Preventing commercial fishing deaths in Alaska

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Abstract

***Objectives*—To evaluate the effectiveness of the United States Commercial Fishing Industry Vessel Safety Act of 1988 in reducing the high occupational death rate (200/100 000/year in 1991–2) among Alaska's commercial fishermen.**

***Methods*—Comprehensive surveillance of deaths in commercial fishing was established by our office during 1991 and 1992 for Alaska. Demographic data and data on risk factors and incidents were compiled and analysed for trend.**

***Results*—During 1991–8, there was a significant ($p<0.001$) decrease in deaths in Alaska related to commercial fishing. Although drownings from fishermen falling overboard and events related to crab fishing vessels (often conducted far offshore and in winter) have continued to occur, marked progress (significant downward trend, $p<0.001$) has been made in saving the lives of people involved in vessels capsising and sinking.**

***Conclusions*—Specific measures tailored to prevent drowning associated with vessels capsising and sinking in Alaska's commercial fishing industry have been successful. However, these events continue to occur, and place fishermen and rescue personnel at substantial risk. Additional strategies must be identified to reduce the frequency of vessels capsising and sinking, to enable parallel improvements in the mortality among crab fishermen, and to prevent fishermen falling overboard and drownings associated with them.**

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Working conditions in the Alaska commercial fishing industry are very hazardous, compounded by isolated fishing grounds, seasonal darkness, cold waters, high winds, icing, and brief fishing seasons. In the early 1990s, this setting resulted in unacceptably high occupational death rate, 200/100 000/year for the 2 year period 1991–2, for Alaska's commercial fishermen.[1] Over 90% of these deaths were from drowning, presumed drowning, or drowning plus hypothermia, in association with ships capsising or sinking or with falls overboard.

Several countries have reported similarly high mortalities related to fishing, also primarily from cold water drowning[2]—for example, Iceland experienced a fishing related death rate of 89.4/100 000/year from 1966–86.[3] Safety programmes implemented by different countries vary, focusing on vessel quality, licensing operators, staffing standards, and safety training.[2] In the United Kingdom, comprehensive regulations implemented in 1975 include inspections of fishing vessels, personnel training, staffing, and watchkeeping requirements. Research from the United Kingdom has shown that human error is a common causative factor among fishing incidents.[4 5] The Canadian commercial fishing industry operates in cold waters and has fisheries similar to the northern United States fishing industry. Canada experienced high mortalities, 46/100 000/year for the period 1975–83.[6] In the mid-1980s, Canada examined the deaths in their fishing industry and developed many safety standards that have been implemented, including: (*a*) requiring safety training to obtain a commercial fishing licence, (*b*) increasing public awareness programmes targeting high risk fisheries, (*c*) inspecting fishing vessels <15 gross tonnes, and (*d*) requiring the annual submission of self inspection checklists as a prerequisite for licensing fishing vessels. Although rates of nonfatal injuries associated with vessel emergencies and workplace hazards continue to occur at about the same rate as previously, deaths have generally been reduced.[2]

Throughout the 1970s and 1980s, Alaska experienced a boom in its commercial fishing industry. By the mid-1980s, it had become clear that deaths related to commercial fishing were the principal category in Alaska's very high occupational death rate.[7] Alaska had the highest state specific occupational death rate in the 10 year period 1980–9, 34.8 deaths/100 000 workers/year, nearly five times the annual average for the entire United States (7.0/100 000).[8] During 1982–7, more than 20 commercial fishing deaths a year occurred in Alaska, versus a mean national annual total of 108 deaths in the commercial fishing industry.[2] Another study identified 31 deaths among Alaskan fishermen a year during 1980–8.[9] The hazards of commercial fishing captured the attention of the United States Congress and led to the enactment of the Commercial Fishing Industry Vessel Safety Act of 1988. During 1990–5, the Commercial Fishing Industry Vessel Safety Act of 1988 required fishing vessels to begin carrying specific safety, survival, and fire fighting equipment, and required crew members to train in first aid and emergency drill.

Methods

In 1991, we established comprehensive surveillance for commercial fishing deaths in Alaska with United States Coast Guards (USCG) reports, our own on site investigations and interviews of survivors, National

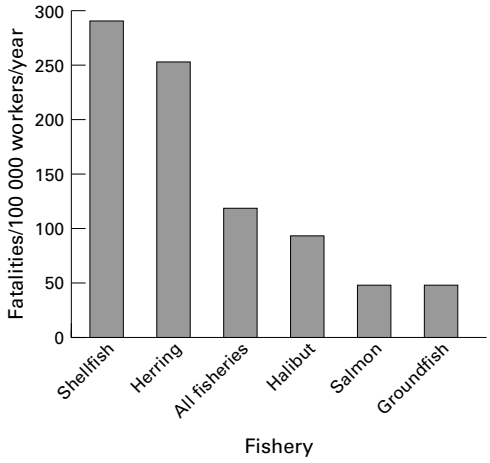

Figure 1 Commercial fishing death rates by fishery: Alaska, 1991–8.

