HHS Public Access

Author manuscript

J Agromedicine. Author manuscript; available in PMC 2023 October 02.

Published in final edited form as:

J Agromedicine. 2023 October ; 28(4): 881–889. doi:10.1080/1059924X.2023.2229827.

Commercial fishing fatalities and injuries described by linked vessel incidents

Laurel Kincl[a,*], **Solaiman Doza**[a], **Jasmine Nahorniak**[b], **Samantha Case**[c], **Amelia Vaughan**[a], **Viktor Bovbjerg**[a]

[a]College of Public Health and Human Sciences, Oregon State University, Corvallis, Oregon;

[b]College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, Oregon;

[c]Western States Division, National Institute for Occupational Safety and Health, Anchorage, Alaska

Abstract

Objectives: The Risk Information System for Commercial Fishing (RISC Fishing) merged information on fishermen and vessel incident types from various databases. This descriptive study examined linked fisherman injury records (fatal and nonfatal) and vessel incident records in Oregon and Washington from 2000 to 2018 in the RISC Fishing database. The circumstances of incidents and any association with fishermen outcomes were explored to identify injury prevention opportunities.

Methods: The statistical analyses included a descriptive study of incidents related to the injury characteristics and frequency of outcomes by incident type. Further analyses included contingency tables and Pearson Chi-Square tests for select variables to determine if there was an association between vessel incident outcomes (fatality, nonfatal injury, no injury).

Results: A total of 375 reported incidents with 93 cases of fatalities, 239 nonfatal injuries and over 6,575 fishermen with no injury were described. Ninety percent of fatalities were due to drowning with only 2% wearing an immersion suit properly. Deckhands experienced fatal and nonfatal injuries most frequently. The most common factors associated with nonfatal injuries included *contact with objects* (event), *walking on vessel and hauling gear* (work activities), and *fractures and open wounds* (nature). The most common final event leading to a vessel disaster with no injury being reported was *sinking* (76%). Distributions between the incident outcomes (fatality, nonfatal injury and no injury) differed by vessel activity/type, fishery/gear, and event leading to the incident.

Conclusion: Linked information of fishermen injury outcomes and vessel incident information showed that events and settings that involve fatalities are qualitatively different from only nonfatal injuries or survivors with no injury. Vessel-level approaches for mitigating fatalities, such as ensuring vessel stability, improving navigation/operation decisions, and spotlighting lifejacket policies/rescue priorities could have a significant impact. Work task-specific prevention strategies for nonfatal injuries related to the larger vessels (catcher/processors and processors) and smaller

*corresponding author: Laurel.Kincl@oregonstate.edu.

vessels (with pot/trap gears) is paramount. The use of information provided in reports when linked can provide a fuller picture with the goal to advance efforts to improve the working conditions of commercial fishermen.

Keywords

Disasters; Drowning; Survivors; Safety; Fishing; workplace injuries

Introduction

Fatal and nonfatal injuries are a preventable burden in the commercial fishing industry. Injuries can devastate the industry, communities, and families with the loss of lives and livelihood through associated disabilities. An initial step to understanding the burden of injury is with the surveillance of commercial fishing incidents and the related injuries. According to the Bureau of Labor Statistics (2021)[1], commercial fishing remains one of the most hazardous industries in the United States (US) based on the high fatality rate. Because of this, the US National Institute for Occupational Safety and Health (NIOSH) has collected incident information in the Commercial Fishing Incident Database (CFID) in cooperation with the US Coast Guard (USCG). CFID data includes information from USCG reports, news reports, police reports and medical examinations.

The CFID system historically has collected vessel disaster and commercial fishermen fatality data and has been used effectively to inform and evaluate safety initiatives[2;3;4;5;6;]; but did not have the capacity to incorporate nonfatal injury information. Previously, nonfatal injury and vessel casualty data were abstracted into separate databases for special projects. As part of a research surveillance project in the Pacific Northwest (PNW), the Risk Information System for Commercial Fishing (RISC Fishing) expanded the CFID scope by modifying the database through the addition of new variables (e.g., injury treatment location) and adding the regional nonfatal information so that PNW fishing incident data were compiled in a single database. RISC Fishing linked information about injuries sustained by commercial fishermen in the fleets that operate in Washington and Oregon from various sources, including USCG reports and state trauma registries[7]. All study activities reported are approved by the Oregon State University Human Research Protection Program and Institutional Review Board and consent was waived (Study protocol: 7633).

