Classification Societies from the Perspective of United States Law, 22 Tul. Mar. L.J. 75 (1997); Beck, Liability of Marine Surveyors for Loss of Surveyed Vessel: When Someone Other than the Captain Goes Down with the Ship, 64 Notre Dame L. Rev. 261 (1982); C. M. Davis, Maritime Law Deskbook, 316-319 (2000 Supp.).

5. Requirements for Commercial Fishing Industry Vessels.

6. Marine Casualty Report, Investigation into the Circumstances Surrounding the loss of the Commercial Fishing Vessel Adriatic, O.N. 579941, Eight NM East of Barnegat Light, New Jersey on January 18, 1999 with the Loss of Four Lives. Report dated August 4, 2000, page 31.

7. U.S. Coast Guard, Investigation into the Sinking of the F/V Two Friends on January 25, 2000, Transcript, Day Two, February 2, 2000, Pages 361-362.

8. 46 CFR Part 28 Subpart E – Stability.

COMPARISON OF SAFETY DISCREPANCIES FOUND DURING SAFETY EXAMS ON FISHING VESSELS TO CASUALTY INFORMATION ON FISHING VESSELS IN THE WATERS OF SOUTHEAST ALASKA

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The United States Coast Guard conducts a voluntary safety program with the commercial fishing fleet in S.E. Alaska waters. This is an extension of a national program being conducted in all United States ports. Mr. Tim Clepper and Mr. Larry Snyder are civilian employees who are assigned to Marine Safety Office Juneau Alaska. Mr. Snyder and Mr. Clepper are unit coordinators for this program in S.E. Alaska. In Southeast Alaska approximately 400 commercial fishing vessels participate annually and request a "Courtesy Dockside Exam".

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This paper will describe the most common deficiencies found during dockside safety exams in Southeast Alaska during 1999-2000. The deficiency data covers a two-year period, as decals are valid for a two year period.

CASUALTY DATA

An analysis of 28 commercial fishing vessel casualties that occurred in Southeast Alaska during the past two years was made. Causative factors documented in formal marine investigation reports are utilized in our findings.

1. Striking submerged objects and charted rocks or grounding contributed in 36 percent of these casualties.

2. Fatigue and inattention contributed in 35 percent of these casualties.

3. Down-flooding from unknown sources contributed in 28 percent of these casualties.

4. Fire on board occurred in 17 percent of these casualties

5. Rapid capsize/stability issues contributed in 11 percent of these casualties.

6. Weather was a major factor in 10 percent of these casualties.

7. Improper mounting of safety equipment was a factor in 7 percent of these casualties.

8. Lack of required VHF/radio equipment occurred in 3 percent of these casualties

More than one factor may have contributed in these various casualties.

Factors that contributed to crew survival are also examined in the casualty analysis. Listed below are specific reasons why crewmen managed to survive these marine casualties at sea.

CREW SURVIVAL FACTORS

1. Adequate VHF radio equipment on board contributed to crew survival in 70 percent of the marine casualties.

2. Rescue efforts by other vessels including Coast Guard search and rescue forces contributed to crew survival in 64 percent of the casualties.

3. Crew training and immediate response, including first aid was a survival factor in 42 percent of the casualties.

4. Immersion suits on board were a survival factor in 25 percent of these marine casualties.

5. Having adequate survival craft on board was a survival factor in 28 percent of the casualties.

6. Having a 406Mhz EPIRB that functioned properly was a survival factor in 14 percent of the casualties.

COMPARISON OF SAFETY DEFICIENCIES TO CASUALTY DATA AND CREW SURVIVAL FACTORS

Immersion suits were the most common repetitive deficiency in comparisons from 28 commercial fishing vessel casualty investigations. Immersion suits were also a significant factor in crew survival in 25 percent of the reported casualties. This finding helps emphasize the importance of immersion suits in saving lives. It also indicates a need to continue focusing on immersion suit carriage requirements, including their use, care and the proper storage of survival suits. We focus on immersion suits in our examination already. We will now seek additional ways of communicating the importance of immersion suits to commercial fishermen. A policy of 100 percent inspection of immersion suits aboard will be maintained on all dockside exams conducted.

Our findings indicate that various discrepancies were found regarding the 406 Mhz EPIRBs, and were the second most common repetitive deficiency during dockside safety exams. The data shows that functioning 406 Mhz EPIRBs contributed to crew survival in 14 percent of the reported casualties. During our dockside exam efforts we will continue to stress proper 406 Mhz EPIRB mounting, maintenance, and proper registration with NOAA SARSAT center. We will also continue to assure testing of each EPIRB found during courtesy dockside exams. This testing is strictly an internal diagnostic following EPIRB vendor guidelines. We have begun offering more sophisticated EPIRB testing using test equipment that allows us to verify signal strength, and verify hexadecimal codes which are unique for each separate 406 Mhz EPIRB.

Visual distress signals were the third most common repetitive deficiency found during our courtesy dockside safety exams. Usually expired distress signals were the most common finding. Even though distress signals have not been documented to have contributed as survival factors in our documented casualties, distress signals have enormous potential to attract attention to a marine casualty. We will continue our efforts of assuring required distress signals are aboard fishing vessels we examine. A common complaint from fishermen has been short shelf life of distress signals commonly used. Industry should be encouraged to develop distress signals with longer shelf lives.

