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OREGON CRAB FISHING SAFETY ASSESSMENT

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Oregon Crab Fishing Safety Assessment

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Abstract

The Oregon Dungeness crab fishery represents one of the most dangerous work environments in the US, with most fatalities (79%) resulting from capsized vessels while crossing river bars or working near shore. During the period 2003-2009, 14 deaths were recorded. None of the 14 drowning victims were wearing a personal flotation device (PFD) at the time of the incident. A study was conducted to investigate the perceptions and experiences of Oregon Dungeness crab fishermen regarding critical safety issues. The study entailed a dockside survey of crab fishermen in November 2010 in Newport, Oregon, as they prepared for the 2010-2011 season. In addition, five different types of PFDs were distributed to 50 fishermen who completed the dockside survey. These volunteers were asked to complete and return a survey after using the PFD for 30 days. A total of 83 fishermen, including 24 vessel captains, completed the dockside survey and a completed PFD assessment survey was returned by 33 of the fishermen. Overall, PFD use was found to be infrequent, with the majority of respondents indicating a PFD was never routinely worn either crossing the bar, working on deck, or in transit. Just 61 and 54 percent of the respondents indicated they would wear a PFD during an emergency or storm, respectively. Respondents indicated lack of comfort (31%), potential for gear entanglement (31%) and interfering with movement when working (60%) as the primary factors for not wearing a PFD. Respondents' perspectives regarding key safety issues were also insightful. Weather and tide, and to lesser degree economic factors affected a vessel captain's decision to cross a river bar; the following factors were found to be "very important" as indicated by the percentage of total respondents: timing of tides (96%), weather reports (83%) , height of tide (67%), time of season (39%), amount of crab caught (21%), and time since pots last tended (17%). Seventy-five percent of the captains interviewed successfully completed a U.S. Coast Guard (USCG) Commercial Fishing Vessel Safety Exam and had a Vessel Safety Decal affixed to their vessel. The dockside exams were considered to be valuable by 59 percent of the respondents and 72 percent indicated the USCG dockside exams improve safety. Marine safety classes had been completed by 60 percent of the participants, with 86 percent indicating they were valuable. Safety drills were conducted on board according to 72 percent of the respondents, with about one-third indicating drills were conducted once at the beginning of the season and another third indicating drills were conducted a few times each season. Most captains (56%) do not have a stability report for their vessel, although 68 percent of the captains thought stability reports were valuable. Overall, an inflatable vest type PFD received the most favorable comments regarding its comfort and ability to work in. However, each PFD assessed was found to have distinct advantages and disadvantages, an indication that personal preference is an important factor in an individual's selection and subsequent use of a PFD. Based on the study results, additional efforts should be made to encourage PFD use, expand safety training and on board safety drills, and improve understanding of vessel stability.

Introduction

Commercial fishing is one of the deadliest occupations in the United States. In 2010, fishermen and related fishing industry workers had the highest fatality rate of any occupation in the country, despite a reduction in fatalities from 57 deaths in 2009, to 29 deaths in 2010 (US Department of Labor, 2009; US Department of Labor, 2010). The 2010 fatality rate of 116 deaths per 100,000 FTEs is 33 times higher than the general fatality rate for all workers, and nearly 1.3 times greater than logging workers- the second most deadly occupation in 2010 (US Department of Labor, 2010). Data collected during 2000-2009, indicates the fatality rate (310 deaths per 100,000 FTEs) in the Northwest crab fleet is higher than the Bering Sea Aleutian Island crab fleet (260 deaths per 100,000 FTEs) (Lincoln & Lucas, 2008; Lincoln & Lucas, 2010). The Northeast multispecies groundfish fishery had the highest fatality rate during the same time period (600 deaths per 100,000 FTEs); however, the Northwest Dungeness crab, specifically the Oregon Dungeness crab fishery, is uniquely hazardous due to dangerous coastal conditions and workforce and industry characteristics (Lincoln & Lucas, 2010; Hardin & Lawrenson, 2010).

The Oregon Fatality Assessment and Control Evaluation (OR-FACE) program recorded 14 worker fatalities in eight incidents involving crab boats along the Oregon Coast over a seven year period (2003-2009): three of the eight incidents involved a worker falling overboard at sea and the remaining five involved capsized boats while crossing a bar or in the surf near shore (Hammond, Zoller & Rischitelli, 2010). Several risk factors stand out in the Oregon incidents. First, according to OR-FACE research, none of the victims wore a personal flotation device (PFD) or a survival suit when they entered the water. Second, all the capsized crab fishing boats were small vessels (below 79 feet), and four of the five involved vessels under 50 feet long.

Members of the United States Coast Guard (USCG) Commercial Fishing Vessel Safety program also identify specific hazards faced by crews fishing for Dungeness crab in Oregon (Hardin & Lawrenson, 2010). Crab vessels access the ocean by coastal ports that are located on river entrances with hazardous bars. The *bar* is the area where the deep water of the ocean joins shallow river water, which causes wave action to increase. Crab fishing also requires the vessels to travel at low speed, in relatively shallow water along the coast, at times with heavy gear over the sides of the boat or several tons of empty pots on the deck. These features, in addition to the small size of the boats, can make the vessels unstable. In addition, 75 to 80 percent of the season's harvest, which runs from about December 1 through August 14, is caught in the first eight weeks when winter weather along the Oregon Coast is extreme and dangerous, with increasingly fewer operations actively harvesting after the beginning of March when weather improves. However, it should be noted that the Oregon Dungeness crab fishery differs from the Alaska king crab fishery by generally not having the hazard of ice accumulation on the rigging and gear on deck.

Fishing vessels ranging in length from about 30 to 80 feet are typical of most Dungeness crab fishing operations with the smaller vessels operated by a crew of three and larger vessels having a crew of four and sometimes five fishermen. Crabs are caught in cylindrical traps called pots about three feet in diameter and weighing between 60 and 120 pounds. The pots, which are set

at a depth ranging from 30 to 450 feet along a continuous line in a given area, are attached by a line to a buoy that marks the location and owner of the pot. There are no limits to the amount of crab a particular fishing vessel can harvest before the second Monday in June, although there are limits to the number of crab pots that can be carried. In addition, only male crabs larger than 6-1/4 inches measured across the carapace can be taken. This limitation has been sufficient, in the absence of any catch limits, to maintain a sustainable Dungeness crab fishery. In recognition of this, the Oregon Dungeness crab fishery has been designated as being sustainable by the Marine Stewardship Council.

The Oregon Department of Fish and Wildlife allows pots to be set 64 hours prior to the start of the crab season and cannot be harvested until the season officially starts. Once the season begins, fishermen run through a near continuous cycle of pulling, emptying and re-setting pots. A typical operation will have the boat captain trolling the vessel along a line of pots, with one crew member using a hydraulic winch to hoist the pot on board and a second crew member removing the crabs, re-baiting the pot and then setting it back into the water. During the early part of the season, 16 to 20 hour work days are commonplace. Most vessels are equipped with lights allowing for harvesting to continue through the night. A return trip is typically made to port when the hold is full or an impending storm threatens.

Commercial crab fishing in Oregon is a profitable industry, especially relative to the size of the workforce. Based on Oregon Department of Fish and Wildlife data from 2004-2010, it is estimated the average annual value of commercially caught Dungeness crab is approximately $38 million, making it the most valuable 'single-species' fishery in Oregon (http://www.dfw.state.or.us/fish/commercial/#Statistics; http://www.oregondungeness.org/general-info/ODCC_the_fishery.htm). The annual crab harvest ranges from 3.2 to 33 million pounds, with 15.8 million pounds being caught in 2010. Most of the catch is delivered to one of seven ports, with slightly more than a third of the harvest being landed in Newport (Table 1).

