Fishing Occupational Health and Safety: A Comparative Analysis of Regulatory Regimes

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INTRODUCTION

Commercial ocean fishing is a very dangerous occupation. In a 1999 report, the International Labour Organization estimated that, worldwide, 24,000 fatal and 24 million non-fatal injuries occur annually in the fishing industry (ILO, 1999). Available statistics for countries with significant commercial fisheries indicate that fishing occupational fatalities and injuries occur at rates much higher than national averages for occupational fatalities and injuries, regardless of the level of industrialization (FAO, 2001). These high rates of fatalities and injuries can be partially attributed to the inherently dangerous working conditions involved in the industry. These include: an unpredictable and often hostile marine environment; unstable work platforms; resources that are mobile, variable, diverse, often dangerous (bites, poison, allergies) and often located in remote offshore areas; moveable and often heavy equipment, and a dependence on vessels for shelter and survival. Furthermore, shift work and the intense and prolonged working activity typically associated with fishing can cause fatigue, a common factor in many fishing-related incidents (ILO, 1999). Processing activities on vessels and in factories expose workers to industrial diseases such as occupational asthma and allergies (ILO, 1999; Beaudet *et al.*, 2002) and a variety of soft-tissue injuries and chronic conditions (ILO, 1999; Ben-Yami, 2000; Thomas *et al.*, 2001).

While fisheries are inherently dangerous, the actual levels and types of occupational health and safety risks vary across fisheries and over time, thus pointing to the role of social, economic, cultural and regulatory factors in influencing risk within the industry. At a macro-scale, there is some evidence that risk varies from country to country (ILO, 1999). Similarly, risks associated with small boat fisheries tend to differ from those associated with large vessel fisheries with the former more subject to foundering, etc., and the latter sometimes more subject to the risk of industrial-type accidents, such as getting caught in machinery. Risks may also vary with the types of fishing activities, area of operation, vessel condition, and crew experience.

Research has shown, moreover, that the nature, extent and type of risk that harvesters encounter, as well as their consequences, can change over time. This has become particularly relevant in the context of the fisheries of Newfoundland and Labrador (Canada). In response to a perceived high rate of fishing incidents in Newfoundland in the late 1990s, the Canadian Coast Guard conducted a fishing vessel safety review in 2000 that incorporated SAR data and DFO fisheries data from 1993 to 1999 to highlight trends in safety (DFO, 2000). The review concluded that injury rates, workers compensation claims, and Search and Rescue (SAR) incidents appeared to be on the rise in the Newfoundland fishing industry and correlated with a shift in target species from inshore groundfish to primarily offshore shellfish. The review data were also subjected to a comprehensive analysis by a Dalhousie University researcher who correlated SAR incidents with vessel length classes, species fished, distance from shore, and location (Pelot, 2000). Both reports revealed significant trends in SAR incidents for the less than 65-foot Newfoundland fishing fleet: SAR incidents increased between 1993 and 1999 and were highest in the 35- to 45-foot length class; the mean distance of activity from shore has noticeably increased for the 35- to 45-foot and 45- to 65-foot length classes; the

fishing sectors with the largest number of incidents were those targeting crab and groundfish; and sealers had the highest incidence of all. This pattern of SAR incidents, accidents and injuries points to the potential influence on risk of a range of factors including not only vessel size but also targeted species. Underlying this pattern and these spatial and sectoral trends in SAR incidents are substantial and rapid industrial changes triggered by environmental degradation (linked to fisheries mismanagement) and industrial and policy change (Dolan *et al.*, 2005). These changes are dealt with in more detail in other parts of this report.

COMPARATIVE ANALYSIS OF REGULATORY REGIMES

One prominent approach to risk reduction is regulation. Regulatory regimes governing fishing safety are becoming increasingly complex and are being extended to a growing proportion of fisheries, including small boat fisheries (Ben-Yami, 2000). As in other industries, but perhaps particularly in fisheries, regulations directly aimed at promoting occupational health and fishing vessel safety are only one set of regulations with potential consequences for risk. Others types of regulation can have an indirect and sometimes unintended impact. These include fisheries management regulations, regulations that influence labour markets and thus training, incomes, employment alternatives and crew turnover, as well as regulations that influence industrial structure and patterns of ownership and control.

The scope and interaction of these regulatory regime components affecting commercial fishing are often poorly understood in terms of actual or potential effects on health and safety (NRC, 1991). In many cases, there has been no attempt to correlate the implementation of such policies with fishing health and safety outcomes. To our knowledge there have been no comprehensive reviews of all regulatory policies directly and indirectly affecting fishing risk within countries with significant commercial fisheries. Similarly, there is an even greater lack of comparative international research related to this issue. It is these gaps that the Comparative Analysis of Regulatory Regimes (CARR) component of SafeCatch was designed to document and begin to address.

Study Objectives

The objectives of the CARR component of SafeCatch are as follows:

1. to review the literature related to fishing health and safety in order to identify sources of risk and to provide international contextual information and insights as a frame for a multi-levelled case study of Newfoundland and Labrador fishing safety (the remainder of SafeCatch);
2. to develop a comprehensive framework that identifies potential sources of direct and indirect risks to fishing health and safety in order to identify potential pathways from regulation to fishing safety;
3. to generate a comprehensive description of the regulatory regimes in Canada and five other countries (the U.S., the U.K., New Zealand, Iceland and South Africa) with a

focus on regulations that potentially impact (either directly or indirectly) on areas of risk identified through our framework;
4. to highlight similarities and differences in these regulatory regimes across countries;
5. to the extent possible, to document and compare trends in the recent history of accidents, fatalities and search and rescue incidents in these countries; and,
6. to establish collaborative efforts with researchers and government representatives in relevant countries, with the intention of meeting near the end of the study in order to review and disseminate the results of the CARR project and to encourage the development of future research initiatives designed to extend this work.

Subsequent sections of this report lay out the methods and findings for each of these objectives.