The lack of required navigation information was the fourth most common repetitive deficiency. Findings indicate 36 percent of the fishing vessel casualties involved fishing vessels striking submerged objects (primarily charted rocks). Current Coast Guard regulations mandate only U.S. documented fishing vessels on offshore routes be required to have on board the following:

1. Complement of charts for region being fished or being transited;

2. United States Coast Pilot;

3. Coast Guard Light List;

4. Tidal tables; and

5. Tidal current tables.

These publications are essential navigation tools for all commercial fishermen regardless of route. The Coast Guard may wish to consider these navigation tools on all fishing vessels (U.S. documented and state registered). In the interim we will continue to encourage all commercial fishermen to adhere to voluntary compliance of having these navigation aides aboard on all routes. Our goal is to see a reduction in casualties involving fishing vessels hitting charted rocks or going aground due to a lack of knowledge of their positions.

Our fifth most common repetitive deficiency has been with survival craft being in compliance for various reasons. We're finding 10 percent of the canister rafts we examine during courtesy dockside exams are installed incorrectly in some manner. It has been determined that functioning survival craft has contributed to crew survival in seven percent of the documented fishing vessel casualties. We will look for additional ways of emphasizing the importance of survival craft and their proper maintenance to commercial fishermen.

It has also become evident how important VHF radios have been for commercial fishermen who have faced various emergencies at sea in summoning aide. Of the commercial fishing vessel casualties examined, 70 percent reflected VHF radio's contributing to crew survival. Fortunately a lack of VHF radio equipment has been documented in only three percent of the casualties. Our

U.S. commercial fishing vessel regulations mandate that only U.S. Documented commercial fishing vessels on offshore routes be required to have VHF radios aboard. Our findings indicate a need for this equipment to be on all fishing vessels regardless of route. Over 50 percent of the commercial fishing fleet are excluded from mandatory VHF radio carriage requirements. The Coast Guard should explore avenues to close this regulatory loophole. A consideration for all commercial fishing vessel examiners in the future will be to not only encourage carriage of VHF radios on all commercial fishing vessels, but to assure this equipment is fully operable as well.

As mentioned in this report, crew training played a great part in overall crew survival. The *U.S. Code of Federal Regulations* mandates fishing vessels with a crew of sixteen or more, or fishing vessels that fishes beyond the boundary line must conduct monthly drills. While most fishing vessels in Southeast Alaska mainly fish inside the boundary waters, they are exempt from meeting this regulation. Our research indicates informal training and or casualty pre-planning has saved crewmen's lives in nearly every case. At the time of this writing effort is being made to make monthly drills mandatory for *all* fishing vessels regardless of the size and or the number of persons aboard. Under the auspices of the Fishing Vessel Safety program, a training suite has been deployed for the Coast Guard in Southeast Alaska. The training suite consists of four distinct, but interrelated, training devices [Paitl 1999].

Interactive Intact Stability Trainer – Was designed as a device by which to offer commercial fisherman a practical demonstration of a vessel's response to various vessel loading and operating conditions. This trainer facilitates the simple articulation of very complex stability phenomena that are difficult to relay in a lecture-type setting. This trainer is a free floating, scaled fishing vessel (stern trawler) model that replicates the actual operating conditions often experienced at sea, yet while in a nonthreatening, learning environment. The trainer is used to simulate the following commonly experienced on board commercial fishing vessels:

Sloshing liquid in wide slack tanks or holds;

Sloshing liquid in narrow slack tanks or holds;

Loading catch or supplies on, above, and below the main deck; and

Icing conditions.

The Interactive Intact Stability Trainer will improve the performance (decision making process) of mariners who are faced with a variety of hazardous vessel operating and loading conditions. The practical demonstration simplified by this trainer allows fishermen the opportunity to identify similarities between training scenarios and their own vessel operations. The demonstration also encourages fishermen to take the necessary steps to avoid or minimize the duration of these operating conditions in the future.

Small Vessel Damage Stability Trainer – Is designed to address concerns that were identified during the investigation of a number of commercial fishing causalities in Northern New England during 1993 and 1994 [Ciampa, 1996]. The combination of poor weather, breached watertight integrity, and compromised transverse bulkheads created down flooding and progressive flooding conditions that resulted in vessel losses, while vessels were in port as well as underway. The small vessel Damage Stability Trainer consists of three models that are constructed of steel or aluminum and fitted with Plexiglas decks. Identical in external dimensions, the three models vary internally as follows:

One is of an open hull construction;

One is subdivided by internal watertight transverse bulkheads; and

One is fitted with compromised transverse watertight bulkheads

Each model is outfitted with identical flooding scenarios. The model may be flooded through the engine compartment or the lazarette space, and may be used to effectively demonstrate the significance of hull subdivision on the damage stability performance of a vessel. The Small Vessel Damage Stability Trainer models are intended to improve a fisherman's awareness of implications of modifying (i.e. drilling or cutting holes) a vessel's watertight bulkheads. Through the use of these models, fishermen are able to readily visualize hazardous effects that are able to often associate with the improper installation of equipment or machinery. The practical demonstration facilitated by Small Vessel Damage Control Trainer models give fishermen an opportunity to identify similarities between the models and their own vessel's internal construction arrangements. More importantly, the practical demonstration prepares and encourages fishermen to make "real-life" corrections to the construction arrangements of their vessels to avoid potential down flooding and progressive flooding events.