Table 1: Oregon Dungeness Crab Landings by Port - 2010

Ocean Ports (North to South)	2010 Catch (millions of pounds)	Landing %
Astoria	3.33	21.1
Garibaldi	0.89	5.6
Newport	5.72	36.1
Winchester Bay	0.16	1.0
Charleston	4.12	26.1
Port Orford	0.35	2.2
Brookings	1.22	7.7
Other	0.04	0.23
Totals	15.83	100.00%

Important aspects of commercial crab fishing are the procedures and practices to both minimize the risk of an accident and to effectively respond to an accident if one unfortunately does occur. A commercial fishing boat at sea faces a number of potential safety hazards including on-board medical emergencies, fires, equipment failure, flooding (from leaks or heavy seas), man

overboard, and capsizing. The captain/owner of a well-run fishing vessel will take time at the beginning of the fishing season, as well as each trip, to ensure their vessel is seaworthy and properly equipped to maximize incident response and reduce the potential for injury. To this end, the USCG has developed a Ready for Sea Checklist (Page, 2000; Appendix A) to help captains to prepare their vessel and crew.

Perhaps the most important component of commercial fishing safety is an understanding of vessel stability with respect to the vessel's operation. Indeed, vessel stability played a prominent role in many of the fatality related capsizings that have occurred in the Oregon Dungeness crab fishery. Of particular importance is how the vessel is loaded, whether carrying fishing gear on the way out to sea, hauling the catch back to port, or fishing operations that introduce a substantial load to the side or port of the ship. Vessels 79 feet or more in length built after 1991, or having undergone a major conversion after September 15, 1991, are required by federal law to have a stability report prepared for their vessel and carry the report on-board. The stability report provides specific guidance on the maximum weight that can be safely carried in various holds, as well as the height gear such as crab pots can be carried on-board. Unfortunately, most of Oregon's commercial crab fishing fleet is not required to have a stability report, and for many vessels, especially those for which architectural drawings are not available, a stability report is cost prohibitive. Despite the lack of a stability report, there are best practices a fishing vessel captain and crew can implement to ensure vessel stability is not compromised.

If an accident occurs at sea, the effectiveness of the ensuing response is dependent on the level of crew training and expertise, and availability of essential safety gear. At the beginning of a fishing season, a vessel operator should not only ensure the vessel's safety gear is in place and fully operational, but also that the crew knows how to properly respond to an accident. To ensure a rapid and effective crew response to an accident, many vessel operators conduct safety drills at the beginning of and during the fishing season. Many crewmembers will also attend a two-day drill conductor training course sponsored by the Alaska Marine Safety Education Association (AMSEA) or North Pacific Fishing Vessel Owner's Association (NPFVOA), the purpose of which is to train crew members on how to conduct emergency response training drills on their vessels. The training addresses a number of topics including making May Day calls, activating the vessel's emergency position-indicating radio beacon (EPIRB), firing a flare, donning a survival suit, responding to an on board fire, man overboard and vessel flooding emergencies, and abandoning ship. In order for the training to be of value, it is imperative that the vessel's crew participates in drills to ensure an efficient and effective response to an emergency situation. A properly trained crew allows the ship captain to oversee and manage the response, as opposed to having to focus on specific details.

Despite the inherent hazards of commercial crab fishing, the USCG currently has minimal regulatory oversight regarding this and other commercial fisheries. Current regulatory authority, a result of the Commercial Fishing Industry Safety Act, passed in 1988, gave the USCG authority to develop and implement basic safety regulations. These regulations largely require certain safety and survival equipment, such as immersion suits, life rafts, signaling devices, fire extinguishers, and EPIRBs, be carried and maintained in proper working function. Onboard examination of stability information is limited to fishing vessels 79 feet or longer in length, constructed or having undergone a major renovation after 1991. Very few, if not none of the

fishing vessels in the Oregon Dungeness crab fishing fleet are 79 feet or longer that were constructed or renovated prior to 1991.

Although there are no inspection requirements for vessels less than 79 feet long or constructed prior to 1991, in 2000, the USCG implemented Operation Safe Crab (Hardin & Lawrenson, 2010), which is a voluntary dockside vessel safety examination program. Operation Safe Crab, conducted at all seven major Oregon commercial crab fishing ports, entails a 15-minute vessel examination of required safety and survival gear, and very cursory assessment of the vessel's stability relative to intended loading. Safety gear is examined to not only ensure it is onboard, but that it is also accessible and in proper operating condition. Assessment of the vessel's stability is largely limited to ensuring there is at least six inches of freeboard (distance between water line and freeboard deck), freeing ports (for draining water on deck) are adequately sized and clear, the vessel's watertight envelope is maintained, and downflooding points (lowest point water can enter ship's watertight envelop) are above 35 degrees.

Operation Safe Crab is a cursory spot check examination that is less rigorous than the USCGs voluntary dockside examination (VDE). Vessels that pass the VDE are issued a USCG Commercial Fishing Vessel (CFV) Safety Decal. In contrast, vessels passing the Operation Safe Crab dockside exam do not receive a CFV Safety Decal, but are given a copy of the examination paperwork as record of passing the Operation Safe Crab exam. Vessels that do not pass this exam are required to address any items identified in the exam before they are allowed to leave port. Although Operation Safe Crab is considered voluntary, vessel operators decline the examination with the understanding they will undergo such an examination after being boarded at sea or may not be allowed to leave the port.

The USCG officer overseeing a port, the Captain of the Port (COTP), has wide ranging authority over the waterway, and can close the bar to incoming and outgoing recreational vessels and vessels carrying passengers if passage is deemed unsafe. This authority does not extend to fishing vessels, although the COTP can advise fishing vessels not to leave the port. The USCG's legal authority to require PFD use for commercial fishermen is limited to Regulated Navigation Areas, which include several Oregon ports with river bar crossings. Fishermen are required to wear a PFD crossing the river bar when a bar crossing restriction is in effect for recreational vessels.

While many studies have been published about the epidemiology of work-related injuries for commercial crab fishermen (Lincoln & Conway, 1999; Lincoln & Lucas, 2008; Lincoln & Lucas, 2010; Lincoln, 2011; Matheson, Morrison, Murphy, Lawrie, Ritchie & Bond, 2001), much less has been documented from their point-of-view regarding the experience of working, and their knowledge and attitudes about work, safety and health. Recent studies, which use survey data collected from groups of fishermen in Maine and the Texas Gulf Coast, highlight the particular risks and safety perceptions of fishermen (Levin, et al, 2010; Davis, 2012). While these studies, in addition to the pivotal fishing studies in Alaska, provide important baseline data, only some of these factors are applicable in Oregon due to the workforce composition, type of fishing being done, and distinctive coastal features of the state. This study, the Oregon Crab Fishing Safety Assessment, incorporates the elements of a health promotion model called "precede-proceed", which involves first identifying a population at risk, then moves through a

process of risk assessment using mixed methods (employing both quantitative and qualitative data) to understand the worker situation and suggest sensible policies and processes, which when implemented may then reduce risk factors and improve well-being (Classen et al, 2007).