CONCEPTUAL FRAMEWORK

Methodology

The first stage of the CARR project involved a number of key activities. First, we started by defining what we meant by a regulatory regime. A commercial fisheries regulatory regime may be described as the body of rules that direct the industry; it can consist of laws, policy statements, rules, guidelines and standards (Howlett and Ramesh, 1995). Fisheries regulatory regimes are often complex, with administrative jurisdiction falling simultaneously within the scope of sub-national, national or international authorities. Furthermore, coordination both within and between administrative agencies is often limited, with the result that different policies within a regulatory regime may have conflicting objectives and/or impacts. This may create situations in which regulatory regime components inadvertently increase risks to persons employed in the commercial fishery, despite having the opposite intention. The development of our conceptual framework involved a review of existing research on fishing safety to identify potential sources of risk (Figure 1).

Findings

We found that the primary literature has for the most part focussed on the frequency and attributed causes of fishing-related injuries and incidents (e.g., vessel accidents) using national and sub-national case studies. For all countries, studies reporting rates of fishing-related illnesses were rare (for review (Matheson *et al.*, 2001). Even fewer studies have approached fishing safety from the perspective of OHS management systems (NRC, 1991; Van Noy, 1995). Many of the available and most recent studies on injuries and accidents have come from the U.S. and the U.K. These include studies of injury and incident rates in Alaska (Schnitzer *et al.*, 1993; NIOSH, 1997; Lincoln and Conway, 1999; Thomas *et. al.*, 2001; Lincoln *et al.*, 2001), North Carolina (Marshall *et al.*, 2004), the north-eastern U.S. (Jin and Thunberg, 2005), and the entire U.S. fishing industry (Jin *et al.*, 2001), as well as sub-national and national case studies of the U.K. (Hopper and Dean, 1992; Matheson *et. al.*, 2001; Lawrie *et al.*, 2003; Roberts, 2004; Wang *et al.*, 2005). The frequency of fishing accidents has also been studied for Poland (Jaremin *et al.*, 1997; Jaremin and Kotulak, 2004), Sweden (Torner *et al.*, 1995), Denmark (Jensen, 1996; Jensen, 2000), Australia (Driscoll *et al.*, 1994) and New Zealand

(Norrish and Cryer, 1990). The most widely cited Canadian reference is a 15-year-old study focussing on fishing mortality rates for Atlantic Canada (Hasselback and Neutel, 1990). A 2002 report by Transport Canada examined trends in national fishing accidents and injuries between 1990-2000 (Transport Canada, 2002a). Given the relative importance and size of the Canadian fishing fleet in the global industry, we note an especially large gap in the literature focussing on Canadian fishing injuries and incidents, and particularly in recent analyses. The Fishing Vessel Safety Longitudinal Analysis (FVSLA) component of SafeCatch addresses this gap for the Newfoundland and Labrador fisheries through a comprehensive analysis of trends in occupational injuries and fatalities, SAR incidents and their relationship to industry changes.

A number of comprehensive studies have focussed on fishing health and safety, both the work sponsored by international organizations (ILO, 1999; Ben-Yami, 2000; FAO, 2001; ILO, 2003) and initiatives led by individual governments (CCG, 1987; NRC, 1991; U.S.C.G., 1999; DFO, 2000; Pelot, 2000; Transport Canada, 2002a; MSA, 2003). These studies examine not only the frequency and attributed causes of accidents, injuries and illnesses, but also a range of issues and risks related to safety in the fishing industry. Many include recommendations for reducing various risks in the industry. Of particular relevance to our study was a recent report by the ILO that examined existing legislation concerning labour conditions in the fishing sector in member states and highlighted similarities and differences in the regulatory approaches that various nations have taken regarding a) prerequisites to working in the fishing sector; b) employment; c) occupational safety and health and the provision of food and water, accommodations and medical care; d) social security; and e) administration and enforcement (ILO, 2004).

A portion of the published literature has been devoted to the study of the attitudes and perceptions of fish harvesters towards safety (Poggie *et al.*, 1995; Pollnac *et al.*, 1995; Murray *et al.*, 1997; Pollnac *et al.*, 1998; Kaplan and Kite-Powell, 2000; Eklof and Torner, 2002). Most studies have noted that fishers tend to deny, trivialize, or divert blame for fishing safety problems, and that fatalistic attitudes towards fishing risks are common. Such attitudes may pose a serious obstacle to the development of a safety culture and the effectiveness of regulatory instruments. The Perceptions of Risk (POR) component of SafeCatch is interested in gaps between real and perceived risks among fish harvesters in the Newfoundland and Labrador case study. However, its main focus is documenting harvesters' experiences with risk and injury and their experiential knowledge of the things that put them at risk. The Community Healthy Fishery Program component of SafeCatch explores the potential to improve safety culture at a local level through various community arts activities.

Our review has shown that factors affecting fishing health and safety are multiple and include not only environmental risks but also labour conditions, culture, vessel design, fisheries management and the influence of regulations. It has also pointed to the fact that these factors frequently interact with one another to influence risk (NRC, 1991; Dyer, 2000; Dolan *et. al.*, 2005). Commonly cited direct risks to fishing health and safety include those related to the safety of the fishing vessel (U.S.C.G., 1999; Ben-Yami, 2000; Lincoln *et. al.*, 2001; Roberts, 2004), fishing equipment and handling of the catch

(Hopper and Dean, 1992; Dyer, 2000; Thomas *et. al.*, 2001; Marshall *et. al.*, 2004), lack of safety and survival equipment (NRC, 1991; ILO, 1999), lack of experience and training (NRC, 1991), attitudes towards safety, the physical environment including weather (Ben-Yami, 2000), and human error (NRC, 1991; U.S.C.G., 1999). Mismanagement of fisheries resources can indirectly influence safety through excess fleet capacity, increased competition among, and economic pressures on, fish harvesters, and the promotion of unsafe behaviours resulting from stock uncertainties (CCG, 1987; NRC, 1991; NRC, 1999; Dyer, 2000; Ben-Yami, 2000; Woodley, 2000; FAO, 2001; Kite-Powell and Jin, 2001). Because of perceived economic burdens, fishers operating in marginally successful fisheries may resist the implementation of new regulations despite the apparent benefits to safety (ILO, 1999). Requirements for insurance may also indirectly influence safety (NRC, 1991).