Transportation Safety Board (NTSB) preliminary and final investigative reports, Alaska State Trooper reports, medical examiner reports, death certificates, and local news media reports. We collected and analysed information on deaths related to fishing that occurred from 1991 to 1998, including vessel location, fishery in which the vessel was operating, circumstances, demographic information for victims, and survival equipment used. Death rates were classified as being either vessel related events (capsisings, sinkings, or missing vessels), falls overboard, diving related deaths, or deck injuries—for example, being crushed by crab pots or falling through hatchways. Deaths were calculated for each type of fishery by estimating its workforce at the time of the fatal event.[10 11] Cross tabular and statistical analyses for trend were conducted with *Paradox* (version 7 (computer program), windows version. Borland, 1995) and *Epi-Info* (version 6 (computer program), MS-DOS version, Atlanta (GA) Centers for Disease Control and Prevention, 1994) analytical software.

Results

From 1991 to 1998, 522 occupational deaths occurred in Alaska. Commercial fishermen made up 162 (31%) of these deaths. Given the mean full time equivalent for the Alaska commercial fishing workforce of 17 400,[1] this is equivalent to a rate of 116/100 000 worker deaths/year. This death rate has decreased since that of 1991–2 (200/100 000/year), however, it is still 26 times the overall United States occupational death rate of 4.4/100 000/year.[12]

The death rates among fishermen varied considerably by type of fishery: shellfish (primarily crab) had the highest (275/100 000/year), then herring (250/100 000/year), and halibut (92/100 000/year, fig 1). Fisheries differ in geographic location of fishing grounds, 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 rough weather. Also, the equipment used in crabbing includes large steel cages (pots), each of which weighs up to 800 pounds (empty).

Table 1 Use of personal flotation device (PFD) among victims and survivors involved in vessels capsising or sinking, Alaska 1991–8, n=93

	Victims	*Survivors*	*Total*
Wearing PFD	14	32	46
Not wearing PFD	36	11	47
Total	50	43	93

Odds ratio (95% CI)=7.5 (2.7 to 21.12).

Most deaths related to fishing occur during the months when the greatest number of fishermen are working, particularly in near shore fisheries—for example, salmon and herring—April to September (84, 52%). There is also a peak in reported deaths in the period November to February (66, 41%), when winter crab fisheries open in the Bering Sea. Over half of all reported deaths related to fishing (103, 64%) occurred in the Bering Sea, Aleutian/Pribilof, or southeast Alaska areas.

Most (142, 88%) of the fishermen who died drowned or died from hypothermia, the result of vessel related events (101, 71%), falls overboard (33, 23%), diving incidents (5, 4%), or another event (3, 2%). Other deaths were due to deck injuries (15, 9%), or some other event (4, 2%). Of 101 deaths in vessel related events, the largest proportion (45, 45%) of fishermen were participating in the shellfish fishery. Of those falling overboard and drowning, 16 (48%) were also participating in the shellfish fishery. Deaths from falling overboard were categorised by cause of immersion: entanglement in net or line (11, 33%), unobserved fall (victim missing from vessel) (7, 21%), observed fall (9, 27%), or being washed or blown into the water (6, 18%). None of these workers were wearing a personal flotation device.

Of the 50 fishermen who drowned in vessel related events and for whom use of a personal flotation device was available, 36 (72%) were documented not to have been wearing any type of personal flotation device, whereas 14 (28%) were wearing such devices. (For 51 fishermen in vessel related events, it is unknown whether they were wearing any type of personal flotation device.) Thus, odds ratio calculation shows that survivors of these vessel related events in which at least one person drowned were 7.5 times (95% confidence interval (95% CI) 2.72 to 21.12) more likely to have been wearing a personal flotation device than were those who died (table 1).

Forty eight per cent of the fishermen who died in Alaska during 1991–8 were not residents of Alaska for all of the year, but only 33% of the fishing permits and crew licences were sold to non-Alaskan residents. Many vessels and crew members came from Washington, Oregon, and California to fish the rich Alaskan waters during specific seasons.