Given the exceptionally high fatality rate and unique risk factors among Oregon commercial crab fishermen, the purpose of the study was to survey the fishermen's experiences and views related to five areas of concern: (a) bar crossings, (b) PFD use, (c) vessel stability reports, (d) US Coast Guard dockside examinations, and (e) safety training and readiness. In addition, the study field tested a selection of five PFDs and investigated worker attitudes and risk perceptions. The study design is similar to a study implemented by the NIOSH Alaska Pacific Regional Office in 2010 (Lucas et al, 2012). This project was intended to produce information on the experiences and views of crab fishermen, and also provide a model for the kinds of information, policies, and policy environment involved in commercial crab fishing safety.

Methodology

A crab fishing safety survey was administered over a 2-day period to commercial fishermen on the fishing docks in Newport, Oregon, in late November 2010. The study team chose Newport because it is the most active commercial crab fishing port in Oregon, as measured by the weight of crab (Table 1). At that time, volunteers were solicited to use and assess one of five different PFDs under actual fishing conditions. Mail-in PFD assessment surveys were provided to the volunteers with instructions to complete a survey after one and 30 days of PFD use while crab fishing.

Survey Development

The crab fishing safety survey instrument was devised to solicit information from Oregon crab fishermen regarding their experiences, views, and attitudes to safety training, USCG dockside safety exams, vessel stability reports and the use of personal flotation devices (Appendix B). The survey instrument was based on an instrument developed for a similar study conducted in Alaska (Lucas et al, 2012). The original Alaska survey was revised to reflect safety issues specific to the Oregon crab fishery, such as river bar crossings. The resulting survey included multiple-choice and Likert-scale items for quantitative results, and several open-ended questions and options to comment, which encouraged qualitative responses. The survey consisted of 34 total questions for the crew and an extended survey of 46 questions for the captains. The survey was developed with feedback from the USCG, the Oregon Dungeness Crab Commission (ODCC), and the NIOSH Alaska Pacific Regional Office, and piloted with a small group of crab fishermen.

A second survey instrument, the PFD Assessment, also similar to one used in the Alaska study (Lucas et al, 2012)), was developed to solicit feedback from commercial crab fishermen who volunteered to use a randomly assigned PFD under actual fishing conditions (Appendix C). The PFD assessment queried the participant about the frequency of use under different conditions and also how the PFD performed with respect to a number of questions focusing on comfort and effect on ability to work.

Description of Assessed PFDs

The five PFDs assessed in the study were selected based on feedback from commercial fishermen and the perceived needs of the Oregon Dungenesss crab fishery. An initial, hands-on assessment of 17 PFD types conducted by the USCG at a marine supply store in Newport, Oregon, identified the inflatable vest and inherently buoyant work bib PFDs to be the most popular PFD styles. Based on initial feedback from the Alaska study, other important features for commercial fishermen revolved around comfort and how the PFD affected work. With these factors in mind, the following five PFDs were selected for assessment in this study: Regatta Fishermen bibs, Mustang MD 3188 inflatable work vest, Mustang MD 3025 inflatable belt pack, Kokatat Bahia kayak foam vest ,and Stearns I424 foam vest (Figure 1).

Figure 1: PFDs Assessed by Oregon Crab Fishermen

Regatta Fishermen bibs

Mustang MD 3188

Mustang MD 3025

Kokatat Bahia

Stearns I424

The five PFDs selected for assessment in this study are briefly described in Table 2. The Mustang 3188, Kokatat Bahia and Stearns I424 are all conventional vest type PFDs, with the Kokatat and Stearns models utilizing foam flotation and therefore being inherently buoyant, and the Mustang 3188 providing flotation upon inflation. The foam floatation vests, available for less than $100, are an affordable alternative to the inflatable type PFDs which typically cost close to $300. The Mustang 3188 is inflated by a carbon dioxide cartridge located inside the vest that is manually, or hydrostatically activated, and can also be inflated by breath through a tube. All three of the vest type PFDs have a relatively low profile, an important feature for working on

deck on a commercial crab fishing vessel. The Regatta Fishermen, polyethlylene constructed work bibs, have pieces of foam flotation, about one inch thick, sewn into the front and back of the bib, at chest height. A worker wearing the bibs stays afloat in water, although this PFD is the only one assessed that is not currently USCG approved. The Regatta PFD does however, meet the European standard EN 393 for 50N buoyancy aids. The Mustang MD 3025 is a manually (but not hydrostatically) activated inflatable PFD that is worn as a belt pack on the front of the waist. This device needs to be deployed from the front, after which the inflated vest style PFD is pulled over the neck.

Table 2: Summary of PFDs Assessed

Manufacturer	Model	Description	Weight (lbs)	Cost ($)[a]
Regatta	Fisherman	PVC coated polyester, flotation built into bibs	4.0	$185
Mustang	MD3188	Inflatable vest; hydrostatic/manual activation	2.5	$215
Mustang	MD 3025	Inflatable belt pack; manual activation	1.5	$130
Kokatat	Bahai	Kayak foam vest; low shoulder profile	2.2	$95
Stearns	I424	Vest with mesh on upper half for ventilation	1.2	$45

a - Retail price based on internet search November 2011

Ten PFDs of each type, 50 total, were distributed for trial during the commercial crab fishing season. Both large and extra-large sizes of the Regatta and Stearns PFDs were available for study participants, whereas the other PFDs were only available in a single "adult" or large size. The PFDs assessed in this study were provided by NIOSH as an in-kind contribution.

Survey Implementation and PFD Distribution

Efforts were undertaken to notify crab fishermen of the study in advance and promote the dockside safety survey and PFD assessment. A press release and poster describing the study were developed (Appendix D) and distributed to the Oregon Dungeness Crab Commission (ODCC) and area news outlets. Posters were placed on bulletin boards around the Newport docks and nearby businesses including restaurants and marine supply stores. The posters, and other project information, were also distributed by NIOSH employees at the Pacific Marine Expo held in Seattle in November 2010. Lastly, a project team member attended a two-day Alaska Marine Safety Education Association (AMSEA) sponsored drill conductor training in Newport where the project was announced and participation of the fishermen attending was encouraged.

The crab fishing safety survey was administered to commercial crab fishermen from November 22 through 24 in Newport, Oregon, as the fishermen prepared their vessels for the upcoming fishing season. Vessel captains were approached on the docks, and subsequently informed about the study, and asked if they and their crew could take 10 to 15 minutes to complete the crab fishing safety survey. If desired, the survey was administered orally in a nearby location where confidentiality could be assured.

Upon completion of the dockside survey, crewmembers who completed the dockside survey were invited to participate in the PFD assessment. Captains were not invited to participate in the PFD assessment since they do not typically work on deck. Interested crew members were informed of the study purpose, randomly assigned a PFD and were asked to complete and submit a survey after one and 30 days of PFD use. Each participant tried on their assigned PFD to

ensure it fit and if the PFD did not fit, or a different sized PFD did not fit (Regatta bibs and Stearns vest only), the participant was assigned the next randomly selected PFD. Each PFD study participant received a PFD with an assigned code number, study instructions, two surveys and stamped, addressed envelopes to return the completed surveys. Each participant was asked to provide their telephone number, email and mailing addresses. Participants who did not wish to use the PFD they were randomly assigned were not enrolled in the study.