In order to understand the range of ways occupational health and safety in fishing might be mediated by various agencies and their respective regulatory policies, we have organized potential risks to fish harvesters into broad categories (Figure 1). This makes it easier to visualize potential linkages between risks and regulations. Regulations and policy initiatives that might potentially impinge on any one or more of these areas of risk are then identified and explored in terms of their real or potential relationship to fishing OHS. In this analysis, we distinguish between regulations that are intended to enhance fishing OHS (direct) and those that are associated with other aspects of the fishery but that could also impinge on fishing OHS (indirect).

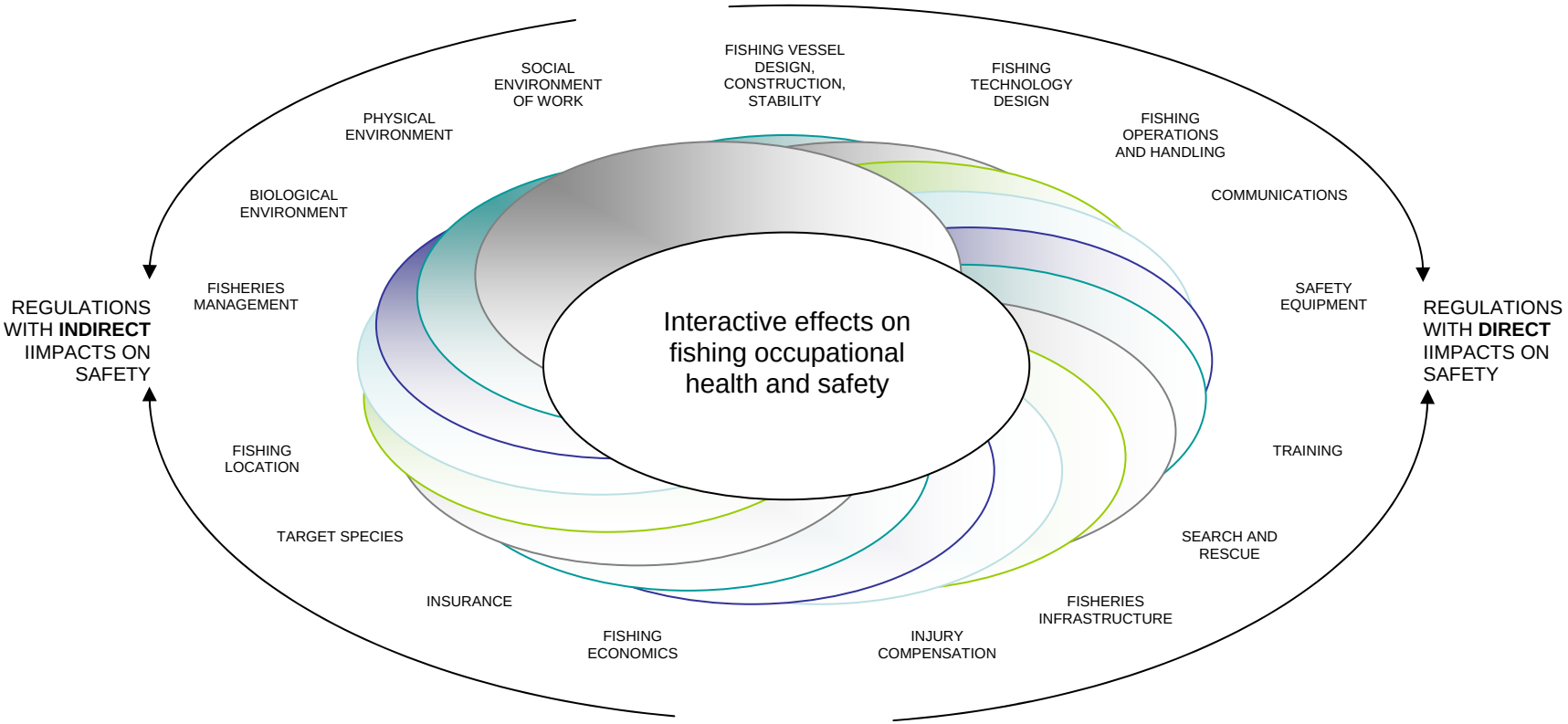

Figure 1. The CARR framework identifies potential sources of risk to fishing health and safety and illustrates possible interactive effects (direct and indirect) of regulations on health and safety outcomes.

DESCRIPTION OF REGULATORY REGIMES

Methodology

In phase two of the project we developed a comprehensive description of the regulatory regimes for the commercial fisheries of Canada, the U.S., the U.K., New Zealand, Iceland, and South Africa (henceforth referred to as 'the CARR countries'). These countries were selected in order to cover a range of differing geographical locations, as well as occupational conditions, government and organizational structures, and management approaches to fisheries resources. Common criteria included a significant commercial marine fishery, an industrialized fishing fleet, and information sources available in English. Given that specific laws affecting fishing health and safety may vary between provinces (e.g., workers' compensation systems), the Canadian case study is focused on the Newfoundland and Labrador fishery.

The analysis of regulatory regime components for each country in the CARR project involved a comprehensive review drawing on a number of information sources. The principal resources included international standards, national statutes and regulations that were available on government websites and published in gazette form, reports from government and industry organizations, primary and secondary literature, media releases, and, where available, interviews with government and industry representatives.

