Commercial Fishing

Working conditions in the commercial fishing industry are very hazardous, compounded in Alaska by isolated fishing grounds, seasonal darkness, cold waters, high winds, icing, and brief fishing seasons. Alaska's commercial fishermen had a high occupational fatality rate of 200/100,000/year for the two-year period 1991-1992.[17] Over 90% of these deaths were from drowning, presumed drowning, or drowning plus hypothermia, in association with vessels capsizing or sinking, or with falls overboard.

Photo 7: Commercial fishermen working in Alaska waters are often exposed to harsh conditions.

Photo 8: An iced-over fishing vessel, Alaska

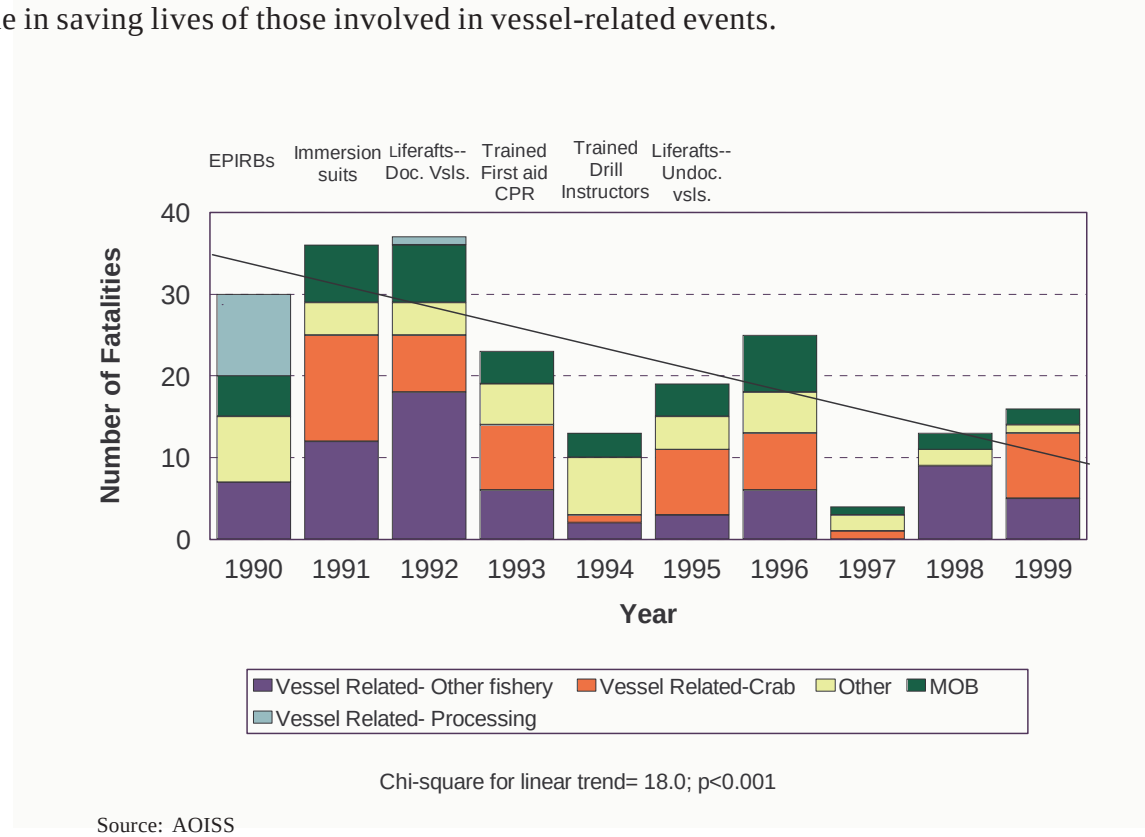
Throughout the 1970s and 1980s, Alaska experienced a boom in its commercial fishing industry. By the mid-1980s, it had become clear that commercial fishing-related deaths were the principal contributor to Alaska's very high occupational fatality rate.[18] In a study published in 1993, researchers found that there were an average of 31 Alaska fisherman deaths per year during 1980-1988.[19]