If no one was present at a vessel, or the captain indicated an interest in conducting the interview at a later time, a "calling card" that described the study and provided a cell phone contact number, was left at the vessel. No remuneration was provided to the study subjects; however, participants in the PFD evaluation were allowed to keep the PFD they were assigned. Plans to administer the survey in Garibaldi, Oregon, on November 24 were canceled due to inclement weather and hazardous traveling conditions. All subject recruitment materials as well as the crab fishing safety and PFD assessment surveys were reviewed and approved by the University of Washington Human Subjects Division and the Oregon Health & Science University Institutional Review Board. Follow-up contacts were made by telephone, one month after the beginning of the crab fishing season (December 12), and if needed, email and US Mail for participants who did not return a PFD assessment survey.

Statistical Analysis

Survey data were entered into a database and assigned codes based on the question number and type of question (e.g., check all that apply). Open-ended questions were entered into the database as they appeared on the questionnaire and codes were assigned when themes became present. To ensure reliable coding, a total of 12 completed survey forms (14.5% of total) were randomly selected for verification. For selected surveys, the response to each question was compared to the resulting entry on a printed copy of the database. A single incorrect entry was found during the audit. Database observations and coding modifications were also discussed and resolved during the audit. STATA version 10 was used to analyze the crab fishing safety survey responses. The PFD assessment survey data was analyzed using SPSS statistical software. Most statistical analyses entailed descriptive statistics. Data regarding the frequency of PFD use, queried in both surveys, was weighted to allow descriptive data to be quantified. The five choices regarding frequency of PFD use were weighted as follows: always = 1; usually = 0.75; about half the time = 0.5; sometimes = 0.25; never = 0. These weightings can be seen as an approximate measure of how often the participant wore the PFD under the prescribed operating conditions. The PFD assessment survey queried the participant to indicate their PFD usage under three distinct operating conditions, crossing river bars, in transit and while working on deck.

Results and Discussion

Dockside Safety Survey

The aim of the dockside safety survey was to solicit Oregon commercial crab fishermen's perceptions of safety risks, and examine their work practices and safety behaviors. The survey included demographic and background questions and questions regarding PFD use and comfort, safety exams and training, bar crossing, and vessel stability. A total of 87 fishermen were asked to participate in the dockside safety survey with 83 of them completing a survey, for a response rate of 95%. The results provide a view of this population's behavior and beliefs relative to critical safety issues.

The first section of the dockside safety survey collected demographic information and results are summarized in Table 3. Crew members account for the majority of total participants (71%). A significant difference in average years of fishing experience exists between captains (24 years) and crewmembers (7 years); however, the age range for captains (19 to 66-years-old) and crewmembers (19 to 61-years-old) is comparable. Most of those surveyed reside in Oregon (86%) and use Newport as their homeport (85%). The participants were given the option to provide the names of ports they use outside of Oregon for crab fishing. Over half (54%) answered this question and listed ports throughout northern California, the entire coast of Washington, and ports along southern Alaska (Appendix E).

Table 3: Demographic Information

Demographic Characteristic[a]		Captain (N=24)	Crew (N=59)	All (N=83)
Position aboard vessel (%)		28.9	71.1	100
Age[b]		48.3 (13.9)	33.1 (10.9)	37.4 (13.6)
Years commercial crab fishing[b]		24.2 (12.2)	7.2 (6.5)	12.1 (11.4)
Home port:	Newport (%)	82.6	86.4	85.3
	Other (%)	17.3	13.5	14.6
Use other ports (Yes) (%)		58.3	51.7	53.6
State of residence:	Oregon (%)	86.9	86.2	86.4
	Alaska (%)	4.3	8.62	7.4
	Other (%)	8.7	5.17	6.1

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.
[b] Values presented as mean (SD).

Characteristics for each vessel, including crab fishing frequency data, were collected from the captains (Table 4); overall, survey data reflects Oregon industry and workforce data (ORFACE, ODCC). Nearly all (91%) of the vessels the captains operate are small (below 79 feet) and the average crew size is 3.5 persons. Each year, the captains devote nearly five months to crab fishing, and actively fish between two and three days per week. The typical duration of a trip lasts roughly three days. The range of pots each vessel carries is large (30 to 500) and less than a quarter (17%) carry 500 pots.

Table 4: Crab Fishing Vessel Characteristics, Mean (SD)

Vessel length (feet)	53.9 (14)
Number of crewmembers	3.5 (0.7)
Number of crab pots carried	203 (157)
Months/year crab fishing	4.8 (2.3)
Trips/week during first 2 months of season	3.3 (1.6)
Trips/week after first 2 months of season	2.3 (1.4)
Typical crab fishing trip duration (days)	3.2 (2.9)

[a] Captain data

Several questions throughout the survey assessed the perception of risk that crab fishermen have regarding work-related hazards (Table 5). Captains' responses (30%) to having fallen overboard were almost double than crewmember responses (17%); suggesting that the probability of falling overboard increases the longer one works in the fishing industry. Data from a 1999 study of the Icelandic fishery supports this hypothesis: accidents involving fishermen are more common the longer they have been on the job, and there is a threefold risk of an occupational fatality if the fisherman has been on the job longer than 10 years (Kristinsson as cited in Petursdottir, Hannibalsson, & Turner, 2001). None of the participants had ever been onboard a vessel that capsized or sank; however, 88 percent of captains and 51 percent of crewmembers have personally known fishermen who have capsized. Almost all of those surveyed believe they either have "a lot" (62%) or "some" (32%) control when it comes to staying alive once a vessel capsizes. Captains tended to have a somewhat even distribution of concern regarding a vessel capsizing, while crewmembers' responses were skewed toward either having "some" (37%) or "not much" (63%) concern. Twenty-two percent of captains had "a lot" of concern about capsizing, while crewmembers only had 3 percent. When asked the open-ended question, "What would increase a fisherman's chance of surviving from a capsized vessel", the most common responses (62 total responses, Appendix E) were safety training (47%), survival gear (32%), and emergency preparedness (11%)

Table 5: Risk Perception (%)

Risk Perception Characteristic[a]	Captain (N=24)	Crew (N=59)	All (N=83)
Fallen overboard (Yes)	29.1	16.9	20.4
Onboard vessel that capsized or sank (Yes)	0	0	0
Know fishermen who have capsized (Yes)	87.5	50.8	61.4
Level of concern regarding vessel capsizing			
A lot	21.7	3.3	8.5
Some	30.4	33.9	32.9
Not much	47.8	62.7	58.5
How much can be done to survive capsizing			
A lot	73.9	57.1	62.0
Some	26.0	33.9	31.6
Not much	0	8.9	6.3