Using risks identified by our literature review (Figure 1), regulatory regimes were divided into two broad categories for comparative purposes: the first category encompasses all regulatory regime components that explicitly address some aspect of health and safety in the fisheries; the second category encompasses all other regulatory regime components that do not explicitly target health and safety, but may have indirect impacts (real or perceived) nonetheless. Each category was further organized into themes that are common to all developed fisheries. For regulatory regime components that directly impact OHS, these themes include proactive policies (related to the prevention of injuries and illnesses) and reactive policies (related to immediate and long-term measures following an injury or illness). For regulatory regime components that indirectly impact OHS, these themes include fisheries management, ecosystem and natural resource management, and fishing economic and financial systems. The comprehensive descriptions of regimes for each country are posted to the SafeCatch website (www.safetynet.mun.ca/projects_1c1.htm).

Findings

Our regulatory review found that, for many of the selected countries, safety regimes tend to have progressed over time from an initially narrow focus on aspects of vessel safety or survival equipment to more comprehensive and mandatory policies covering a wider range of occupational risks. In addition, the applicability of safety policies has tended to expand in terms of the size of vessels and the types of occupations covered.

Overall, the six CARR countries were found to have mostly similar administrative structures in terms of the types of agencies responsible for policies directly affecting fishing health and safety. The compartmentalized nature of fisheries regulatory regimes,

and the recognition that factors that affect fishing health and safety fall within the purview of many agencies, point to the need for intersectoral collaboration between relevant agencies and organizations in order to ensure that regulatory frameworks promote OHS. Intersectoral collaboration can link sectors horizontally (e.g. fisheries management, transportation, social services, etc.), as well as vertically within each sector (e.g. local, regional and national) (Health Canada, 1999). In addition, the effective monitoring and evaluation of regulatory regimes in relation to their impacts on fishing OHS fundamentally requires intersectoral action among relevant parties, without which large and potentially important gaps, both in information and in action, may exist.

Using a systematic methodology based on our conceptual framework, the comparative analysis of policies across the six CARR countries revealed many subtle and significant differences in the coverage and content of regulations with potential direct and indirect impacts to fishing health and safety. Detailed findings of the analysis will be posted to the SafetyNet website. We note the presence of both proactive and reactive types of regulations in all CARR countries, with some key differences:

Direct proactive policies

- In Canada and South Africa, shipping and transportation regulations apply to fishing vessels based on vessel tonnage categories; in the U.S., U.K., New Zealand and Iceland, these regulations apply based on vessel length categories.
- Stability requirements (e.g., incline test) apply to vessels > 24 m in the U.S., > 15 m in Iceland and the U.K, > 15 GT (~10 m) in Canada, > 12 m in New Zealand, and > 100 t South Africa.
- Canada and the U.S. do not implement standards for crew accommodations, in contrast to the other CARR countries.
- Scheduled inspection is mandatory for fishing vessels > 15 GT in Canada, > 15 m in Iceland and the U.K., and all vessels in New Zealand and South Africa. In Canada and the U.K., self-inspections using a checklist are mandatory for all smaller uninspected vessels, which represent over half of each country's fleet. Inspection in the U.S. is implemented through random dockside and at-sea boarding by the Coast Guard.
- Training in terms of survival, safety and fire-fighting courses is mandatory for all fish harvesters in Canada, Iceland, and the U.K. New Zealand incorporates safety training and orientation as part of each ship's mandatory safety management system. Basic safety induction training is required for all fish harvesters in South Africa, while U.S. regulations require only onboard safety orientation.
- The U.S. does not require competency training for most fish harvesters, in contrast to all other CARR countries.
- Crewing requirements such as minimum complements and the minimum number and types of certificates apply to all vessels in Iceland, New Zealand and the U.K., vessels > 5 GT in Canada, vessels > 25 t in South Africa, and vessels > 24 m in the U.S.
- Safety management systems involving safety committees and risk assessments are mandatory on most New Zealand and U.K. vessels, and many Icelandic vessels. Safety management systems are not required for fishing vessels in Canada, the U.S. or South Africa.

- All countries require some form of monthly safety drill to be performed and recorded in the vessel's log, although the applicability varies: drills are required only on large fishing vessels in Canada (> 150 GT or ~24 m) and South Africa (> 100 t), vessels > 15 m in Iceland and the U.K., vessels with > 2 crew in New Zealand, and all vessels in the U.S.

Direct reactive policies

- Carriage requirements for safety equipment (life-saving and fire-fighting) are based on vessel length and operating region in Canada, the U.S., Iceland, and the U.K., and on a risk-based approach that incorporates operating distance from shore in New Zealand and South Africa.
- Medical stores are required on all fishing vessels in Canada, New Zealand and the U.K., U.S. vessels > 5 t or > 16 crew or fish tender vessels in Aleutian trade, vessels > 15 m in Iceland, and > 25 t in South Africa.
- No-fault compensation and rehabilitation benefits are available to all injured fish harvesters in Canada, Iceland, New Zealand, the U.K. and South Africa, although these differ in terms of required qualifying hours vs. automatic coverage, calculation of benefits as a proportion of earnings vs. fixed rate, the duration of benefits, and the types of injuries and illnesses covered by compensation. Workers' compensation in Canada applies to fishers in NL and BC, while fishers in the Maritimes (NS, NB, PEI) are explicitly excluded. In NL, workers' compensation benefits do not count towards qualifying hours for employment insurance, which is relied on heavily during the off-season. For some workers, this may be a factor in the decision whether or not to report, or seek compensation for, an injury or illness. In the U.S., where the compensation system combines no-fault compensation and fault-based liability, fish harvesters are not eligible for compensation. Coverage is automatic for fishers in New Zealand and Iceland.