Data from the USCG included in RISC Fishing have been periodically abstracted through an existing USCG/NIOSH Memorandum of Understanding to obtain the relevant information about the vessel incident with the incident, vessel, fishermen and injury details. NIOSH research staff accessed the USCG Marine Information for Safety and Law Enforcement (MISLE) electronic system to obtain incident reports (CG-2692 forms) and investigations. The USCG Report of Marine Casualty (CG-2692)[8] is required to be completed when an incident results in any of the following: (1) intentional or unintentional grounding; (2) loss of propulsion or primary steering; (3) loss of seaworthiness or fitness for service; (4) loss of life; (5) injury which requires treatment beyond first aid and renders the individual unfit to perform routine duties; and (6) damage exceeding $25,000. The USCG will directly respond to and/or investigate the reported incident to determine causal factors. This study

includes only the USCG reported data that were abstracted into the RISC system in separate databases for the vessel, fatality, and nonfatal injury information.

Vessel incident types, which could involve some combination of injury events including fatalities, injured fishermen or uninjured survivors, are categorized into the following: vessel casualty, fall overboard, onboard injury/illness, onshore injury/illness, or diving injury/illness. A vessel casualty can be a vessel disaster, which is defined as a sinking or capsizing of the vessel where the crew must abandon the vessel. Not all vessel casualties are disasters, however, and these incidents are defined by consequences resulting from the failure of the vessel short of sinking or abandonment, such as flooding, fire, or loss of steering, power, or propulsion. In connection with a vessel casualty, there may be an accompanying report related to the outcome of the crew, if injured. Case and Lucas (2020)[9] have presented a fuller distinction and discussion related to commercial fishing casualties and disasters.

The fleets in the PNW region include groundfish such as halibut, pollock, sole and black cod; shellfish such as Dungeness crab and shrimp; and pelagic fish such as salmon, sardine, and tuna. Research on injuries in these fisheries has often been limited to fatalities[3,10,11]. Previous research documented the dual burden of both fatal and nonfatal injuries in one commercial fishing fleet operating in the PNW, the Dungeness crab fleet. Case et al.[12], reported 28 fatalities and 45 nonfatal injuries for Dungeness crab fishermen from 2002–2014 abstracted from USCG investigation reports, but did not link the fatal and nonfatal datasets to determine if these injuries were inter-related in any way. For Alaska's fishing industry, Syron et al.[13], linked datasets (the Alaska Trauma Registry, Fishermen's Fund, and USCG investigation reports) to characterize nonfatal injury and illness. The different databases provided unique cases of injury and illness, but the Syron et al.[13] study did not include fatalities.

This paper is the first to report comprehensive injury characteristics of both nonfatal and fatal injuries, as well as documenting the existence of survivors, from information contained in USCG reports on vessel incidents in Oregon and Washington. We explored the differing level of details provided as well as circumstances related to the injury outcomes. By quantifying injury and vessel risks and hazards, we will facilitate commercial fishing safety stakeholders to focus on aspects that are higher risk, more common, or of greater concern.

Methods

Our study examined the linked fatality, nonfatal injury, and vessel casualty CFID incident records in Oregon and Washington during 2000 to 2018. The RISC Fishing database is maintained on a SQL Server Express 2016[14] database and contains injury and vessel incident variables such as date, time, location, injury characteristics, vessel characteristics, and contributing factors. Multiple SQL queries generated the following data tables: (1) commercial fishing incidents with both fatal and nonfatal injuries, (2) commercial fishing incidents with fatalities but no nonfatal cases, and (3) vessel casualty survivors with or without nonfatal injuries during a fatal event. The incident type was included in our SQL queries as it categorized the type of commercial fishing incidents – *vessel casualty,*

fall overboard, onboard injury/illness, onshore injury/illness, and *diving injury/illness*. The *vessel disaster* variable (Yes/No) determined whether the vessel casualty was also a disaster event (e.g., sinking, capsizing). Survivors were recorded in the RISC Fishing dataset during vessel disaster events with fatalities. When fatal or nonfatal injuries were due to other incident types, such as fall overboard or onboard injury/illness events, no survivor information was recorded. To estimate the total survivors in those instances, we subtracted the number of fatalities during the event from the total number of people onboard. For fatal event survivors, we identified the crew who suffered nonfatal injuries by using the nature of injury and incident narrative.