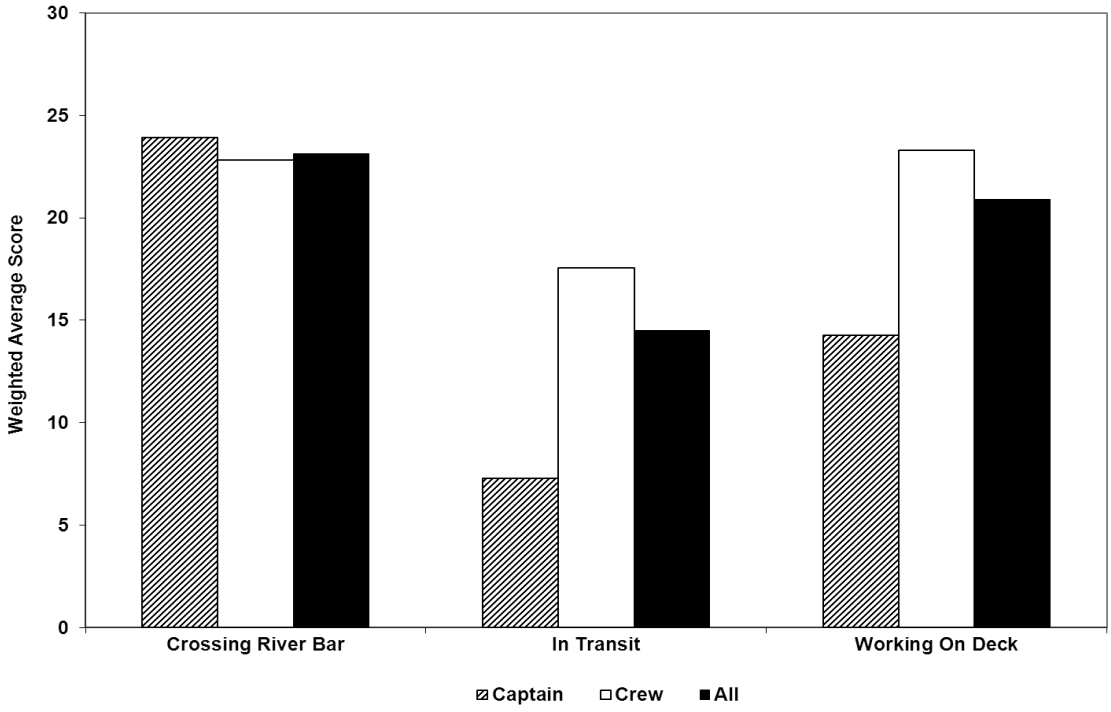
[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.

A set of survey questions sought to determine the types of PFDs worn, as well as the frequency of PFD use under different operating conditions (crossing bar, in transit, and while working on deck). The wording of the initial question, "What type of PFD do you wear out crab fishing", intended to identify the types of PFDs being worn. This question was apparently interpreted

literally as, “What type of PFD do you wear when you are in the act of crab fishing”, versus in transit or rigging gear. Since numerous respondents indicated “none” to this question, but then indicated in subsequent questions that they used a PFD during a specific operating condition. Consequently, respondents that indicated “none” to the initial question, and also indicated they wore a PFD under a specific operating condition, were classified as wearing an “unknown type” PFD. Overall, roughly 28 percent of those who participated in the survey use an “unknown type” of PFD. The remaining participants mostly wore Offshore Inflatable Suspenders (19%) and Type II Buoyant Vests (9%).

A weighted average PFD frequency of use was utilized to better interpret the three questions seeking to determine the frequency of PFD use under different operating conditions. The calculation entailed weighting the five PFD use choices as follows: always = 1; usually = 0.75; about half the time = 0.5; sometimes = 0.25; never = 0. Overall, these weightings can be seen as an approximate measure of how often the participant wore the PFD under the prescribed operating conditions. For example, a weighting of “1” corresponds to using a PFD 100 percent of the time; a weighting of “0.5” corresponds to 50 percent. PFD use is not currently required for crab fishermen, though use is strongly recommended by the USCG during bar crossings or heavy weather. The general frequency of PFD use is noted to be the highest while crossing the river bar and lowest during transit. On average, the crewmembers tended to use their PFDs at a higher relative frequency than the captains; however, the percentages of all those who either, “always” or “usually”, used a PFD while crossing a bar, in transit, and while working on deck were remarkably low- with all responses between 0 and 9 percent (Figure 2).

Figure 2: Frequency of PFD Use Under Different Conditions



In a set of two multiple choice questions, where participants were allowed to check all that apply, the respondents indicated conditions that prompt them to wear and not wear a PFD.

Crewmembers cited "interferes with movement when working" (64%) and "increases risk of entanglement" (32%) as the main conditions that prompt them to not wear a PFD. Captains, however, equally cited "uncomfortable" (50%) and "interferes with movement when working" (50%) as the main conditions that prompt them to not wear a PFD; crewmembers ranked "uncomfortable" (23%) as the third condition to not wear a PFD. Crewmembers and captains have approximately the same distribution within reasons they choose to wear a PFD, and "storm or high seas" (61%) and an "emergency" (54%) rank the highest among the conditions that prompt them to wear a PFD. An open-ended question solicited additional comments about the use of PFDs on crab boats and 45 percent of responses (31 total responses) reflected design and comfort issues addressed in other parts of the survey (Appendix E). A question regarding their willingness to spend certain amounts on a PFD that was comfortable and did not constrain deck operations was asked, and as the price of a PFD increases, the less likely the participants are to purchase one. The $150 price point is noteworthy, as only 39 percent of the captains and 36 percent of the crew would be willing to spend more than this amount for the "ideal" crab fishing PFD.

Table 6: PFD Perceptions and Use (%)

PFD Characteristics[a]	Captain (N=24)	Crew (N=59)	All (N=83)
Type of PFD survey respondents use[b]			
Type I: Offshore jacket	4.17	3.7	3.8
Type I: Inflatable suspenders (offshore)	20.8	18.5	19.2
Type II-IV: Inflatable suspenders (near shore)	0	0	0
Type II: Buoyant vest	4.1	11.1	8.9
Type III: Bladder jacket, other float aid	12.5	5.5	7.6
Type V: Flotation coveralls	0	1.8	1.2
None	0	3.7	2.5
Don't know what type	0	0	0
Other	0	0	0
Unknown type of PFD	45.8	20.3	28.2
Conditions prompting fishermen to wear a PFD[b]			
Storm or high seas	58.3	62.0	60.9
Emergency	58.3	51.7	53.6
When crossing a bar	29.1	20.6	23.1
Darkness	8.3	10.3	9.7
Anytime on deck	4.1	8.6	7.3
Anytime on deck, in transit	4.1	0	1.2
Conditions prompting fishermen to not wear a PFD[b]			
Interferes with movement when working	50.0	64.2	60.0
Uncomfortable	50.0	23.2	31.2
Increases risk of entanglement	29.1	32.1	31.2
Use survival suit instead	29.1	17.8	21.2
Makes fishermen feel foolish	4.1	1.7	2.5
Peer pressure	4.1	0	1.2
Amount fishermen willing to spend on ideal PFD			
$50 - $100	19.0	42.8	36.3
$100 - $150	52.3	21.4	29.8
$150 - $200	19.0	23.2	22.0
$200 - $250	9.5	12.0	11.6

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.

[b] Participants could check all responses that applied. % sums do not total 100.

A series of questions queried the participants regarding their bar crossing experiences during a typical fishing season (Table 7). Captains and crewmembers have similar perceptions about the hazards associated with river bar crossings, with a notable exception: captains are only very concerned about crossing the bar because 17% of them said that more than half of the time they are very concerned because it is treacherous. While 35% of crewmembers stated that they were very concerned under the same conditions. Captains were asked how often they head back early due to concerns regarding bar crossing and they return an average of 6.6 times per season.

Table 7: Bar Crossing Experiences and Perceptions (%)

Bar Crossing Experience During a Typical Crab Fishing Season[a]	Captain (N=24)	Crew (N=59)	All (N=83)
Not very concerned, crossing is routine			
Always	11.1	24.5	21.1
Usually	27.7	30.1	29.5
Half the time	27.7	13.2	16.9
Sometimes	33.3	18.8	22.5
Never	0	13.2	9.8
Concerned, crossing is treacherous			
Always	25	17.6	19.7
Usually	5	3.9	4.2
Half the time	15	19.6	18.3
Sometimes	55	49.0	50.0
Never	0	9.8	7.0
Very concerned, crossing is very treacherous			
Always	11.1	23.4	20.0
Usually	0	6.3	4.6
Half the time	5.5	6.3	6.1
Sometimes	77.7	42.5	52.3
Never	5.5	21.2	16.9
How often during typical season vessel heads back early due to concerns regarding bar crossing[b]	6.6 (3.5)		
More inclined to assume greater risk crossing bar early in season compared to later	70.8 (% of captains surveyed)		

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.