Policies with indirect influences on fishing OHS

- Fisheries management acts and subordinate legislation in Canada (Fisheries Act), New Zealand (Fisheries Act 1996) and Iceland (The Fisheries Management Act 1990) deal strictly with resource conservation issues and do not incorporate explicit safety objectives. In contrast, the main policy instrument directing fishing activities in the U.S. (Magnuson-Stevens Fishery Conservation and Management Act), the U.K. (Common Fishery Policy) and South Africa (Marine Living Resources Act 1998) contain specific requirements and provisions to promote safety. In recent years, a number of integrated fisheries management plans (IFMPs) in Canada have included a provision stating that the plan is consistent with relevant federal and provincial requirements for safety at sea.
- In all countries, the development of fisheries regulations and management measures involves some form of consultation with industry stakeholders. This mechanism provides an opportunity for impacted parties to raise possible safety concerns. Generally, this has led to a reactive approach in which existing fisheries management measures are modified based on trial and error. For example, in response to safety concerns raised by industry, supplementary vessel replacement rules were introduced in Atlantic Canada in 1997 with the objective of allowing more flexibility for fishers

to choose a vessel size appropriate for their fisheries, provided that conservation objectives were met. In the New England surf clam and quahog fisheries, safety concerns associated with rules restricting fishing effort led to the revision of management measures to allow more days at sea (Lassen and Van Olst, 1986). Small adjustments to fisheries plans as a result of safety experiences have likely taken place in all countries of interest, although this has not been examined in any detail.

- Fisheries management regulations that restrict the length of fishing vessels are common in Canada but not in other CARR countries. Fishing vessel length restrictions may encourage fish harvesters to modify vessel design parameters such as width and height in order to increase fishing capacity and this can lead to stability problems (NRC, 1991; DFO, 2000; Friis, 2006). Vessel design issues are examined in the Safer Fishing Vessel Seakeeping (SFVS) component of SafeCatch. Design modifications may also lead to slower, less fuel-efficient fishing vessels, with potential impacts on the profitability of fishing enterprises. Vessel length restrictions may make it difficult to adapt to changing fisheries and evolving shipping regulations by limiting available deck space for multi-species gear, storage of safety equipment, and storage capacity to preserve higher value catches (Friis, 2006). Fish harvesters who fish in offshore waters may also be limited to using smaller vessels that are unsuitable for such conditions (DFO, 2000; Pelot, 2000). The POR component of SafeCatch presents findings regarding how fish harvesters within the Newfoundland and Labrador fishery have adapted to these regulatory restrictions and indications of ways their actions have influenced safety.
- Individual quotas (IQs) are a relatively new tool in fisheries management (for review, see NRC, 1999), and have been promoted in many cases as a means to improve fishing safety. IQs have been applied to the majority of fisheries in New Zealand and Iceland, many fisheries in Canada and the U.K., and relatively few fisheries in the U.S. South Africa recently implemented a national policy for the redistribution of fishing allocation rights, which are similar to ITQs but differ in that they cannot be automatically transferred and have a finite term (Branch and Clark, 2006). However, it has been argued that the introduction of long-term allocation rights in 2006 will essentially implement a de facto ITQ system in the South African fishing industry (Nielsen and Hara, 2006).
- Requirements for fishing vessel insurance were noticeably lacking in all countries studied.

Differences in the applicability and specifics of safety regulations must be interpreted with caution, given that fleet characteristics, weather conditions and operating areas differ greatly between countries. For example, policies requiring immersion suits may be more appropriate in the cold climates of Canada and Iceland than in South African waters, while scheduled inspections may be more difficult to implement in the case of the large U.S. fishing fleet compared to the relatively small New Zealand fleet. Rather, it is perhaps more useful to describe the scope of policies within each country.

Overall, CARR countries were relatively similar in terms of many of their key features. The notable exception was the U.S. regulatory regime, which primarily involves reactive strategies, focuses on the worker rather than the workplace, does not cover many of the

risks associated with fishing activities, and lacks substantial enforcement of mandatory requirements. These deficiencies have been noted in several U.S. publications (NRC, 1991; Van Noy, 1995; Lincoln and Conway, 1999; U.S.C.G., 1999; Dyer, 2000; Thomas *et. al.*, 2001). Of the CARR countries, only Iceland has implemented the Torremolinos Protocol 1993, the first and main international Convention covering safety requirements for the construction and equipment of new, decked, seagoing fishing vessels >24 m. However, most other countries have incorporated parts of the Protocol in their national legislation. Detailed information on the implementation of international standards is included in the regulatory summaries for each CARR country that have been posted to the SafetyNet website.

COMPARISON OF FISHING HEALTH AND SAFETY DATA

Methodology

A potential indicator of the effectiveness of regulatory regimes in promoting safety is the rate at which injuries, fatalities and illnesses occur in a specific industry. We conducted a comprehensive review of international peer-reviewed publications and government reports in order to gather information on past and current trends in fishing-related accidents, incidents and near-misses.

Injury, fatality and illness rates are most often calculated as the number of occurrences divided by the total number of people employed in an industry and are standardized to reflect rates per thousand or hundred thousand people. These rates are limited by the accuracy and scope of the reporting systems that exist within a country, as well as the accuracy with which the population at risk is defined (Thomas *et. al.*, 2001). An alternate and more accurate reflection of accident rates is based on the number of occurrences per unit of effort, as represented by total hours worked. However, hours of effort remain difficult to quantify in the fishing industry, given the seasonal nature of work, widespread self-employment, and the informal relationships that exist between employers and employees (Matheson *et. al.*, 2001). As such, the reported injury, fatality and illness rates of fishers are typically calculated using total employment estimates.

Findings

Our review of the available international data for fishing-related accidents revealed a widespread lack of consistency in the manner in which countries categorize and count fishing health and safety outcomes. Injury, fatality and illness data varied not only between countries but also among individual countries' sub-national components. For example, we note discrepancies in the number of fishing fatalities recorded for Newfoundland by federal and provincial agencies based in Newfoundland over the same time period (see Appendix 1). These differences are likely due to the different mandates and methods of data collection that are employed by relevant agencies, as well as different data treatments. This lack of standardized reporting and uneven data quality is particularly troubling given that commercial fishing is consistently ranked as one of the most dangerous of occupations, and that accurate information on the levels of risk is necessary for assessing and improving the effectiveness of health and safety policies.