The statistical analyses included a descriptive study of incidents related to the injury characteristics and frequency of outcomes by incident type. We used contingency tables and Pearson Chi-Square tests to determine if there was an association between the three vessel incident outcomes (fatality, nonfatal injury, no injury) and the *vessel activity* (transit, fishing, moored, anchored, unknown), *vessel ty*pe (catcher, catcher/processor, processor, skiff, dive boat), *fishery type* (groundfish, shellfish, pelagic fish, unknown), *gear type* (trawl, pot/trap, troll, seine, longline, gillnet, dive, no fishing gear, unknown), *first event leading to the incident* (flooding, struck rocks/bottom, smoke/fire/explosion, instability, crossing hazardous bars, struck by large wave, unknown) and the *final event of the incident* (sinking, grounded, capsized, unknown). The *first event* and *final event* were recorded for the vessel disasters but not other vessel incidents. The variables in the contingency tables were each reviewed by the category within the variable, which were dropped if there were less than 10 total cases or collapsed if similar, such as classifying set net skiff and other skiff into a combined skiff category. The percent distributions were then reviewed to identify trends in the associations between the vessel incident outcome and variables tested.

Results

From our review of Oregon and Washington incident records during 2000 to 2018 from the RISC Fishing database, there were a total of 375 incidents with 93 cases of fatalities, 239 nonfatal injuries, and over 6,575 non-injured survivors. Of the 375 incidents, 259 incidents had less than 100 crew on board, while 41 incidents had 100 or more crew on board and 75 incidents had no information of the number of crew on board. For the 41 incidents with 100 or more crew on board, which contributed to most of the survivor cases, the number of crew ranged from 100–208 and the vessels were *catcher/processors* (n=33) or *processors* (n=8). Table 1 shows a summary of the crew outcomes of the 375 incidents by fatalities reported (18%), nonfatal injuries reported (56%), and survivors with no reported injuries (26%).

Fatal incidents (n=67)

There was a range of 1–3 fatalities and 0–6 survivors per vessel with a fatal incident, with one outlier. One incident was from a larger vessel with a total of 100 crew with 1 reported onboard fatality, and therefore 99 survivors. Emergency position-indicating radio beacons (EPIRBs) were present in less than half (40%) of the fatal vessel incidents with 16% with no EPIRB recorded and 44% with unknown EPIRB status. EPIRBs are required by the US Coast Guard when off shore more than 3 miles.[16]

No survivors: Eighteen (27%) of the vessels with fatal incidents had no survivors and accounted for 35 out of the 93 fatalities. For these 18 fatal vessel incidents with no survivors, vessel disasters accounted for 14 of the incidents, falls overboard for 2, and one incident each of a diving and an onshore injury/illness.

Fatalities: The remaining 49 vessels with fatal incidents had a total of 58 fatalities and 196 survivors. Of the survivors, there was information reported for 42, an additional 154 with no information were estimated from the number of crew onboard.For the 93 fatalities, drowning was the cause of death for 84 of the fishermen (90% of the fatalities). Of the fishermen who drowned, 4 of the fishermen were reported as wearing an immersion suit at the time of the incident with 2 of them only partially donned (15 were reported as unknown for use of a PFD/immersion suit). Of the 84 fishermen who drowned, 63 were deckhands (75%). Other causes of fatalities included 4 deaths due to blunt force, 3 embolisms (divers),1 asphyxiation and 1 unknown cause.

Nonfatal injuries: Ten crewmembers experienced nonfatal injuries during 9 vessels capsizing. The nonfatal injuries were split between deckhands and owner/operators, with 6 abandoning to the water, 3 to land and 1 evacuated by helicopter. Two of the injured who abandoned to water were unable to enter a life raft but were wearing a PFD, and the others swam to shore. Hypothermia was the most common injury (7 of the 10 injuries).