[b] Number of times vessel returned early during a typical fishing season. Values presented as mean (SD).

Captains also provided their rationale for crossing the bar under different circumstances (Table 8). The time of high and low tides (96%), the weather report (83%), and the height of high and low tides (67%), respectively, are all "very important" factors that impact a captain's decision to head out to sea and fish or alternatively, return to port earlier than planned. Economic factors also appear to influence when a captain will cross the bar, since over 70 percent of captains are more inclined to assume greater risk crossing the bar early in the season, compared to later. Additionally, 83 percent indicated time of season was "somewhat" or "very important", 78 percent indicated time since their pots were last tended as "somewhat" or "very important", and 67 percent indicated the amount of crab caught during the season was "somewhat" important or "very important".

Table 8: Importance of Different Factors for Making a Decision to Cross Bar (Captain)

Factor	Not Important	Somewhat Important	Very Important
Weather report	4.1	12.5	83.3
Time of high and low tides	0	4.1	95.8
Height of high and low tides	0	33.6	66.6
USCG closed bar for recreational vessel crossing	25.0	37.5	37.5
Crew concerns	12.5	50.0	37.5
Time of season	17.3	43.4	39.1
Time since pots last tended	21.7	60.8	17.3
Amount of crab caught during season	33.3	45.8	20.8

Several questions investigated the participants' impressions of the USCG Voluntary Dockside Exams (Table 9). Seventy-two percent believe the safety exams improve safety and over half of the respondents agree that they are valuable (59%) and are necessary to ensure safety (56%). As one crewmember indicated, "[USCG dockside safety exams] are great for showing the gear and maintenance" (Appendix E). Three-fourths of the vessels operated by the captains have received a voluntary USCG safety exam, with all of the exams having taken place within the last three years. Fifty-one percent of respondents think that dockside safety exams should be required for all commercial fishing vessels; however, 36 percent believe the exams should still remain voluntary. Once new regulations are promulgated, the Coast Guard Authorization Act of 2010 will require dockside safety examinations at least once every two years for vessels operating beyond 3 nautical miles; voluntary exams will continue to be promoted for vessels operating inside the 3 mile boundary (http://www.gpo.gov/fdsys/pkg/PLAW-111publ281/pdf/PLAW-111publ281.pdf).

Table 9: USCG Dockside Safety Examinations (%)

USCG safety exam characteristics [a]	Captain (N=24)	Crew (N=59)	All (N=83)
Vessel has USCG dockside safety exam decal	75.0		
Year of most recent USCG safety exam			
2010	66.6		
Other	26.6		
Don't know	6.6		
USCG exams improve safety			
Yes	70.8	72.7	72.1
Maybe	16.6	18.1	17.7
No	4.1	0	1.2
Don't know	8.3	9.0	8.8
USCG safety exams voluntary status			
Remain voluntary	54.1	28.3	36.3
Required for vessels with specific problems	4.1	16.9	12.9
Required for all commercial fishing vessels	41.6	54.7	50.6
Impressions regarding USCG safety exams[b]			
Valuable	66.6	56.3	59.4
Necessary to ensure safety	33.3	65.4	55.7
Too much of a hassle	4.1	3.6	3.8
Too expensive	4.1	0	1.2
Unnecessary	0	0	0
Don't know	0	0	0

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses. [b] Participants could check all responses that applied. % sums do not total 100.

Several reputable fishing and marine safety training programs exist and the prices vary from free to $125 per person. The classes are typically promoted and held before the start of the crab fishing season, with a limited number offered throughout the season. Nearly one-half of all crew members and one-fifth of captains have not completed a fishing or marine safety class (Table 10).

Table 10: Safety Training and Readiness (%)

Safety Training Characteristic[a]	Captain (N=24)	Crew (N=59)	All (N=83)
Marine safety class completion (No)	20.8	48.2	40.0
Safety training class sponsor[b]			
AMSEA	33.3	37.5	36.2
NPFVOA	20.8	5.3	10.0
USCG	33.3	10.7	17.5
Other	12.5	8.9	10.0
Year training completed			
2010	11.1	50.0	38.7
2009	44.4	13.6	22.5
2008	0	13.6	9.6
Before 2008	44.4	22.7	29.0
Safety training helps improve crew safety			
Yes	91.3	98.1	96.1
Maybe	8.7	1.8	3.9
No	0	0	0
Safety class impressions[b]			
Valuable	95.6	82.7	86.4
Necessary to ensure safety	34.7	53.4	48.1
Too much of a hassle	0	0	0
Too expensive	0	6.9	4.9
Unnecessary	0	0	0
Fishing vessel crew conducts safety drills			
Yes	95.4	62.5	71.7
No	4.5	16.0	12.8
Don't know	0	21.4	15.3
Safety drill frequency			
Once at beginning of season	33.3	30.5	31.5
Few times each season	33.3	36.1	35.0
Regularly, # times/week[c]	3.1(1.2)	4 (0)	3.5(1)
Prior to each fishing trip	0	2.7	1.7
Don't know	0	13.8	8.7
Familiar with USCG "Ready for Sea" checklist (Yes)	68.1	45.6	51.9
How often is the checklist used			
Once at beginning of season	13.3	23.0	19.5
Few times each season	60.0	34.6	43.9
Regularly, # times/week[c]	0	4 (0)	4 (0)
Prior to each fishing trip	13.3	3.8	7.3
Don't know	13.3	34.6	26.8

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.

[b] Participants could check all responses that applied. % sums do not total 100.

[c] Values are presented as mean (SD).

Of those crewmembers who participated in a safety training program, 38 percent took the class sponsored by the Alaska Marine Safety Education Association (AMSEA) and half reported that their most recent class was in 2010. This result might be possible because AMSEA held training sessions within the same month the dockside safety survey was administered in Newport, OR. Captains' fishing and marine safety training history was not as concentrated as the crewmembers'. The captains' participation was fairly evenly distributed among the three training programs and 89 percent of captains either took the training in 2009 or before 2008. All but three participants believe safety training helps improve crew safety (96%), and that it is valuable (86%) and necessary to ensure safety (48%). 95 percent of the captains report that they conduct onboard safety drills either once or a few times each season (66%). In comparison, 63 percent of crewmembers report that they conduct safety drills either once or a few times each season (67%). The majority of respondents (52%) are familiar with the USCG "Ready for Sea" checklist, which prompts the user to confirm the presence of survival gear, communication equipment, and knowledge of weather and vessel stability conditions; though; over a quarter do not know how often it is used onboard. The remaining majority reports that they use the "Ready for Sea" checklist either once or a few times each season (63%).

Captains were asked their opinions regarding the utility of vessel stability reports and all agreed that stability reports are needed for small boats and 68 percent believe they are valuable (Table 11). Captains, however, also had some critical comments regarding vessel stability reports: 9 percent responded that stability reports need to be easier to understand and 18 percent think the reports need to have clear models to apply to work conditions.