During 1991–8, in Alaskan crab fisheries, 34 fatal events led to 65 deaths. Of these incidents, 38% (n=13, 65% of deaths) were vessel related; most (62%) of the affected vessels were in heavy weather (winds >25 knots or waves >15 feet). Crabbing is particularly hazardous

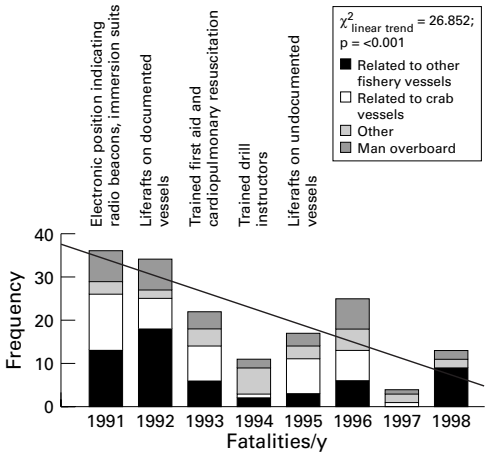

Figure 2 Deaths in commercial fishing and implementation of the Commercial Fishing Industry Vessel Safety Act 1998, Alaska, 1991–8, n=162.

because harvesting of most crab species in Alaska takes place during the winter months due to the biological cycle of the crab. This means fishermen are often operating in conditions of cold air and water temperatures, high winds, snow, sleet, ice, short daylight hours, and high seas.

In Alaska's salmon fishery, 25 fatal events resulted in 28 deaths; 13 incidents (16 deaths) were vessel related. However, most (62%) of the vessels were in moderately calm waters at the time of the incident. Ten of these 28 deaths related to salmon fishing resulted from falls overboard, and 46% of them occurred in calm waters.

In the period 1991–4, 11 people died in six fatal events while halibut fishing in Alaska; all incidents were vessel related and occurred in heavy seas. No deaths have been reported in the halibut fisheries since a change in the management of that fishery in 1995. Until 1995, the halibut fishery had been managed as a "derby style" fishery, working for 24 hour periods on dates established months before and not changeable in response to weather conditions. In 1995 a new fishery management style, individual fishing quotas (IFQs), was implemented for the Alaskan halibut and sablefish (black cod) fisheries, assigning individual catch limits for each vessel. The fishermen now have 8 months to catch their quotas so they can often avoid harsh weather conditions if they choose to do so.

The reduction of deaths related to fishing since 1991 has been associated primarily with events that involve a vessel operating in any type of fishery other than crab (fig 2). It should be noted that in 1994 an anomaly occurred due to a reduction of crab stocks and a closure of the largest (and historically most dangerous) red king crab fishery in Alaska (according to a Fisheries Information Officer, Division of Commercial Fisheries, Alaska Department of Fish and Game, Juneau, Alaska). The processed net weight of crab was down 51% from 1992.[13] No similar resource anomaly occurred in 1997.

Our analysis of USCG vessel casualty statistics for 1991–8 showed that vessels lost have remained relatively constant (mean 35, median 36), as did the number of workers aboard (number of people at risk, mean 106, median 106), whereas remarkable progress has been made in the case death rate (number died/number at risk) in these types of vessel related deaths. This figure has dropped from 27% in 1991 to 7% in 1998 (table 2).

Table 2 Case fatality rate, Alaska commercial fishing industry, 1991–8

Year	*Vessels lost* (n)*	*Onboard* (n)*	*Onboard killed*† (n)*	*Case fatality rate‡ (%)*	*Total fishing fatalities (all causes)§*
1991	39	93	25	27	36
1992	44	113	26	23	35
1993	24	83	14	17	22
1994	36	131	4	3	11
1995	26	106	11	10	18
1996	39	114	13	11	24
1997	31	84	1	1	4
1998	37	124	9	7	13

*†Source: USCG, 17th district, fishing vessel safety coordinator
†χ^2 for linear trend = 33.345; p<0.001.
‡Case fatality rate = (number killed/number at risk) × 100 %.
§χ^2 for linear trend = 26.852; p<0.001.

Discussion

Our surveillance findings for causes of deaths related to fishing parallel those for the Alaska commercial fishing industry reported in previous reports of surveillance data, incident investigations, and survey information collected for 1980–92 by the National Institute for Occupational Safety and Health (NIOSH),[9] USCG,[14] National Research Council (NRC),[2] NTSB,[15] and the University of Alaska.[16] Workers at greatest risk of fatal injuries related to fishing are those who fish for crab aboard unstable vessels. However, our more recent findings show consistent reduction of deaths linked to vessel related emergencies. Please note that there was no loss of life in 1998 due to vessel related incidents in the crab fishery. This frequency pattern could, however, change at any time, or regress toward the historical mean, given the extreme variations in Alaska's climate.