Nonfatal incidents (n=210)

The majority (77%) of the nonfatal incidents were an onboard injury or illness and the most frequently injured were deckhands (41%) followed by processors (23%). The most common events leading to injuries were contact with another object (45%), the vessel operations/ transportation (21%), and slips, trips and falls (19%). Various work activities were reported at the time of injury. The most common work activities included traffic on board (the fishermen walking or otherwise moving on the vessel) (13%), hauling gear (11%), on watch (10%), processing the catch (9%), handling the gear on deck (7%), or handling frozen fish (7%). The nature of injury included fractures (18%), open wounds (16%), amputations (11%), surface wounds and bruises (11%), and sprains, strains and tears (10%). Using the Maximum Abbreviated Injury Scale (MAIS)[15] the specific injuries were predominately minor (34%) or moderate (35%) with some serious (19%) and relatively few severe/critical (3%). EPIRBs were present in less than half (44%) of the nonfatal vessel incidents with the other half (56%) recorded unknown EPIRB status. For the incidents where the fisherman abandoned to water (n=16), another vessel (n=9) or life raft (n=8), an immersion suit was worn in 14 of the cases, with 12 cases having an unknown use.

Incidents with no fatal/nonfatal injury reported (n=98)

Twenty six percent of incidents reported to the USCG did not have any fatal or nonfatal injuries associated with the event. On these vessels, crew size ranged from 1–7 crew members onboard with a total of 270 crew without sustaining an injury. Ninety four percent of the vessels were catchers, with most being geared with pot/traps (28%), followed by troll (21%), and seine (12%). EPIRBs were present in more than half (51%) of these vessel incidents with the other half (48%) recorded unknown EPIRB status. The precipitating or

initial event reported for the incidents were most commonly flooding (27%) and struck rocks/bottom (22%) while the most common final event was sinking (76%). Most of these vessel incidents used a radio to mayday (60%) followed by a cell phone (12%).

Associations with vessel incident outcomes

All the vessel descriptor and fishing activity variables were significantly associated with the vessel incident outcomes. Table 2 displays the percent distributions of no injury, nonfatal injury and fatality outcomes and Chi-Square results for the variables tested.

For the vessel activity, when the vessel was in transit, fishing or moored, nonfatal injuries predominated, while when the vessel was anchored, there was a more equal distribution between the outcomes. Incidents were most common when in transit (n=141) and when fishing (n=121). For the vessel type, catcher vessels had a higher percentage of nonfatal injury, but for the catcher/processors, and processors the nonfatal injuries accounted for nearly all the reported incidents. Most of the incidents were with the catcher (n=251) and catcher/processor (n=74) vessel types. Dive boats and skiffs had a higher percentage of fatal injuries but had lower numbers of incidents (13 and 14, respectively).

When reviewing the fishery and gear type, groundfish had the most incidents (n=136) and the majority (80%) of the incidents resulted in a nonfatal injury; trawl gear, commonly used to catch groundfish, was the most common gear type in use during incidents. In the case of shellfish and pot/traps, while the highest percentage of injuries are nonfatal, the percentage of fatal incidents is also high (> 20%). For trollers (n=37) the highest percentage of outcomes was no injury. For the dive (n=14) and gillnet (n=16) gear types, fatalities were the most common outcomes. While the fishery and gear type were found to be significantly related (Farrar-Glauber Multicollinearity $X^2 = 14.9$, $p < .001$), both are important to consider. Fisheries management practices and how they would be relevant to safety would be related to the fishery, but the more specific gear type may provide more distinct risk results.

The results of the first event leading to the incident and the final event of the incident were also each associated with the vessel incident outcomes. A significant number of both the first (n=200) and final event (n=196) of the incident were recorded as unknown since this was only recorded in the system for vessel disasters. Therefore, the Chi-Square tests were run for only the vessel disasters (removing all the unknowns) and remained significantly associated. For the first event leading to the incident with the unknowns excluded, crossing the bar and being struck by a wave were associated with a relatively high percentage of fatalities but also of no injury. For the final event of the incident with the unknowns excluded, sinking accounted for the most incidents (n=104) and had a higher percentage of no injury, but capsizing accounted for fewer incidents (n=8) yet 55% of fatalities.