Table 11: Vessel Stability Reports (%)

Vessel Stability Report Characteristic[a]	Captain (N=24)
Use of a stability report	
Vessel has stability report and it's used	30.4
Have report but don't use it	8.7
Vessel doesn't have stability report	56.5
Intend to obtain stability report	8.7
Stability report not technically practical	30.4
Stability report is too expensive	8.7
Don't know	4.3
Stability report impressions (*check all that apply, sum doesn't equal 100*)	
Valuable	68.1
Not valuable	0
Necessary to ensure safety	22.7
Not needed for small vessels	0
Too expensive	4.5
Should be subsidized for small crab boats	27.2
Need to be easier to understand	9.0
Need to have clear models to apply to work conditions	18.1
Don't know	0
Voluntary versus mandatory stability reports	
Required only for crab boats > 79 feet long	17.3
Required only for crab boats > 50 feet long	26.0
Required for all crab boats	26.0
Other	8.7
Don't know	21.7

[a] Values calculated by number (*n*) of respondents answering question. *n* values vary for each question due to missing and invalid responses.

When asked about their actual use of stability reports onboard their vessels, 30 percent of captains have and use a stability report, while 57 percent of vessels do not have a report. 30 percent of captains do not use stability reports because they do not think they are technically practical. Responses regarding mandatory USCG vessel stability report policies were mixed: 26 percent of captains think stability reports should be mandatory for all crab boats; 26 percent of captains think stability reports should be mandatory only for boats longer than 50 feet; and 17 percent of captains think stability reports should be mandatory only for boats longer than 79 feet.

Several open-ended questions regarding weather reports were on the extended dockside safety survey for the captains (Table 12, Appendix E). Captains check weather reports about three times per day and indicate their main sources for receiving weather reports include their onboard VHF radio, TV, or Internet. Most of the respondents obtain weather updates from the National Oceanic and Atmospheric Administration (NOAA)/National Weather Service and the USCG. Feedback on how to improve weather information and reporting mostly yielded responses about increasing the frequency of updates, though, 63 percent indicated weather reports were updated frequently enough when queried again in a close-ended question. All respondents were asked if a live Internet feed weather camera showing conditions at the bar would be useful and 71 percent agreed.

Table 12: Weather Reports (%)

Weather Report Characteristic[a]	Captain (N=24)	Crew (N=59)	All (N=83)
Internet live feed weather camera is useful for showing conditions at the bar (yes)	77.2	68.4	70.8
Frequency of checking weather reports (times/day) [b]	3.1 (1.4)		
Weather reports updated frequently enough?			
Yes	62.5		
No	37.5		

[a] Values are calculated by number (*n*) of respondents who answered question, not total number (N) for the survey. *n* values will vary for each question due to missing and invalid responses.
[b] Values are presented as mean (SD).

PFD Assessment

PFD Assessment Surveys were returned by 33 of the 50 subjects that were assigned PFDs. The lower than anticipated response rate of 66 percent may have resulted from the delayed start to the Oregon Dungeness crab fishing season, which began on December 12, 11 days after the scheduled start. The crab fishing season was delayed as a result of catch pricing negotiations between the crab fishermen and the processors. In recognition of the delayed start, a post card reminder (Appendix D) was sent by US Mail to each of the 50 participants.

A month after the season commenced, efforts were made to contact the study participants by telephone as only five surveys were returned by mail. An electronic version of the survey was sent by email to study participants who had not responded to telephone queries, three months after the season started. Finally, a survey was mailed to study participants who had not responded four months after the season started. Efforts to contact the study participants were discontinued six months after the start of the crab fishing season. Of the 33 responses, 14 were obtained by mail and 19 by telephone. Only five surveys were returned after one day of PFD use and these were considered to be valid. Another five surveys returned as a "one day of use" survey were not considered valid, because they were returned at least 38 days after the beginning of the crab fishing season. Consequently, the 33 surveys received reflect 30 days (or more) of PFD use by the study participants. The number of surveys received for each of the five PFDs assessed were as follows: Regatta bib 7, Mustang inflatable vest 9, Mustang inflatable belt pack 6, Kokatat foam vest 6, Stearns foam vest 5.

Overall, PFD participants had a similar demographic profile as that of the crew members that completed the dockside survey (Table 13). This was an expected outcome as the PFD assessment cohort comprised 56 percent of the dockside survey crew member cohort. Overall, fishermen that participated in the PFD assessment were in their early 30s and had about 7 years of commercial crab fishing experience. About a fifth of the PFD assessment volunteers had fallen overboard at some point in their career and about half of the participants knew fishermen who had been in a vessel that capsized.

Table 13: Demographic Profile of PFD Assessment Participants

Demographic Characteristic	PFD Study Participants (n = 33[a])	Dockside Survey Participants	
		Crew (n = 59)	Captain (n = 24)
Age	32.5 (10.4)	33.1 (10.9)	48.3 (13.9)
Years commercial crab fishing	7.1 (5.9)	7.2 (6.5)	24.2 (12.2)
Vessel length (feet)	54.4 (14.6)	56 (15.9)	53.9 (14.0)
Position aboard vessel	1 captain		
Fallen overboard (yes)	21.2 %	17.0 %	29.2 %
Know fishermen capsized (yes)	45.5 %	50.9 %	87.5 %

a - Cohort includes one fishing vessel captain and 32 crewmembers, all of which are part of the dockside survey cohort

The PFD assessment survey (Appendix C) primarily used closed-ended questions to determine the participant's opinion regarding how comfortable the PFD was to wear and how the PFD affected their work. Closed-ended questions were also used to determine how frequently the participant wore the PFD under three different fishing vessel operating conditions: crossing river

bars, in transit and crab fishing. Lastly, open-ended questions were used to elicit general comments regarding the participant's assigned PFD, as well as how the assigned PFD might be improved, and any features the participant would like to see in an "ideal PFD" for crab fishermen.

Crab fishermen reported varying levels of overall comfort for the five PFDs that were assessed (Table 14). The Mustang inflatable vest had the highest percentage of fishermen reporting that this PFD was comfortable, with none indicating the PFD was uncomfortable. In contrast, 29 percent of the participants using the Regatta bibs thought they were comfortable and 43 percent indicated this PFD was uncomfortable. The level of comfort for the other three PFDs assessed was roughly in between that of the Mustang vest and Regatta bibs, with about a third to half of the participants using these PFDs indicating they were comfortable and about a fifth indicating these three PFDs were uncomfortable.

Table 14: Respondent Assessment of PFD for Overall Comfort

PFD Type	N	Comfortable	Semi-Comfortable	Uncomfortable	Don't Know
Regatta bib	7	28.6	28.6	42.9	0
Mustang vest	9	77.8	22.2	0	0
Mustang belt pack	6	33.3	33.3	16.7	16.7
Kokatat foam vest	6	50.0	33.3	16.7	0
Stearns foam vest	5	60.0	20.0	20.0	0

The survey asked an additional five questions regarding specific comfort attributes that give insight into the participants' assessment of overall comfort (Table 15). With respect to the participants' assessment of weight, tightness, rubbing and bulkiness for the PFDs they used, the Mustang vest had the highest or second highest percentage of fishermen that provided a favorable assessment for these key comfort characteristics. The low comfort rating the study participants assigned to the Regatta bib appears to be a result of the bibs being somewhat tight and bulky and also having a tendency to rub against the skin. The two conventional foam PFDs were both considered to be somewhat bulky by the fishermen that used this device. Half the participants that used the Kokatat PFD found it to be somewhat heavy or very heavy, whereas all of the participants using the Stearns foam vest indicate that they "hardly felt the weight". Interestingly, most participants using the Mustang belt pack felt it was "semi-comfortable" or "uncomfortable", despite the very favorable ratings for weight, tightness and rubbing this PFD received from the participants. Overall, more than 75% of those surveyed indicated that their PFD was comfortable or semi comfortable.