Small Vessel Damage Control Trainer – This is a multifaceted trainer that is useful for reaching a variety of audiences. This trainer is designed to prepare mariners for a whole host of possible flooding and sinking events. Like the Small Vessel Damage Stability Trainer, this trainer was developed as a result of a study of marine casualties involving commercial fishing vessels in Northern New England waters in 1993 and 1994. During that time period, one third of all Northern New England fishing vessel casualties involved watertight integrity (sinking or flooding) issues. These fishing vessel casualties which ranged from simple "flooding on mooring" to open ocean sinking, all seemed to have a common thread-the crew's limited ability to control flooding [Ciampa, 1996].

The Small Vessel Damage Control Trainer is a towable, appropriately scaled (size and application) version of the U. S. Navy's damage control simulator used to simulate damage conditions aboard much larger military vessels. The trainer is designed to improve the performance of mariners faced with flooding situations. It helps facilitate basic damage control procedural training and serves to increase industry awareness of the *source and effect* of typical flooding risks.

Best Practices Guide to Vessel Stability – The *Best Practices Guide to Vessel Stability* [U. S. Coast Guard, 1998] is a thirty-page booklet, jointly developed by the United States Coast Guard and the Commercial Fishing Industry Vessel Safety Advisory Committee (CFIVAC). The booklet was modeled after two similar Canadian publications, *Small Fishing Vessel Safety Manual* and *An Introduction to Fishing Vessel Stability* [Canadian Coast Guard, 1993, Transport Canada, 1993]. This guide capitalizes on the success and popularity realized by the two Canadian booklets in addressing vessel safety and stability.

The *Best Practices Guide to Vessel Stability* provides an introduction to vessel stability along with sound recommendations to help fishermen avoid unsafe operations often encouraged during routine fishing operations. The theme of this guide is "Survive to Fish Another Day," and consequently, the guidance contained in the booklet is preventative in nature. The guide addresses the following areas of interest:

Watertight integrity;

Vessel subdivision;

Vessel loading;

Intact stability;

Damage control;

Vessel cleanliness;

Crew training; and

Prudent seamanship.

The *Best Practices Guide to Vessel Stability* illustrates, through the use of words and graphics, the same concepts that can be demonstrated through the use of the Commercial Fishing Vessel Training Suite. The guide is certainly not intended to be a complete course of study. However, in order to be adequately prepared to brave the dangers of the sea, fishermen should be familiar with the basic concepts contained in the guide, and should completely understand the potential safety implications of the various operating conditions described in the guide. Following the simple guidance contained within this guide will prevent most flooding, sinking and capsizing

REFERENCES

Canadian Coast Guard [1993]. Small Fishing Vessel Safety Manual. Canada: Minister of Supply and Services.

Ciampa J [1996]. Damage Stability Demonstration Models. Portland, Maine:U.S.Coast Guard Marine Safety Office.

Paitl G Jr. [1999]. Commercial Fishing Vessel Safety. Washington, D.C.:U. S. Coast Guard.

NEW ENGLAND FISHERMEN AND SAFETY AT SEA: A CASE STUDY

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The commercial fishing industry in the United States is one of the most highly ranked on all listings of occupational dangers and, according to the United States Coast Guard, is among the highest for fatality rates.[1] Although both the federal government and the commercial fishing industry have acknowledged the high level of danger, legislation for fishing vessel safety has been fraught with controversy. It was not until 1988 that the first safety legislation, specifically targeting commercial fishing vessels, was enacted through the Commercial Fishing Industry Vessel Safety Act.[2] In 1991 the U.S. Coast Guard published the Commercial Fishing Industry Regulations [3] and expanded on their coverage in 1999 with the Fishing Vessel Casualty Task Force Report.[1]

Research findings strongly assert that fishermen's attitudes about their work, particularly with regard to risk, may sharply contrast those of the government.[4,5,6] Unfortunately, there is limited emphasis placed on co-management and the safety process compared with other aspects of safety regulations and fisheries management. This is of particular concern since compliance and effectiveness of the regulatory process is diminished when user groups are not involved in the policy decision-making process.[7,8,9,10,11]

The Fisheries Management Council system, specifically designed under the United States Magnuson-Stevens Fishery Conservation and Management Act, was created with the intention of providing a mechanism for input from members of the commercial fishing industry. The council system, however, has met with mixed responses from the industry, with criticisms regarding representation and the adequacy of fishermen's input not infrequent comments.[12,13]

Fishermen's perceptions about their work roles is an important area of research since it provides information regarding policy adequacy, effectiveness, and compliance—all essential components for the assessment of safety at sea and the regulations that attempt to promote increased safety.

The purpose of this work is to examine the attitudes of fishermen regarding safety at sea and fishermen's participation in the safety regulatory and fisheries management process; the perceived role of the New England Fisheries Management Council with regard to safety issues is also discussed, and the importance of the relationship between the fishing community and the U.S. Coast Guard is noted.

Twenty two experienced boatowners, captains, and crew in the scallop fishery of New Bedford were interviewed about their attitudes regarding safety at sea and the safety regulatory and fisheries management process.