The causative factors for deaths in Alaska associated with commercial fishing are complex (table 3). Gear type, fatigue, and environmental conditions also contribute to

Table 3 Features of commercial fishing injury events, Alaska

	Host or human	*Agent or vehicle*	*Environment*
Before event or injury	Captain and crew fatigue, stress, illegal drugs or alcohol, inadequate training or exposure	Unstable vessel, unstable work platform, complex machinery and operations	High winds, large waves, icing, short daylight, limited fishing seasons, vessels far apart
Event or injury	Captain and crew reaction to emergency, personal flotation device not available or not working	Leaning or capsised vessel, delayed abandonment, emergency circumstance not understood, man overboard	High winds, large waves, darkness, poor radio communications, cold water
After event	Poor use of available emergency equipment, hypothermia, drowning, lost at sea	Vessel sinking, poor crew response to man overboard	High winds, large waves, cold water

*Table 4 Requirements of the Commercial Fishing Industry Vessel Safety Act of 1988 (implemented 1990–5)**

	Host or human	*Agent or vehicle*	*Environment*
Before event or injury	Drills		Navigation publications, compasses, anchors
Event or injury	Radios, immersion suits, personal flotation devices	Fire extinguishers or systems, fireman's outfits or self contained breathing apparatus, high water alarms, bilge pumps or alarms	
After event	Immersion suits, personal flotation devices	Distress signals, life rafts, electronic position indicating radio beacons	First aid kits, cardiopulmonary resuscitation and first aid

*Note emphasis on after incident.

Table 5 Alaska commercial fishing injury countermeasures: proposed by CDC/NIOSH Alaska

	Host or human	*Agent or vehicle*	*Environment*
Before event or injury	Licensing of skipper, increased training on vessel stability, increased drills, develop standard operating procedures for all tasks	Stability and hull integrity, new vessel design standards, reassessment of stability after refitting, machine guarding, retrofitting of sponsons	Evaluate impact of management regimes for fisheries, no sail guidelines due to weather, development or refinement of icing nomograms
Event or injury	Wearing personal flotation devices, man overboard alarms, personal emergency position indicating radio beacons		
After event			

the severity, if not the frequency, of occupational incidents.

The Commercial Fishing Industry Vessel Safety Act of 1988 emphasises the use and availability of safety equipment during and after an emergency incident at sea (table 4). The findings presented here show considerable reductions in deaths in some sectors of this industry, but show persistent problems in other areas. We have recommended augmenting the currently standard approach to minimising the deaths associated with commercial fishing by preventing such emergency incidents in the first place, as well as preparing workers in advance on how to react to such emergencies if they should occur. The critical aetiological factors that must be considered for definitive, primary prevention in this industry are vessel stability and hull integrity to keep vessels afloat, licensing and training of operators and crew to ensure a minimum level of competency, management regimes, avoidance of the most harsh sea and weather conditions, and avoidance of falls overboard (table 5). Our detailed set of recommendations, from which this report derives, has been published elsewhere[17] (a copy of this report can be found on the NIOSH website: www.cdc.gov/niosh/homepage.html).

The impressive progress made during the 1990s in reducing mortality from incidents related to fishing in Alaska has occurred largely by reducing deaths after an event has occurred, primarily by keeping fishermen who have evacuated capsised or sinking vessels afloat and warm (using immersion suits and life rafts), and by being able to locate them readily, through electronic position indicating radio beacons. All of these regulations required by the Commercial Fishing Industry Vessel Safety Act 1988 were implemented in 1990–5.

The interventions implemented over the past decade to prevent loss of life among Alaskan fishermen have been successful. However, the continuing pattern losing 25 to 45 vessels every year and about 100 people who must be rescued each year from cold Alaskan waters is unacceptable. Successful rescue is still dependent on the expertly trained personnel of the USCG search and rescue operations, and such efforts can be hindered by the harshness of seas and the weather.[18] Furthermore, the people involved in USCG search and rescue operations are themselves at considerable risk of injury or death during these rescue attempts.

Effective surveillance and interventions of mortality in Alaska related to commercial fishing, historically the worst in the United States, should provide a useful paradigm and productive venue for prevention of similar deaths throughout the world. The substantial progress made to date in Alaska's most hazardous industry, through the thoughtful application of the public health prevention model, as well as the incorporation of new technologies and comprehensive training, should encourage others to try similar approaches elsewhere and in response to other problems. Building further on the progress already made in preventing deaths in the historically dangerous occupation of fishing could lead to much safer working conditions for commercial fishermen.

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