In the literature, the most common types of accidents reported are fatalities (Appendix 2). This is likely due to several factors, notably the fact that fatalities generally receive more official inquiry than non-fatal injuries and accidents and fatalities are more easily associated with conditions of work. In many cases, information on non-fatal injuries and illnesses is also available but it seems probable that the reported rates are well below the actual rates, as many accidents, incidents and illnesses go unreported or are not recorded adequately by the proper authorities. Given that, even for fatalities, health and safety reporting systems may vary between countries and that population-at-risk estimates typically do not reflect hours of exposure to various dangers, reported fatality rates should be approached with caution. Furthermore, comparisons of fatality rates should be avoided in cases where the populations at risk have been calculated using different methods, as rates using a workforce estimate in the denominator are generally much lower than rates based on effort (i.e. full-time equivalents). We found several examples in the published literature where comparisons were made without regard for this distinction (Abraham, 2001; Roberts, 2004). In many cases, moreover, reported fatality rates were over 10 years old, limiting their usefulness to the analysis. Given these many data restrictions we were able to make only a superficial comparison of the reported fatality statistics.

Our review of the literature found estimates for fishing fatality rates in a number of countries with significant commercial fisheries, including all six CARR countries (Appendix 2). The rates were obtained from both the secondary literature and government sources. The most recently reported fishing fatality rate per 100,000 workers was 36 for Canada from 1990-2000 (Transport Canada, 2002a), 43 for Alaska from 1991-1998 (Thomas *et. al.*, 2001), 120 for the U.K. from 1976-1995 (Roberts, 2004), 162 for South Africa from 1996-2002 (Campbell, 2003), and 167 for New Zealand from 1985-2000 (MSA, 2002). Fatality estimates based on measures of effort (i.e., number of hours worked) were only available for the U.S. (119 per 100,000 full-time equivalents) and Iceland (89 per 100,000 person-years). A Canada-wide analysis of fishing vessel accidents between 1990 and 2000 found that fatalities and injuries remained fairly constant, and that the majority of deaths and injuries occurred on smaller vessels (< 15 GT) and mid-sized vessels (15-150 GT) respectively (Transport Canada, 2002a). Between 1990-2002, the majority of commercial fishing-related injuries (88%) and fatalities (85%) on Canadian vessels occurred within 15 NM of shore (Transport Canada, 2002b). Similarly, an analysis of accidents within the north-eastern U.S. fishing fleet revealed that accidents are more likely to occur closer to shore (Jin and Thunberg, 2005). Canadian shipping regulations, including those impacting fishing safety, have remained relatively unchanged over the past decades but are currently in a state of regulatory reform. While Canadian fishing fatalities remained relatively constant from 1990 to 2000 (Transport Canada, 2002a), it remains to be seen if the regulatory restructuring will result in an improved safety record.

It is difficult to correlate trends in fishing fatalities with the implementation of specific policies that may directly or indirectly influence fishing health and safety, given the confounding effects of fleet restructuring and modernization, shifts in target species, gear types and fishing locations, fishing economics, and changes in fisheries management

policies. Recent implementation of national policies that were explicitly designed to improve OHS have correlated with reduced fatalities in the U.S. (Lincoln and Conway, 1999), New Zealand (MSA, 2002), Iceland (Rafnsson and Gunnarsdottir, 1992), and South Africa (Campbell, 2003). Fatality rates in the U.K. fishery remained fairly constant from 1976 to 1995 (Roberts, 2004) but have declined following the recent implementation of new safety regulations, with particular reference to the Fishing Vessels (EC Directive on Harmonised Safety Regime) Regulations of 1999. While fishing fatalities appear to be decreasing in some countries, there is evidence that non-fatal occupational injuries remain alarmingly high in the U.S. (Dyer, 2000; Thomas *et. al.*, 2001) and the U.K. (Roberts, 2004). This may be due to a lack of regulations specifically designed to improve fishing OHS conditions on deck.

We also attempted, where possible, to investigate any major trends in fishing OHS in relation to the types and changing patterns of fisheries management policies. In particular, our analysis focussed on specific types of fisheries management policies that have been purported in the literature to have either positive or negative outcomes for fishing safety. While individual quota (IQ) systems have been promoted as a means to improve fishing safety levels (NRC, 1999; Sigler and Lunsford, 2001), our review found that the evidence in support of this contention remains unclear. Some fisheries have experienced significant improvements in health and safety following the implementation of IQ programs, including the Nova Scotia offshore fishery (Binkley, 1995), the Alaskan halibut and sablefish fisheries (CDC, 1993; Lincoln and Conway, 1999; Woodley, 2000), and the British Columbia geoduck fishery (Heizer, 2000); others have maintained relatively high accident and fatality rates under the IQ system, such as the surf clam and ocean quahog fisheries of New England (U.S.C.G., 1999; NRC, 1999; Woodley, 2000), and the national fisheries of Iceland (NRC, 1999) and New Zealand (MSA, 2003). Our analysis suggests that the maximum amount of quota that individuals or organizations are permitted to aggregate within an industry may be an important factor influencing safety, as fisheries in the U.S. that restrict quota aggregation (e.g., sablefish and halibut fisheries of Alaska) have documented significant declines in fatality rates and vessel incidents following the implementation of IFQs (Lincoln and Conway, 1999), while fisheries with no defined aggregation limit (e.g., surf clam and ocean quahog fisheries) have had continued problems with major vessel accidents and fishing fatalities (U.S.C.G., 1999). Small operators are often limited to leasing quota from large corporations or non-fishers, or working under contract for vertically integrated businesses. In such examples, the expected safety benefits of IQs (e.g., reduced incentives to rush for fish or operate in poor conditions) may be removed if pressures from quota holders supersede the independent decision-making abilities of vessel owners. This may have safety implications for the fisheries of Atlantic Canada, where owner/operator and fleet separation policies are being undermined by so-called “trust agreements” whereby processors essentially pay for licenses and vessels on behalf of small-scale vessel owners and subsequently exercise some control over their fishing activities (CCPFH, 2005).