New Bedford was selected because it is one of the major commercial fishing ports in the United States and the scallop fishery, a significant part of New Bedford commercial revenues, represents a manageable case study of a regulated fishery with important safety concerns. Twenty-one males and one female boatowner participated in the study. All have a minimum of ten years experience in the fishing industry. All are white and their ages range from 29 to 64 years old. Slightly more than half of the respondents worked on boats that experienced a serious accident. One respondent personally sustained a serious injury.

RISK PERCEPTION:

Two-thirds of the respondents feel comfortable with the level of risk they face. Two respondents expressed serious concern about the level of risk.

FISHERIES MANAGEMENT

Two-thirds of the respondents regard fisheries management as important in affecting safety. Most commonly cited safety problems with fisheries management include:

1. Reduced crew size regulations result in overworked and tired crew and prevent new or inexperienced crew from being trained.

2. Limited or short term fishing periods pressure fishermen to go to sea or stay at sea in bad weather or when there may be problems with the boat.

3. Transiting around closed/protected areas causes additional exposure in certain weather conditions.

4. Limiting areas for fishing can cause congestion.

NEW ENGLAND FISHERIES MANAGEMENT COUNCIL

Respondents had trouble distinguishing the practices of the New England Fisheries Management Council from those of the National Marine Fisheries Service. Furthermore, the majority felt that the Council did not adequately take safety into consideration during the management process.

Participants in the study had interesting suggestions for improving the management process. They suggested that fishermen be included in the early stages of the regulatory development process and that communication between the government and members of the fishing community needed to be increased. They also felt that fishermen needed to have more flexibility while boats were at sea during bad weather. In addition, they suggested a revision of crew size limits to help reduce fatigue and to allow for training of new crewmen.

The results of this study, although preliminary, suggest that regulations that are designed to reduce pressure on fish stocks may result in greater risk to fishermen and reduced safety at sea. Cooperative efforts from all groups, including the diverse fishing community, Management Council, National Marine Fisheries Service, and U.S. Coast Guard are needed to improve safety at sea and effective fisheries management.

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REFERENCES

1.United States Coast Guard [1999]. Fishing Vessel Casualty Task Force Report.

2. Commercial Fishing Industry Vessel Safety Act [1988]. Public Law 100-424.

3. Commercial Fishing Industry Regulations [1991]. 46 CFR 28.

4. Havold JI [2000]. Culture in maritime safety. Marit. Pol. Mgmt. *27*(1):79-88.

5. Poggie JR, Pollnac RB, Van Dusen C [1996]. Intracultural variability in the cognition of danger among southern New England fishers. Marine ResourceEconomics. *11*:23-30.

6. McCay BJ, Gordon WG, Levine EB, Gatewood JB, Thompson B, Creed C [1989]. From the waterfront: Interviews with New Jersey fishermen about marine safety and training. Project Report for New Jersey Marine Sciences Consortium. NJMSC-SK_89-1.

7. Kaplan IM [1998]. Regulation and compliance in the New England conch fishery: a case for co-management. Marine Pol. *22:*(4/5)327-35.

8.Jentoft S [1989]. Fisheries co-management: delegating government responsibility to fishermen's organizations. Marine Pol. *13*(2)137-54.

9.Jentoft S [2000]. Legitimacy and disappointment in fisheries management. Marine Pol. *24:*141-48.

10.Kaplan IM [1999]. Suspicion, growth and co-management in the commercial fishing industry: the financial settlers of New Bedford. Marine Pol. *23*(3):227-41.

11. Kaplan IM [2000]. Seafood auctions, market equity and the buying and selling of fish: lessons on co-management from New England and the Spanish Mediterranean. Marine Pol. *24*:165-77.

12. Hanna SS [1995]. User participation and fishery management performance within the Pacific Fishery Management Council. *Ocean and Coastal Mgmnt*. *128*:(1-3)23-44.

13. Cloutier TM [1996]. Conflicts of interest on regional fisheries management councils: corruption or cooperative management. Ocean and Coastal Law J. *2*:101-52.

INTERNATIONAL COMPARISON OF OCCUPATIONAL INJURIES AMONG COMMERCIAL FISHERS OF SELECTED NORTHERN COUNTRIES AND REGIONS

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Objectives: This study evaluates the occupational injury trends and the safety and health practices in the commercial fishing industry of selected countries and regions of the North.

Methods: Data on occupational injuries and fatalities occurring in the fishing industry of different countries were analyzed and compared.

Results: International injury data show the commercial fishing industry as one of the most dangerous jobs worldwide. Fishing fatality rates are higher than the respective national occupational fatality rates, and in many countries are higher than the world average for fishing (80/100,000/year). The highest rates were observed in Denmark, the U.S.A. and UK. Drowning and hypothermia are the leading causes of death in many countries. Eighty percent of vessel-related fatalities were associated with smaller vessels under 80ft/24m due to two leading causes, capsizings and founderings. International examples demonstrate that local, industry-oriented safety strategies, safety training for fishermen, interagency collaboration - among other preventive initiatives - contributed to declining injury trends, (e.g. in Norway (declined by 41%) and in Alaska the fatality rate declined by 42 percent (200 /100,000/ year 1991-1992[1] compared to 116/100,000/year from 1991-1998.[2])

Conclusions: Study confirmed similar causes and circumstances responsible for fishermen's occupational traumatic injuries worldwide, though many limitations exist for research due to differences in country guidelines, registration, surveillance standards, etc. Increased international cooperation and data exchange should be continued with the purpose of closing the gap between injury databases and making a more accurate public health diagnosis and cross-country monitoring of the problem in future research.