Discussion

This is the first effort to consider multiple outcomes of crew in commercial fishing vessel incidents reported to the US Coast Guard. Using a linked dataset, we identified nonfatal injuries that have occurred in a vessel incident resulting in fatalities. We also identified the reporting of crew with no injury outcomes in these incidents. Importantly, we were

able to explore the factors associated with different injury outcomes. For the survivors counted within this study, there was limited information since most were counted through the number of crew documented in incident reports. It is likely not reasonable to collect detailed information about survivors, but our findings showed that of all the crew included in the incident reports, an estimated 95% were survivors.

For most vessel activities, nonfatal injury incidents predominated. Larger vessels, such as catcher/processor and processors, were least likely to be involved in fatal incidents. The larger vessels have their size and stability in their favor and are usually operated by larger companies. These larger vessels, due to the larger crew size, have more opportunity for isolated injury events. In contrast, the smaller vessels, such as the dive vessels and skiffs, were more likely to be involved in fatal incidents and vessel disasters. The size and stability of the smaller vessels is likely a factor in addition to the fishing activities being conducted. Dive fishing activities occur off the vessel. Although the fleet had a small number of fatalities, embolism was noted as a common cause of death.

The groundfish fishery in the Pacific Northwest encompasses many species including hake, halibut, pollock, cod, and Pacific whiting. Typically trawl fishing is used to catch groundfish and nearly 80% of the vessels in this fleet in our data were catcher/processors and processors. Thus, the pattern of injuries being predominantly nonfatal relative to this fishery/vessel/gear is consistent. Other gear types such as dive and gillnets are also consistent with the fishery/vessel results of fatal injuries representing most of the incidents. Small vessels, such as open skiffs used in set net operations, can be more susceptible to swamping and capsizing from extreme weather and wave conditions. Previous research in Alaska has shown that capsizing skiffs are a major contributor to commercial fishing fatalities[11]. In that study, the researchers also identified Alaska dive fisheries as having one of the highest fleet-specific fatality rates in the U.S. Limited training requirements, lack of inspection requirements for dive gear, and fishery management policies may contribute to the high risk in these fisheries, and there may be commonalities in these risk factors between Alaska and the PNW dive fisheries.

Considering the events leading to the reported vessel disasters, the incidents where the first event was associated with the sea conditions (bar crossings and being struck by a wave) were more likely to result in a fatal incident. This contrasts with events that may not necessarily compromise the entire vessel or occur as rapidly, such as fire or grounding, that typically resulted in no injury or nonfatal injuries. Flooding and vessel instability were associated with several fatal incidents, but the majority of these incidents resulted in no injury. For the final event, capsizing can increase the risk of fatality likely due to the sea conditions and reduced ability to abandon the vessel. Capsizing can occur rapidly when a vessel's stability is affected, which can be due to overloading, uneven loading, structural modifications, slack tank, and hauling heavy gear[3] (e.g., pulling up heavy nets of fish that exceed vessel capabilities). Research on vessel disasters in Alaska[17] showed that vessel instability was the leading initiating event in fatal disasters. Because these events can happen so quickly, there may not be enough time for crew to don immersion suits and abandon the vessel into a life raft.

This descriptive analysis has several limitations. Some variables in the RISC Fishing system that would be relevant to explore the relation with fishermen injury outcomes were not always available in the dataset. For example, *miles from shore* had 46% missing data, *weather-related* had 83% unknown, *wave height* had 61% missing, and *sea state* had 99% missing. Conducting a more rigorous statistical testing of predictors of the fishermen injury outcomes is challenging due to the extent of missing information and the collinearity of the variables. Finally, the abstraction of the incident and fishermen noninjury data is a result of ongoing collaborations, it takes significant effort and resources. This study explored the most recent data available did not include the most recent years. Despite these limitations, this effort successfully identified trends and opportunities for further exploration. Ongoing injury surveillance efforts can help to further future analyses.