Photo 9: A partial view of the Port of Kodiak, Alaska

The hazards of commercial fishing captured the attention of the U.S. Congress and led to the enactment of the Commercial Fishing Industry Vessel Safety Act (CFIVSA) of 1988. During 1990-1995, the CFIVSA was implemented incrementally, requiring fishing vessels to begin carrying specific safety, survival, and fire-fighting equipment, and required crew members to obtain first-aid and emergency-drill training. Figure 9 shows the various requirements of the Act, by the individual years of implementation, and demonstrates a concomitant reduction of commercial fishing fatalities with this implementation.

In previous publications, NIOSH had not included floating fish processors in the overall risk factor analysis for commercial fishing. However, to provide a clearer picture of the entire industry, floating fish processor-related fatalities are included in the analysis presented here.

From 1990-1999, Alaska experienced a 49% decline in work-related deaths including a 67% 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 Alaska commercial fishing industry. (See Figure 9.) While man-overboard drownings and vessel-related events in crabbing (often conducted far offshore and in winter) have continued to occur, and still require urgent attention, marked progress (with a significant downward trend, $p <.001$), has been made in saving lives of those involved in vessel-related events.



Source: AOISS

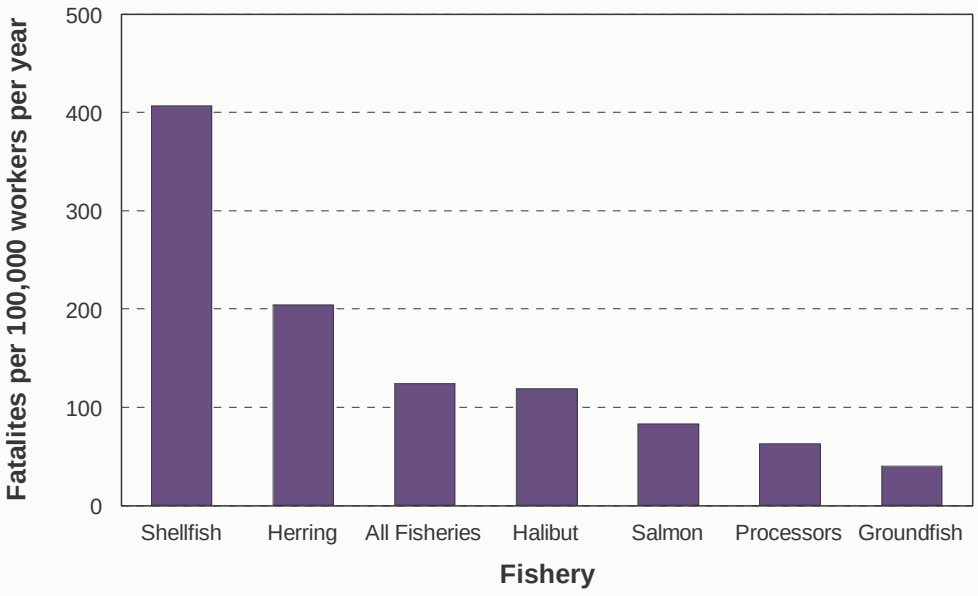
Figure 9: Implementation of the Commercial Fishing Industry Vessel Safety Act of 1988 and Commercial Fishing Fatalities by Year, Alaska, 1990-1999, n=217

Commercial fishermen represented 217 (33%) 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 28 times the overall U.S. occupational fatality rate of 4.4/100,000/year. [5]

The commercial fishing workforce's mean full time equivalent (FTE) does not adequately measure the amount of time an individual fisherman or fish processor spends on the water, and that worker's commensurate risk exposure for drowning. NIOSH's work in determining FTEs included consideration of comparability to commercial fishing FTE rates with other countries and industries. The rates assume that workers are on duty 24 hours a day during the opening of fishing seasons lasting less than 15 days. The rates also credit fishermen with 16-hour work days for seasons that last up to 50 days. However, if a person worked on a vessel for more than 50 days continuously, (i.e., they resided on the vessel), they were only counted as working 8 hours per day. It is important to note that the FTE calculations may not reflect the actual amount of time fishermen spent on the water.