INTRODUCTION

Commercial fishing represents the oldest and one of the most important economies in countries with northern fishing grounds, along with a high occupational safety and health risk for those involved in it. Indicators of this risk were surveyed and analyzed in earlier studies in Alaska and northern countries.[3-13] Fishing related occupational fatalities in Alaska always were higher due to specific, and rapidly changing weather conditions, the far and isolated fishing grounds, and many other circumstances. Earlier studies observed a fatality rate of 414.6 per 100,000 workers for Alaskan fishermen in 1980-84.[3] As a result of prevention oriented regulations and interagency safety collaboration, rates have dropped significantly from 200/100,000/year for 1991-1992[1] compared to 116/100,000/year from 1991-1998.[2] High rates of fatal traumatic injuries have been observed among commercial fishermen of other countries too (Norway 1961-75: 150/100,000;[13] Sweden 1975-86: 110/100,000;[11] Denmark 1989-96: 140/100,000;[12] Iceland 1966-86: 89/100,000.[8]) Our study has focused on international comparison of the recent occupational safety and health status during the 1990s and fishing safety activities in countries with northern fishing grounds, including Canada, Denmark, the Faroe Islands, Greenland, Iceland, Ireland, Norway, Sweden, Russia, the United Kingdom and the U.S.A.

METHODS

Data on fishing vessel casualties and fishing-related occupational injuries and fatalities from Alaskan, U.S., international and other national data sources were collected, compared and analyzed for the 1990s. This included different variables, such as frequencies and fatality rates, death causes and circumstances, nature, type and causes of casualties. Alaskan data were derived from the Alaska Occupational Injury Surveillance System (AOISS), which is maintained by the NIOSH/Division of Safety Research/Alaska Field Station. Access to information of such type in other countries is somewhat limited. Statistical information, reports and descriptions were obtained from appropriate foreign agencies: the Search & Rescue Branch of the Canadian Coast Guard; the Transportation Safety Board of Canada, the Icelandic Maritime Authority, the UK Marine Accident Investigation Branch (MAIB), the Health and Safety Authority of Ireland, the Maritime Authorities (Denmark, Sweden) and fisheries safety research institutions of Scandinavian countries (Sintef/Marintek in Norway) and Russia (Kaliningrad State University). Fishing death rates were obtained either from existing country reports for comparison or were calculated based on the number of registered fishermen. Circumstances and major causes of fishing casualties and fatalities were also compared and analyzed as available data permitted. In addition, fishing vessel safety materials, policy reports and relevant regulations were studied to identify the countries‘ capability and preparedness to prevent injuries and fatalities in the commercial fishing industry.

RESULTS

Occupational safety and health records concerning the fishing industry and fishermen's injuries and fatalities vary from country to country. The main results are summarized as follows:

1. National and international data show fishing as one of the most dangerous jobs in most countries based on various sources of fatality frequencies among fishermen.[14-22] (See table 1.)

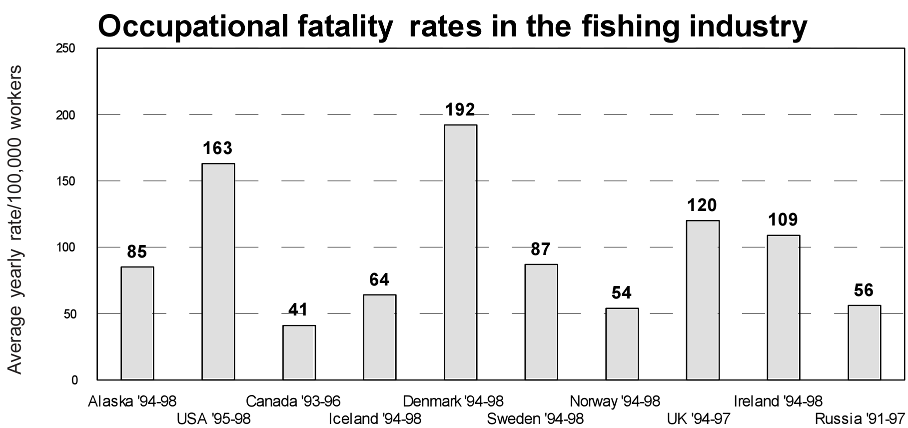
2. Fishing related fatal occupational injury rates range from 41 per 100,000[23] to 192 per 100,000[24] between 1994-98 in countries with northern fishing grounds. (See figure 1.) About half of the countries, analyzed for 1994-98 had rates higher than the world average: 80/100,000 estimated by the ILO.[25] During the 1990s, fishing fatality rates were substantially higher compared to the national average occupational fatality rates in all observed nations.