Conclusion

This unique look at linked information of fishermen injury outcomes and vessel incident information included in the RISC Fishing system was illuminating. Events and settings that involve fatalities are qualitatively different from those that involve only nonfatal injuries and only survivors. Our findings suggest that different approaches may be needed to prevent fatal and nonfatal injuries. For example, vessel stability and non-slip decking materials may both be important considerations for the different outcomes. Ideally identification of prevention measures which could influence both fatality and nonfatal injury reduction is important, but there will be some divergence. Vessel-level approaches for mitigating fatalities, such as ensuring vessel stability, improving navigation/operation decisions, and spotlighting lifejacket policies and rescue priorities could have a significant impact on reducing vessel disasters and associated deaths in the Pacific Northwest, especially with catcher and skiff vessels. Maintenance and appropriate use of EPIRBS as well as personal locator beacons (PLBs) should be promoted and can be incorporated with other fatality prevention efforts such as lifejacket use. Work task-specific prevention strategies for nonfatal injuries related to the larger vessels (catcher/processors and processors) and smaller vessels (with pot/trap gear) is paramount. Engineering and administrative controls that reduce the risk of injury in processing tasks and fishing tasks may differ. Considering equipment and gear improvements or innovations with fishermen input of the development is key. The use of information provided in reports when linked can provide a fuller picture with the goal to advance efforts to improve the working conditions of commercial fishermen.

Bibliography

1. Bureau of Labor Statistics (2021). News Release of National Census of Fatal Occupational Injuries in 2020. [data file] Retrieved from https://www.bls.gov/iif/oshcfoi1.htm.
2. Lincoln JM, Lucas DL, McKibbin RW, Woodward CC, Bevan JE. Reducing commercial fishing deck hazards with engineering solutions for winch design. J Safety Res. 2008;39(2):231–235. doi:10.1016/j.jsr.2008.02.027 [PubMed: 18454975]
3. Lincoln JM, Lucas DL. Occupational fatalities in the United States commercial fishing industry, 2000–2009. J Agromedicine. 2010;15(4):343–350. doi:10.1080/1059924X.2010.509700 [PubMed: 20954029]
4. Lincoln JM, O'Connor MB, Retzer KD, et al. Occupational fatalities in Alaska: two decades of progress, 1990–1999 and 2000–2009. J Safety Res. 2013;44:105–110. doi:10.1016/j.jsr.2012.08.023 [PubMed: 23398711]

5. Fatal and Nonfatal Injuries Involving Fishing Vessel Winches — Southern Shrimp Fleet, United States, 2000–2011. Accessed September 19, 2022. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6209a1.htm
6. Lucas DL, Kincl LD, Bovbjerg VE, Lincoln JM, Branscum AJ. Work-related traumatic injuries onboard freezer-trawlers and freezer-longliners operating in Alaskan waters during 2001–2012. Am J Ind Med. 2014;57(7):826–836. doi:10.1002/ajim.22310 [PubMed: 24585666]
7. Nahorniak J, Bovbjerg V, Case S, Kincl L. Application of data linkage techniques to Pacific Northwest commercial fishing injury and fatality data. Inj Epidemiol. 2021;8(1):26. doi:10.1186/s40621-021-00323-z [PubMed: 34218819]
8. United States Coast Guard. REPORT of MARINE CASUALTY, COMMERCIAL DIVING CASUALTY, or OCS-RELATED CASUALTY. Accessed September 15, 2022. https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/INV/docs/CG_2692.pdf?ver=2019-07-24-113027-740
9. Case SL, Lucas DL. Predicting commercial fishing vessel disasters through a novel application of the theory of man-made disasters. J Safety Res. 2020;75:51–56. doi:10.1016/j.jsr.2020.07.005 [PubMed: 33334492]
10. Commercial Fishing Fatalities --- California, Oregon, and Washington, 2000--2006. Accessed January 25, 2023. https://www.cdc.gov/MMWr/preview/mmwrhtml/mm5716a2.htm
11. Lucas DL, Case SL. Work-related mortality in the US fishing industry during 2000–2014: New findings based on improved workforce exposure estimates. Am J Ind Med. 2018;61(1):21–31. doi:10.1002/ajim.22761 [PubMed: 28833290]
12. Case S, Bovbjerg V, Lucas D, Syron L, Kincl L. Reported traumatic injuries among West Coast Dungeness crab fishermen, 2002–2014. Int Marit Health. 2015;66(4):207–210. doi:10.5603/IMH.2015.0041 [PubMed: 26726891]
13. Syron LN, Case SL, Lee JR, Lucas DL. Linking Datasets to Characterize Injury and Illness in Alaska's Fishing Industry. J Agromedicine. 2021;26(1):31–44. doi:10.1080/1059924X.2020.1845893 [PubMed: 33146590]
14. Microsoft. SQL Server Express 2016. Microsoft® SQL Server® 2016 Service Pack 2 Express. Accessed October 15, 2022. https://www.microsoft.com/en-us/download/details.aspx?id=56840
15. Abbreviated Injury Scale (AIS). Association for the Advancement of Automotive Medicine. Accessed September 19, 2022. https://www.aaam.org/abbreviated-injury-scale-ais-position-statement/
16. 46 CFR 28.150 -- Emergency Position Indicating Radio Beacons (EPIRBs). Accessed January 25, 2023. https://www.ecfr.gov/current/title-46/chapter-I/subchapter-C/part-28/subpart-B/section-28.150
17. Lucas DL, Case SL, Lincoln JM, Watson JR. Factors associated with crewmember survival of commercial fishing vessel sinkings in Alaska. Saf Sci. 2018;101:190–196. doi:10.1016/j.ssci.2017.09.009 [PubMed: 29861549]