Photo 10: Brailing crab at processing plant.

The fatality rate among fishermen varied considerably by type of fishery: shellfish (primarily crab) had the highest rate (407/100,000/year), followed by herring (204/100,000/year), and halibut (119/100,000/year). (See Figure 10.) 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 the winter, which is often characterized by rough weather.



Source: AOISS

Figure 10: Commercial Fishing Fatality Rates by Fishery, Alaska, 1991-1999

Photo 11: Empty crab pots can weigh up to 800 pounds.

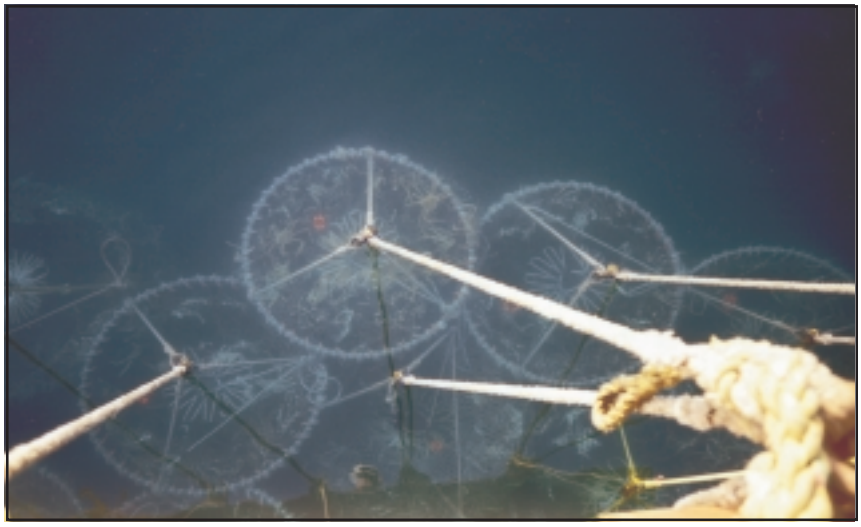


Photo 12: Suspended crab catch.

Most (186, 86%) of the deceased fishermen drowned or died from hypothermia as the result of vessel-related events (133, 72%), falls overboard (43, 23%), diving incidents (5, 3%), or other drowning events (3%). Other fatalities were due to deck injuries (16, 7%), or some other event (15, 7%). Of 133 fatalities in vessel-related events, the largest number (61, 46%) of fishermen were participating in the shellfish fishery. Of those falling overboard and drowning, 22 (51%) were also participating in the shellfish fishery. Fatalities from falling overboard were categorized by cause of immersion: entanglement in net or line (12, 27%), observed fall (12, 27%), unobserved fall (victim missing from vessel) (10, 23%), or being washed or blown into the water (10, 23%). None of the 44 workers who died from falling overboard and drowning were wearing personal flotation devices (PFDs).

Photo 13: A fishing vessel that works in Alaska waters

Of the 133 fishermen who drowned in vessel-related events, information on PFD usage was available for 71—54 (76 %) were not wearing any type of PFD, whereas 17 (24 %) were wearing such devices. (For 62 fishermen in vessel-related events, it is unknown whether they were wearing any type of PFD.) On the other hand, among survivors of such casualties, 34 of 47 were wearing PFDs. Thus, odds ratio calculation shows that survivors of these vessel-related events in which at least one person drowned were 8.3 times (95% CI=3.59-19.24) more likely to have been wearing a PFD than were decedents. (See Table 6.) (For this analysis, immersion suits are included as PFDs.)

Table 6: Personal Flotation Device (PFD) Usage Among Vessel-related Victims and Survivors, Alaska 1990-1999, n=118

	Victims	Survivors	Total
Wearing PFD	17	34	51
Not Wearing PFD	54	13	67
Total	71	47	118

Odds Ratio=8.3 (95% CL=3.6-19.24)

Photo 14: EPIRB, flares and immersion suits on board a commercial fishing vessel.