3. Foundering, capsizings, and grounding were the 3 most frequent, leading risk factors for fishermen's deaths according to international casualty statistics for 17 countries, including in part northern ones as well.[26]

Table 1: Number of occupational injuries among commercial fishermen by area, 1994-98

Year	Alaska	USA	Canada	Iceland	Denmark*	Norway	Sweden	United Kingdom	Ireland
1994	13	75	32	3	19	14		26	1
1995	19	64	17	1	9	7		19	19
1996	25	83	17	9	8	10	4**	20	8
1997	4	62	16	2	8	15	3	29	5
1998	13	73	18	1	7	15	6	26	6
Total	**74**	**357**	**100**	**16**	**51**	**61**	**13**	**120**	**39**
Source:	Alaska Occupational Injury Surveillance System	US Coast Guard	Transportation Safety Board, Marine Occurence Statistics	Intersessional Correspondence Group, University of Iceland	Danish Maritime Authority	MARINTEK/ SINTEF	Swedish Maritime Administration	Marine Accident Investigation Board	Health and Safety Authority

*Note: *Denmark Data Include the Faroes and Greenland.*
*** 4 cases occurred between 1994-96, no seperate data per year available.*



Sources:
1. Alaska: CDC/NIOSH/DSR/Alaska Field Station: AOISS database for numerators (n = 17,400 FTE fishers)
2. United States: US Coast Guard data (Spitzer: Fishing Vessel Casualty Task Force Report 1999). For 1994: n/a
3. Canada: ILO Statictical Yearbook 1998 (fishing inlcudes the whole sector as defined by ISIC 3). Data N/A for 1994-98.
4. Iceland: Icelandic Marine Accident Investigation Committee and Maritime Administration for numerators; Statistics Iceland and the Icelandic Maritime Administration for denominators (full time and part time fishers)
5. Denmark: Institute of Maritime Medicine and the Danish Maritime Administration for rates including Greenland and the Faroe Islands (full-time and part time fishers).
6. Sweden: The Swedish Maritime Administration (numerators and denominators).
7. Norway: MARINTEK/SINTEF - The Norwegian Marine Technology Research Institute, Division of Fisheries and Aquaculture, Trondheim, Norway for numerators and Statistics Norway for full-time and part-time fishermen.
8. United Kingdom: UK Dept. of Transport, Marine Accident Investigation Board (MAIB) for numerators and MAFF (registered total fishermen). For 1998: n/a
9. Ireland: Health and Safety Authority for numerators; Central Statistics Office for the number of total fishermen
10. Russia: Kaliningrad State Technical University, Fisheries Safety Research Project (separate data N/A for 1994-98)

Figure 1: Occupational fatality rates in the fishing industry

4. Eighty percent of vessel related fatalities were associated with medium size and small vessels under 24m/80ft due to capsizing and foundering.[26] Fatal incidents are more likely to have involved small vessels in every country. For example, analysis found that about 80 percent of fatal occupational injuries among British fishers in 1992-97,[21] 80 percent in Canada in 1993-98,[27] and 50 percent in Iceland in 1993-98[28] occurred on vessels under 24m/80ft.

5. Casualty indicators taken by selected countries demonstrate that vessel-related causes are the predominant causes of occupational fatalities in more than or around half of the cases in many countries. Of the vessel-related events, capsizing is usually the leading cause for fishermen's death. Non-vessel related causes are dominated by man-over-board events according to various casualty sources[19,22,24,28,29] from the analyzed countries. (See table 2.)

6. Some fishing technologies, especially crabbing, lobster fishing, are the most dangerous types of fishing, responsible for about 18 percent[30] to - 40 percent[2] of fatalities.

Table 2: Leading causes and circumstances of fishing fatalities in selected countries in the 1990s, by nature of casualty:
(percentage as a proportion of all vessel-related and non-vessel related causes)

	USA	ICELAND	IRELAND	DENMARK	NORWAY
Leading vessel-related cause	49% capsize/sink	25% foundering	33% capsize	40% capsize	26% capsize
Man-over-board	25%	33%	20%	30%	27%
Source:	USCG, 1994-98	Icelandic Marit. Adm. 1996-98	Health & Safety Authority 1994-98	Inst. Marit. Medicine 1990-98	Norw.Marin. Technol. Research Inst.1990-97

7. Drowning, presumed drowned and hypothermia are the predominant death causes for fishers (e.g. 91 percent in Canada,[27] 88 percent in Alaska,[2] and 78 percent in Ireland.[22])

8. Human factors have a substantial impact on the occurrence and outcome of casualties and injuries (e.g. Nordic countries: ~46 percent[31]; U.S.A.: ~80%.[32])

9. Limitations exist for cross-country data comparison due to differences in casualty and injury reporting systems and definitions.

DISCUSSION

Our ability to make meaningful international comparison of occupational injury statistics is limited, because of the differences in national guidelines, registration and surveillance standards, in the ways countries collect information, the use of definitions, the coding practice, and many other factors. The number of reported fatalities varies from country to country depending on the size of the population and the work force involved in fishing. This study attempted to reconcile numerator data derived from different sources, because more often country statistics on the number of fishing deaths included not only fishing operations and technologies, but also other activities with regard to the entire industry as defined in the sector definition as a whole. Some sources included even traffic and leisure time accidents in fishermen's injury statistics. Denominator definitions may also differ within one country: Alaska uses full time equivalent number of fishers to express the rates. Overall U.S. estimates on the number of fishermen are based on annual average estimates of total number of workers employed in fishing occupations; Sweden provided data for fishermen as they are registered by the Swedish Fishermen's Federation, Norway describes full time and part time fishermen in statistical yearbooks, Icelandic data may include both full time and part time fishers, Denmark showed full-time and part- time workers, also full-time equivalent indicator for fishers in the 1990s was found. Different approaches by countries in identifying and categorizing occupations in the fishing industry should influence the final rate results, thus comparison and conclusions should be interpreted cautiously. Similar methodologic problems in investigating data on traumatic injuries were found in other international studies on comparability of general injury statistics as well , which demonstrates the different experience by countries, and the problem of quality and reliability of international statistics.[33]