COLLABORATIVE EFFORTS

Collaborators have been found in New Zealand, the U.S., Iceland, and South Africa, and they have been sent materials relating to the methods, conceptual framework, and individual case studies of the CARR project. Collaborators have been asked to aid in the development of fuller case studies for their respective countries. This task includes gathering relevant information on regulatory regime components with direct and indirect influences on fishing health and safety, providing information relevant to fishing fatalities and injury rates, and reviewing outputs from the CARR project. In addition, SafetyNet is organizing an international conference in June 2006 in St. John's, Newfoundland and we have organized a session where the results of this comparative analysis of regulatory regimes will be presented. Research collaborators from South Africa, New Zealand, and Alaska are planning to attend this conference and will make presentations at the CARR session on topics related to ongoing fishing health and safety issues in their respective countries.

DISCUSSION

Fishing health and safety is an exceptionally complex problem. Previous studies have promoted the vision of fishing safety as a complicated interaction of many factors (NRC, 1991; ILO, 1999; U.S.C.G., 1999; Dyer, 2000; DFO, 2000). Common themes that emerge from the literature include vessel safety, occupational health and safety, training and awareness, and the dire need for a safety culture among fish harvesters. The consolidation of risks, including those that may indirectly impact fishing, into a single conceptual framework helps to illustrate these complex interactions, and to identify types of regulations that may mitigate such risks.

Regulations and related policy instruments that influence health and safety in the fishing industry find their roots in various parts of government. Thus regulations and policies initiated by administrative agencies that are directly responsible for fishing OHS, as well as those originating from agencies with responsibility for other aspects of the fishery, can both influence OHS. The complex administrative structure associated with most fisheries, in which responsibility is often partitioned between transportation, fisheries management, and labour agencies, tends to foster an environment where agencies and organizations function under mandates that do not include the requirement to evaluate policies based on their impact on fishing OHS. Furthermore, the compartmentalization of administrative responsibility has generally precluded systematic evaluation of fishing regulatory regimes with respect to OHS.

Each group involved in the fishing industry (fish harvesters, legislators, fisheries managers) has a unique perspective, training, and goals that may interact in a complex fashion. Fishers are the main actors, involved directly with day-to-day consequences of work on moving platforms. They must deal with economic pressures and work arrangements, transportation regulations, fisheries management regulations, insurance regulations, and other policies that dictate their behaviour within a constantly changing environment of moveable and uncertain resources, weather, and market conditions. It is

important to acknowledge that fishers are not ignorant participants. They have knowledge based on experience, training and culture and represent an important source of information regarding the real impacts of direct and indirect regulations on health and safety. Through interviews with a subsample of participants in the Newfoundland fishery, the POR component of SafeCatch examines among other things how regulatory changes and current policies have affected perceived and real risks in the industry. Regulations have the potential to modify behaviour in many directions – they can improve safety, but can also promote unsafe behaviours. We recommend that policy makers, particularly those that may indirectly influence fishing occupational health and safety, should include safety objectives wherever possible in relevant regulations.

We note the presence of both proactive and reactive types of regulation in all countries examined, with some key differences. Overall, the U.S. regulatory regime stood apart from the other CARR countries for its relative lack of proactive safety policies. Most of the current legislation pertaining to fishing health and safety in the U.K., South Africa, Iceland, and New Zealand has been implemented recently (~10 yrs) and incorporates many provisions from relevant international conventions on marine safety. The main policy instrument dealing with fishing safety in the U.S. was implemented in the early 1990s and lacks many of these international provisions for smaller vessels. In Canada, safety-oriented policies have remained relatively unchanged for several decades, though new and updated policies are expected to be implemented within the next few years following a significant regulatory reform project.

Research that links theory and practice in terms of regulations is particularly important, as a comparative analysis based solely on prescribed laws and regulations without attention to their actual interpretation and implementation would be of limited value. Compliance with regulations is difficult to measure; however, there are indications in the published literature that compliance is generally low and that fishers lack a safety culture. In South Africa, the detention rate for small fishing vessels that are deemed unseaworthy following ad-hoc inspections is 21%, with approximately 50% non-compliance with basic safety tenets (Campbell, 2003). In Newfoundland and Labrador, approximately 75 % of fishing vessels not exceeding 15 GRT inspected for acceptance in the Canadian Coast Guard Auxiliary fail to meet the standards (DFO, 2000). Interviews with fish harvesters in the U.S. reveal a poor safety culture and suggest that compliance with safety regulations may be superficial (Poggie and Pollnac, 1997). The issue of compliance in the Newfoundland fishery is also discussed in the POR component of SafeCatch. **Examination of compliance with safety regulations is critically important to a meaningful analysis of regulatory regimes.**

The actions and behaviours of fish harvesters are largely influenced by fisheries management regulations that set out who can fish, where, when and how they can fish, and the amount of fish they are permitted to take. Given this simple truth, it is surprising that the majority of national and international fisheries policies have traditionally been developed without regard for their potential impacts on health and safety. Fisheries management systems have the potential to affect safety at sea by indirectly encouraging unsafe behaviour or by leading to the reduction of safety features of fishing vessels

(FAO, 2001). Regulatory regimes that do not address fleet overcapacity, limited entry, fishing effort, gear selectivity, and biological factors such as minimum sizes, sensitive fishing seasons, and areas closures will likely result in declining fisheries resources, with subsequent impacts on factors affecting fishing safety such as marginal profits per capita and increased competition (Lassen and Van Olst, 1986). Rather, it has been recommended that fisheries managers adopt more flexible policies and reassess policies that have potential impacts to safety such as inflexible opening dates for competitive fisheries (NRC, 1991; Kaplan and Kite-Powell, 2000), limited crew sizes to restrict fishing effort (U.S.C.G., 1999; Kaplan and Kite-Powell, 2000) and vessel replacement restrictions (CCG, 1987; DFO, 2000). To date, there has been no comprehensive and comparative analysis of the impacts of various fisheries management measures on safety outcomes. **This represents a significant research gap with important policy implications.**