Table 1.

Summary counts of crew injury outcomes for all incidents (n=375) reported to the US Coast Guard occurring in Oregon and Washington from 2000–2018.

Incident	N (%)	Fatalities (n)	Nonfatal Injuries (n)	Survivors with no injury (n)
Fatal Incidents	**67 (18%)**	**93**	**10**	**186** *
Incident type:				
Diving Injury/Illness	*7 (2%)*			
Vessel Casualty	*36 (11%)*			
Fall Overboard	*17 (5%)*			
Onshore Injury/Illness	*3 (<1%)*			
Onboard Injury/Illness	*4(1%)*			
Nonfatal Incidents	**210 (56%)**	**0**	**229**	**6,119** **
Incident type:				
Diving Injury/Illness	*5 (1%)*			
Vessel Casualty	*28 (8%)*			
Fall Overboard	*2 (<1%)*			
Onshore Injury/Illness	-			
Onboard Injury/Illness	*173 (46%)*			
Incidents with no crew fatal/nonfatal injury reported	**98 (26%)**	**0**	**0**	**270** ***
Incident type:				
Diving Injury/Illness	-			
Vessel Casualty	*98 (26%)*			
Fall Overboard	-			
Onshore Injury/Illness	-			
Onboard Injury/Illness	-			
Total	**375 (100%)**	**93**	**239**	**6,575**

* (from 63 vessel incidents with crew information)

** (from 139 vessel incidents with crew information)

*** (all 98 vessel incidents had crew information)

Table 2.

Percent distributions of no injury, nonfatal injury and fatality outcomes for variables tested with Chi-Square. Shades represent the quartiles (lighter with the lowest quartile).

Variable (X^2(1), p)	n	No Injury (row %)	Nonfatal Injury (row %)	Fatal Injury (row %)
Vessel activity (43.5, p< .001)				
Transit	141	40	45	15
Fishing	121	21	54	26
Moored	54	6	85	9
Anchored	10	30	30	40
Unknown	44	23	64	13
Vessel type (119.8, p<.001)				
Catcher	251	37	45	18
Catcher/processor	74	1	96	3
Processor	17	0	100	0
Dive boat	13	8	38	54
Skiff	14	29	0	71
Fishery (69.5, p< .001)				
Groundfish	136	10	80	10
Shellfish	113	23	50	27
Pelagic fish	83	47	34	19
Unknown	43	47	37	16
Gear type (132.6, p< .001)				
Trawl	114	9	85	6
Pot/Trap	95	28	45	26
Troll	37	57	32	11
Seine	25	48	48	4
No fishing gear	19	0	100	0
Longline	18	28	44	28
Dive	14	7	43	50
Gillnet	16	25	13	63
Unknown	34	49	29	23
First event leading to incident - without unknowns (23.5, p=.009)				
Flooding	39	67	8	26
Struck rocks/bottom	33	67	24	9
Smoke/fire/explosion	17	59	41	0
Instability	14	64	7	29
Crossing hazardous bars	13	46	8	46
Struck by large wave	11	55	9	36
Final event leading to incident - without unknowns (21.8, p< .001)				

Variable ($X^2(1)$, p)	n	No Injury (row %)	Nonfatal Injury (row %)	Fatal Injury (row %)
Sinking	104	71	10	19
Grounded	14	54	31	15
Capsized (afloat)	8	36	9	55