DEVELOPING FISHING VESSEL SAFETY PROGRAMS

By the 1990s, many major fishing countries established their basic regulations for fishing safety. Different government agencies and organizations were assigned to take the primary lead for fishing vessel safety. Fishermen's associations also started to focus on safety and health issues associated with their work. Despite these increasing efforts in prevention, the fishermen's job still represents one of the most dangerous occupations. In recent years interagency actions were activated in response to major casualties and increased fatalities in different countries (e.g. the U.S. Coast Guard Fishing Vessel Casualty Task Force of 1999,[34] the UK Safe Fishing Campaign 1998,[35] development of a joint casualty database (the Nordic Dama) by Iceland and Scandinavian countries; operating the United Nations University Fisheries Training Center in Iceland, focusing on fishermen's safety education and coordinating minimum inter-Nordic requirements for safety training,[36] introducing compulsory basic safety training for fishermen associated to license certification in Norway,[37] monitoring the fishing industry by different government bodies and providing special occupational safety courses, followed by yearly examinations in Russia.[25] On the international level, the ILO Sectoral Activities Program is one of the most important stakeholders for facilitating fishing industry safety in close collaboration with the IMO, FAO, and WHO, who issue different codes and guidelines for the industry.[25] Table 3 gives a brief summary of the most important steps and activities by countries. (See table 3.)

CONCLUSIONS

Results from this international comparison of northern countries and regions confirm that fishing-related workplace death is a major occupational safety and health problem in many northern nations. There are similar causes and circumstances responsible for fishermen's occupational traumatic injuries in each country, but close comparison is not always possible because categories may be different for each countries (i.e., capsize vs. foundering vs. sinking). Results however, may indicate the major problem area and should be useful in for establishing safety priorities. Industry-oriented interagency safety programs can decrease fishing fatalities (e.g., Alaska,[38] Norway.[37]) Both national and international fishing safety data require more coordination and improvement in each country. Also there is a need for more international collaboration, detailed data exchange and further in-depth studies to better understand etiology,

Table 3: Fishing Safety strategies

Country	Major agencies	Preventive programs, activities
Canada	Canadian Coast Guard Office of Boating Safety; Transport Canada Marine Safety Branch; Workers' Comp. Board	Coordination for safety, annual marine emergency workshops for fishers, safety check list for small vessels, etc. Regulations: Canada Shipping Act; Canada Labor Code, Marine OS&H Regulations; Fishing Vessel Inspection Regulations, etc.
Denmark, Faroe Islands, Greenland	Danish Maritime Authority;Fishing Safety Councils; Maritime Authority of the Faroes; Greenland Fisheries Licence Control (GFLC)	Activities for implementation of the Danish Safety at Sea Act and its Technical Regulations for protection of the crew and working environment, safety courses at fishing schools, etc.
Iceland	Icelandic Maritime Administration; National Lifesaving Association; Ministry & Directorate of Fisheries	Vessel stability projects, Weather and sea state information system; vessel renewal programs, Inter-Nordic fishing vessel safety education program. Regulations: Ship Survey Act of 1993; Icelandic Maritime Administration Act 1996, etc.
Ireland	Health and Safety Authority; Department of the Marine	Fishing vessel safety survey in the 1990s; recommendations for new comprehensive safety regulations and requirements for fishing safety, e.g. mandatory EPIRBs, Programs for improving safety culture, etc.
Norway	Norwegian Maritime Directorate,Tromso Maritime School	Control of seaworthiness, certification for skippers, mandatory basic and advanced safety course for fishers
Russia	Federal Inspectorate of Labor; Fishing Fleet Academy	Monitoring safety & health in fishing; safety course during vocational training; regular safety instructions for the crew
Sweden	Swedish Maritime Administration; National Board of Fisheries	Implementation of the Swedish Maritime Code, registration, licensing, safety training; maintains national ("SOS") and international (Nordic Dama) casualty data system, etc.
United Kingdom	Maritime and Coast Guard Agency; Sea Fisheries Inspectorate; MAIB	Safe Fishing Campaign 1998; Developing Code of Safe Practice for smaller vessels; other joint initiatives with the Fishing Industry Safety Group
USA	US Coast Guard	Fishing vessel safety task force of 1999; PTP - Prevention Through People (human factor); Commercial Fishing Industry Vessel Safety Act of 1988

determinants and prevention of fishing injuries and to learn more from each other's safety experience.

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REFERENCES

1.CDC (Centers for Disease Control and Prevention) [1993]. Commercial fishing fatalities -Alaska, 1991-92. MMWR *42*:18

2. Lincoln JM, Conway GA [1999]. Preventing commercial fishing deaths in Alaska. Occup Environ Med *56*: 691-695

3.Schnitzer PG, et al [1993]. Occupational injury deaths in Alaska's fishing industry, 1980 through 1988. Am J Public Health 83(*5*):685-8

4.Kennedy RD, Lincoln JM [1997]. Epidemiology of fatal injury in the U.S. commercial fishing industry. In Langley RL et al. Safety and Health in Agriculture, Forestry, and Fisheries, ch 34.