NIOSH analysis of USCG vessel casualty statistics for 1991 through 1999 revealed that the number of vessels lost per year has remained relatively constant (mean 34, median 36), as did number of workers on board (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% in 1991-1993, to 92% in 1994-1996, and then to an average of 94% from 1997-1999. (See Table 7.) (This information is not available for 1990). These data only represent fatalities due to the loss of a vessel. Therefore, man-overboard (MOB) events, crushings, and fires are not represented.

While mortality in commercial fishing has indeed been reduced, the continuing pattern of losing 25 to 45 vessels every year and approximately 100 persons who must be rescued each year from cold Alaska waters remains problematic. Successful rescue is still dependent on the expertly trained personnel of the USCG Search and Rescue (SAR) operations, and such efforts can be hindered by distance and the harshness of seas and the weather. Furthermore, the workers involved in USCG SAR operations are themselves at considerable risk for injury or death during these rescue attempts.

Table 7: Recent Decrease in Case Fatality Rate, 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: US 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

Surveillance findings for causes of fishing-related fatalities for the Alaska commercial fishing industry parallel those reported in previous surveillance data, incident investigations, and survey information collected for 1980-1992 by NIOSH,[18,19] USCG,[20] NRC,[21] NTSB,[22] and the University of Alaska.[23] Workers at greatest risk for fishing-related fatal injuries are those who fish for crab aboard unstable vessels. However, our more recent findings reveal consistent reduction of fatalities linked to vessel-related emergencies.[24,25]

The causative factors for Alaska commercial fishing-associated fatal and nonfatal injuries are complex. Gear type, fatigue, and environmental conditions also contribute to the severity, if not the frequency, of occupational incidents. (See Table 8.)

Table 8: Features of Commercial Fishing Injury Events in Alaska

	Host/Human	**Agent/Vehicle**	**Environment**
Pre-Event/ Pre-Injury	Captain & crew Fatigue Stress Inadequate training/ exposure	Unstable vessel Unstable work platform Complex machinery and operations	High winds Large waves, icing Short daylight Limited fishing seasons Vessels far apart
Event/Injury	Captain & crew Reaction to emergency PFD not available/ not working	Leaning or capsized vessel Delayed abandonment Emergency circumstance not understood Man overboard (MOB)	High winds Large waves Darkness Poor radio communications Cold water
Post-Event	Poor use of available emergency equipment Hypothermia Drowning Lost at sea	Vessel sinking, Poor crew response to MOB	High winds Large waves Cold water

The impressive progress made during the 1990s in reducing mortality in fishing-related incidents in Alaska has occurred largely post-event, primarily by keeping fishermen who have evacuated capsized or sinking vessels afloat and warm (using immersion suits and life rafts), and by being able to locate them readily, via electronic position indicating radio beacons (EPIRBs). All of these regulations required by the CFIVSA were implemented during 1990 through 1995. (See Table 9.)

Table 9: Alaska Commercial Fishing Injury Countermeasures - Commercial Fishing Industry Vessel Safety Act of 1988 (implemented 1990-1995)

	Host/Human	**Agent/Vehicle**	**Environment**
Pre-event/ Pre-injury	Drills		Navigation publications Compasses Anchors
Event/Injury	Immersion suits PFDs	Fire extinguishers/ systems Firemen's outfits/ SCBAs High water alarms Bilge pumps/alarms	
Post-event	Immersion suits PFDs	Distress signals Life rafts EPIRBs	First-aid kits CPR & first aid

Photo 15: Fishing in Southeast Alaska

The CFIVSA emphasized the use and availability of safety equipment during and after emergencies at sea. The findings presented here show considerable reductions in fatalities in some sectors of this industry, but show persistent problems in other areas and no change in the most severe nonfatal injuries. NIOSH has recommended augmenting the current standard approach to minimizing the deaths associated with commercial fishing by attempting to prevent such emergency incidents in the first place, as well as preparing workers in advance on how to react to emergencies if they should occur.[24,25]One of Alaska's innovative marine safety training programs, conducted by the Alaska Marine Safety Education Association (AMSEA), has effectively prevented fishing-related deaths.[26]