Our analysis of published fatality statistics highlights a key problem in fishing safety research. **Our results suggest that fishing fatality, injury and illness data should be interpreted with caution and that a meaningful comparison of international data is not possible at this time.** There is a critical need for a standardized system of identifying, recording and reporting fishing-related occupational injuries and diseases. The variability of fishing accident statistics in terms of availability, study period, methodology, and reliability poses a significant obstacle for the comparison of regulatory regimes. For example, it is unclear why the Alaska fishing industry, characterized by a dangerous environment, few proactive safety policies and relatively limited enforcement of safety regulations, reports a significantly lower fatality rate than countries with tougher safety standards such as New Zealand, Iceland and the U.K. The use of fatality rates is not an ideal method of gauging the safety levels of the fishing industry. Fatality rates may be misleading, especially where numerous fatalities are the result of a few vessel incidents (e.g., the sinking of large vessel). Non-fatal injury, illness and near-miss data are more appropriate for discussion of safety outcomes, as they are more representative of the types of incidents that are common throughout the fishing industry. However, these data are not available in the international published literature and those thar are available are insufficient for comparative purposes. Data linkages initiatives such as the ones carried out as part of the FVSLA component of SafeCatch have the potentially to substantially improve the quality of administrative data available for the study of fishing safety. The Injured Fishers component of SafeCatch reports on common types of injuries to fish harvesters in the Newfoundland and Labrador fishery, as well as the impacts of long-term disability in terms of social consequences and support services.

We point to the need for comprehensive and systematic national case studies based on similar methods and data treatments, similar to the SafeCatch project. Such studies are essential to improve our capacity to do meaningful comparisons not only of regulatory regimes but, in addition, on their relationship to safety and safety outcomes. Of particular import is the collection and synthesis of standardized data (preferably rates) on fishing-related injuries, illnesses, accidents and near-misses, SAR incidents, and claims for social benefits.

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APPENDIX 1

Comparison of fishing-related fatality statistics for Newfoundland from four sources.

Year	WHSCC (FVSLA Database)[1]	WHSCC Fishing Industry Fact Sheet[2]	Coast Guard SAR[3]	TSB Marine[4]
1989	9			16
1990	13			6
1991	4			3
1992	5			3
1993	3		10	4
1994	10		9	7
1995	4		3	3
1996	4		3	2
1997	2		7	4
1998	7		4	2
1999	1	1	0	1
2000	10	10	10	7
2001	4	3		4
2002		4		4
2003		1		0
2004				2

[1]Email from Maureen Keough (Dalhousie) to B. Neis, April 28/2005
[2]Injury statistics from WHSCC Industry Fact Sheets "Fish Harvesting Industry" (http://www.whscc.nf.ca/pubs/industry.htm)
[3]DFO. 2000. Fishing Vessel Safety Review (less than 65 feet). Canadian Coast Guard, Maritime Search and Rescue, Newfoundland Region.
[4]Email from Melissa Donovan, Project Officer, TSB, June 2/2005

APPENDIX 2

International comparison of commercial fishing-related fatality statistics. Fatality rates (per 100,000 fishermen/year) are reported where available.

Country	Scope	Authors	Year Published	Study Period	Fatalities	Population at risk	Fatality rate/yr
Australia	National	Driscoll *et al.*	1994	1982-1984	47	32867	**143**
Canada	Newfoundland	Neis	1990	1975-1988	30	14579 (Trawlers)	**206**
	Newfoundland	DFO	1999	1993-2000	46	N/A	**N/A**
	Newfoundland	WHSCC	2001	1989-2001	76	N/A	**N/A**
	Newfoundland	MIL Report	2002	1990-2000	59	N/A	**N/A**
	Maritimes	Hasselback and Neutel	1990	1975-1983	84	183378	**46**
	National	MIL Report	2002	1990-2000	287	788425	**36**
Iceland	National	Rafnsson and Gunnarsdottir	1992	1966-1986	132	147649	**89**
New Zealand	National	Norrish and Cryer	1990	1975-1984	79	30385	**260**
	National	Feyer *et al.*	2001	1985-1994	58	N/A	**226**
*	National	MSA	2002	1985-2000	105	63040	**167**
Norway	National	Thomas *et al.*	2001	1961-1975			**150**
Poland	Baltic Sea	Jaremin *et al.*	1997	1975-1984	33	48113	**69**
	Deep Sea	Jaremin *et al.*	1997	1975-1984	11	64044	**17**
	Small-scale fishing industry (<24 m)	Jaremin and Kotulak	2004	1960-1999	177	198920	**89**
South Africa	National	Campbell	2003	1996-2002	198	122180	**162**
Sweden	National	Torner *et al*.	1995	1975-1986			**110**
UK	National	Reilly	1985	1961-1980	711	420710	**169**
	National	Hopper and Dean	1989	1971-1980			**170**
	National	Roberts	2004	1976-1995	527	440355	**120**
	National	Matheson *et al.*	2001	1994-1998	120	N/A	**N/A**
US	National	NIOSH	1994	1982-1987	648	1378723	**47**
	National	U.S.C.G.	1999	1994-1998	396	N/A	**N/A**
	National	U.S.C.G.	2004	1994-2000	466	N/A	**N/A**
	Alaska	Knapp and Ronan	1990	1981-1984	103	32227	**320**
	Alaska	Thomas *et al.*	2001	1991-1998	167	392000	**43**
*	Alaska	Schnitzer *et al.*	1993	1980-1988	278	67052	**415**
*	Alaska	CDC	1993	1991-1992	70	34800	**201**
*	Alaska	Lincoln and Conway	1999	1991-1998	162	139200	**116**
*	Alaska	Lincoln and Conway	2001	1990-1999	217	175000	**124**
*	Alaska	Thomas *et al.*	2001	1991-1998	167	140000	**119**

*Indicates fatality rates are based on units of effort (hours of work) and not on workforce estimates