5. NIOSH [1997]. NIOSH Current Intelligence Bulletin 58: Commercial fishing in Alaska, Risk factors and prevention strategies. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-163.

6. NIOSH [1994]. NIOSH Alert: Preventing drownings of commercial fishermen.Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-107.

7. Hasselback P et al [1990]. Risk for commercial fishing deaths in Canadian Atlantic provinces. Br J Ind Med. 7(*7*):498- 501.

8. Rafnsson V et al [1992].Fatal accidents among Icelandic seamen: 1966-86.Br J Ind Med. *49*(10):694-9.

9. Reilly MS [1985]. Mortality from occupational accidents to United Kingdom fishermen 1961-80. Br J Ind Med 42(12):806-14.

10. Hopper D. Safety engineering and equipment for vessels under 20m: results of trials on two vessels. Sea Fish Industry Authority, UK: Mandalia and Silverline, pps. 278-289.

11.Torner et al [1995]. Analysis of serious occupational accidents in Swedish fishery. Safety Sci *21*:93-111.

12. Jensen OC et al [1996]. Occupational injuries among Danish fishermen. Bull Inst Marit Trop Med Gdynia. *47*(14):118.

13. Aasjord H [1980]. Occupational safety in fishery. FTFI-nytt, Institute for Fishery Technology Research, Trondheim, Norway, 1980

14. NIOSH/DSR/AFS - Alaska Occupational Injury Surveillance System data

15. USCG [1999]. Fishing Vessel Task Force Casualty Analysis –Highlights, 16721/15 November 1999. [http: www. uscg.mil/d11/msosf/dprtmnts/fishboat/ 9498casfollowrpt.doc].

16. Transportation Safety Board Canada [1998]. Marine Occurrence Statistics, Annual Report. Ottawa, Canada: Transportation Safety Board.

17. IMO/Intersessional Correspondence Group on Fishing Vessel Safety, Casualty data for Iceland, 1996-98 [http: www.sigling.is/imo/imofishing.htm].

18. Danish Maritime Authority [1998]. Fishing vessel casualty statistics report 1998. Copenhagen, Denmark: Danish Maritime Authority.

19. Asjord H [2000]. Registration and statistics of accidents in the Norwegian fishing fleet. Private email message, Februrary 2000.

20. Swedish Maritime Administration [1999]. Summary of reported marine casualties and incidents and accidents to persons - Swedish merchant and fishing vessels 1997 and 1998. Norköpping, Sweden: Marine Casualty Investigation Staff.

21. Department of Transport [1999]. Marine Accident Investigation Branch (MAIB) Annual Reports 1996 – 1998. London, UK: Marine Accident Investigation Branch.

22. Health and Safety Authority [1999]. Annual Reports 1994-98. Dublin, Ireland: Health and Safety Authority.

23. United Nations [1999]. Statistical Yearbook 1998, Occupational Fatalities in the Fishing Industry, Canada. Geneva: International Labor Organization.

24. F/V Casualty Statistics database of the Institute of Maritime Medicine and the Danish Maritime Administration, Denmark, 1990-98 [1999].

25. United Nations [1999]. ILO Report for the discussion at the Tripartite Meeting on safety and health in the fishing industry. Geneva: International Labor Organization.

26. IMO casualty statistics and investigations [1999]. Collection and analysis of casualty statistics of fishing vessels and fishermen. FSI 7/6/2.

27. IMO/Intersessional Correspondence Group on Fishing Vessel Safety, Casualty data for Canada, 1993-98. [http: www. sigling.is/imo/imofishing.htm].

28. Icelandic Marine Accident Investigation Committee, fishing vessel casualty data 1993-98 [www. sigling.is/skipamal.html].

29. U.S.C.G. [1999]. Analysis of Fishing Vessel Casualties 1994-98. USCG HQ: Office of Investigation and Analysis, Marine Safety and Environmental Protection Directorate.

30. F/V SAR Statistics 1990-98 [1999]. Ottawa, Canada: Search and Rescue Branch of The Canadian Coast Guard.

31. The Nordic Dama [1995]. Stockholm, Sweden: Swedish Maritime Administration.

32. Summary of the meeting of the Commercial Fishing Industry Vessel Advisory Committee (CFIVAC) [1996]. Seattle, Washington [http:www.uscg.mil/hq/g-m/advisory/cfivac/min0496.htm].

33. CDC National Center for Health Statistics [1994]. Proceedings of the International Collaborative Effort (ICE) on Injury Statistics. Vol. 1.

34. Spitzer J [1999]. Dying to fish - Living to fish, Fishing Vessel Casualty Task Force Report 1999; by U.S. Coast Guard [http: www .uscg.mil/hq/g-m/moa/docs/fishing.htm].

35. The UK Maritime and Coast Guard Agency [2000]. Annual report and accounts 1998-99 [http: www .mcagency.org.uk/annualreport].

36. Pettursdotir G [1999]. The University of Iceland, Fisheries Research Institute, Reykjavik, private e-mail message, June 1999.

37. Aasjord H [2000].SINTEF/MARINTEK - The Norwegian Marine Technology Research Institute, Trondheim, Norway, private e-mail message, March 2000.

38. Conway, et al [1999]. Alaska's Model Program for Surveillance and Prevention of Occupational Injury Deaths. Pub Health Rprts *114*:550-558.

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