The critical etiologic factors that must be addressed for definitive, primary prevention efforts 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, coordination of management regimes and safety considerations, avoidance of the harshest sea and weather conditions, and avoidance of falls overboard. Special attention should also be given to worker safety around deck machinery, an area that has not been addressed with current regulations. Efforts are underway to concentrate on the relationship between the vessel, fishing equipment and the worker. (See Table 10.)

Table 10: Alaska Commercial Fishing Injury Countermeasures - Proposed by CDC/NIOSH Alaska Field Station

	Host/Human	**Agent/Vehicle**	**Environment**
Pre-event/ Pre-injury	Licensing of skipper Increased training on vessel stability Increased drills	Reassessment of stability after refitting Retrofitting of sponsons Separating lines from workers	Evaluate impact of management regimes for fisheries No-sail guidelines due to weather Development/refinement of icing nomograms
Event/Injury	Wearing personal flotation devices (PFDs) Man overboard (MOB) alarms Personal emergency position indicating radio beacons (EPIRBs)		
Post-event			

Alaska efforts have started to benefit fishermen in other parts of the U.S.: in 1999, the USCG established a "Fishing Vessel Casualty Task Force" to perform a fast track examination of commercial fishing industry operational and safety issues that may have contributed to a recent increase in marine casualties on the east coast of the U.S. A report of their findings was published in April 1999 and included a list of recommendations for the fishing fleet.[27] The task force relied heavily on three earlier government studies including a 1987 report from the NTSB,[22] a 1991 NRC proposal for a national fishing safety program,[21] and a 1997 NIOSH study [24] of Alaska fishing-related deaths.

Several countries have reported similar safety problems with their commercial fishing fleets. Iceland experienced a commercial fishing fatality rate of 89.4/100,000/year from 1966 through 1986.[28] Safety programs implemented by different countries vary, focusing on vessel quality, operator licensure, crew standards, and safety training.[21] In the United Kingdom, comprehensive regulations implemented in 1975 include inspections of fishing vessels, personnel training, staffing and watch-keeping requirements.[21,29] However, more recent research from the United Kingdom shows that vessel casualties are still a major problem. Fatigue is a common theme in UK commercial fishing incidents, so another recommendation calls for a reduction in the numbers of hours worked by the crew.[30]

The Canadian commercial fishing industry operates in cold waters and has fisheries similar to the northern U.S. fishing industry. Canada experienced high mortality rates, 46/100,000/year for the period 1975 through 1983.[31] In the mid-1980s, Canada examined the fatalities in their fishing industry and developed many safety standards that have been implemented, including (a) requiring safety training to obtain a commercial fishing license, (b) increasing public awareness programs targeting high-risk fisheries, (c) inspecting fishing vessels under 15 gross tons, and (d) requiring the annual submission of self-inspection checklists as a prerequisite for vessel fishing licensure. Although rates of nonfatal injuries associated with vessel emergencies and workplace hazards continue to occur at about the same rate as previously occurred, fatalities have generally been reduced.[21]

The USCG has also recently developed a number of innovative programs, including damage control training, vessel risk indexing, and safety checks prior to historically high-risk fishery season openings. Effective surveillance and interventions for commercial fishing-related mortality in Alaska, historically the worst-case setting in the United States, should provide a useful paradigm and productive venue for prevention of similar deaths throughout the world. Using surveillance data as the basis for action, collaborative efforts have been used to continue the progress made in reducing the fatality rate in Alaska's commercial fishing industry since the implementation of the CFIVSA. Although other factors, such as changing fisheries management and climate change, may have contributed to these successes, the strong temporal association between the implementation of the regulations and the fatalities in Alaska's commercial fishing industry are evidence of the effectiveness of a collaborative approach.

The substantial progress made to date in Alaska's most hazardous industry, through the 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.