Table 15: Respondent Assessment of Specific PFD Characteristics - Comfort

PFD Weight

PFD Type	N	Hardly Felt Weight	Somewhat Heavy	Very Heavy	Don't Know
Regatta bib	7	71.4	14.3	14.3	0
Mustang vest	9	100	0	0	0
Mustang belt pack	6	83.3	16.7	0	0
Kokatat foam vest	6	50.0	33.3	16.7	0
Stearns foam vest	5	100.0	0	0	0

PFD Tightness

PFD Type	N	Hardly Felt Tight	Somewhat Tight	Very Tight	Don't Know
Regatta bib	7	28.6	57.1	14.3	0
Mustang vest	9	66.7	33.3	0	0
Mustang belt pack	6	100.0	0	0	0
Kokatat foam vest	6	50.0	50.0	0	0
Stearns foam vest	5	20.0	80.0	0	0

Rubbing or Chafing Skin

PFD Type	N	No Rubbing	Rubbed Somewhat	Rubbed a Lot	Don't Know
Regatta bib	7	57.1	14.3	28.6	0
Mustang vest	9	88.9	11.1	0	0
Mustang belt pack	6	83.3	16.7	0	0
Kokatat foam vest	6	83.3	0	16.7	0
Stearns foam vest	5	100.0	0	0	0

PFD Bulkiness

PFD Type	N	Wasn't Bulky	Somewhat Bulky	Very Bulky	Don't Know
Regatta bib	7	14.3	71.4	14.3	0
Mustang vest	9	88.9	11.1	0	0
Mustang belt pack	6	50.0	33.3	16.7	0
Kokatat foam vest	6	0	66.7	33.3	0
Stearns foam vest	5	0	60.0	20.0	20.0

PFD Warmth

PFD Type	N	No Extra Warmth	Somewhat Warm	Lot of Extra Warmth	Don't Know
Regatta bib	7	14.3	28.6	57.1	0
Mustang vest	9	55.6	33.1	11.1	0
Mustang belt pack	6	100.0	0	0	0
Kokatat foam vest	6	16.7	33.3	33.3	16.7
Stearns foam vest	5	40.0	40.0	20.0	0

Considerable variation is noted regarding the participants' impressions of how much warmth their assigned PFD provided. Overall, the results reflect the amount of core insulation the PFD provides, with all of the fishermen that used the belt pack indicating this PFD provided no additional warmth and over 50 percent of the participants who used the Regatta bib indicating this PFD provided a "lot of extra warmth". Of the three conventional vest type PFDs, the Mustang inflatable vest, essentially an empty air bladder, was found by more than 50 percent of the fishermen that used this device to provide no extra warmth; whereas, a comparably larger fraction of the individuals that used the Kokatat and Stearns foam PFDs found these PFDs to be "somewhat warm" and "lot of extra warmth". The level of comfort associated with the amount of insulation or warmth provided by a PFD is relative to the ambient temperature of the work environment and level of physical activity. In cold environments, especially when the level of

physical activity is low, a PFD that provides considerable insulation may be a welcome addition to the clothing being worn. Conversely, a PFD that provides considerable insulation could be a hindrance during warm weather and might not be worn.

The level to which the PFD interferes with work is another important factor regarding the overall usability of a PFD for commercial Dungeness crab fishermen. The participants were asked to indicate the frequency that their assigned PFD interfered with work. Each of the five PFDs assessed were noted to have at least one third of the fishermen indicate that the PFD they used "sometimes" or "very often" interfered with work (Table 16). The Mustang belt pack had the highest percentage of study participants indicating the PFD never interfered with work, only one-third of the respondents indicated it sometimes interferes with work. In contrast, over 70 percent of the fishermen that used the Regatta bib indicated that this PFD sometimes (29%) or very often (43%) interfered with work. A similarly high percentage of the individuals that used the Mustang vest (67%), Kokatat foam vest (83.4%), and Stearns foam vest (60%) also indicated that these PFDs sometimes or very often interfered with work.

Table 16: Respondent Assessment of PFD for Frequency of Interfering With Work

PFD Type	N	Never	Sometimes	Very Often	Don't Know
Regatta bib	7	28.6	28.6	42.9	0
Mustang vest	9	33.3	55.6	11.1	0
Mustang belt pack	6	66.7	33.3	0	0
Kokatat foam vest	6	16.7	66.7	16.7	0
Stearns foam vest	5	40.0	40.0	20.0	0

Several survey questions sought to better define how the PFD interfered with work, with the level at which the PFD limited motion and the frequency of the PFD getting snagged by gear being the most important work interference characteristics (Table 17). Other, less important factors used to assess work interference, included the amount of padding or protection the PFD had and the level of difficulty donning and keeping the PFD clean. All of the field trialed PFDs were found to both restrict movement and get snagged by gear by some of the participants. The Kokatat foam vest had the highest percentage of participants, 83 percent, that found this PFD to be somewhat or very restrictive. Overall, the other four PFDs were reported to be less restrictive with 33 to 60 percent of the participants indicating their assigned PFD was either somewhat or very restrictive. The two Mustang products had the largest percentage of participants (67%) that indicated their assigned PFD sometimes or very often were snagged by gear when working on deck. The other three PFDs were reported by a smaller percentage of the study participants to get snagged by gear, with 50 to 60 percent of the participants assigned to use these PFDs indicating their PFD was never snagged by gear.

Table 17: Respondent Assessment of Specific PFD Characteristics – Ability to Work

Constricted or Limited Motion

PFD Type	N	Free Range Motion	Somewhat Restrictive	Very Restrictive	Don't Know
Regatta bib	7	42.9	42.9	14.3	0
Mustang vest	9	55.6	44.4	0	0
Mustang belt pack	6	66.7	16.7	16.7	0
Kokatat foam vest	6	16.7	50.0	33.3	0
Stearns foam vest	5	40.0	60.0	0	0

How often did PFD get snagged by gear?

PFD Type	N	Never	Sometimes	Very Often	Don't Know
Regatta bib	7	57.1	42.9	0	0
Mustang vest	9	33.3	44.4	22.2	0
Mustang belt pack	6	33.3	50.0	16.7	0
Kokatat foam vest	6	50.0	33.3	16.7	0
Stearns foam vest	5	60.0	20.0	20.0	0

How did you experience the PFD padding/protection?

PFD Type	N	No Extra Padding	Somewhat Padded	A Lot of Padding	Don't Know
Regatta bib	7	0	42.9	57.1	0
Mustang vest	9	44.4	55.6	0	0
Mustang belt pack	6	50.0	33.3	0	16.7
Kokatat foam vest	6	16.7	50.0	33.3	0
Stearns foam vest	5	40.0	40.0	20.0	0

How was it donning the PFD?

PFD Type	N	Easy	Somewhat Difficult	Very Difficult	Don't Know
Regatta bib	7	85.7	14.3	0	0
Mustang vest	9	88.9	0	0	11.1
Mustang belt pack	6	100.0	0	0	0
Kokatat foam vest	6	83.3	16.7	0	0
Stearns foam vest	5	80.0	0	0	20.0

How was it to keep the PFD clean?

PFD Type	N	Very Easy	Somewhat Difficult	Very Difficult	Don't Know
Regatta bib	7	85.7	0	14.3	0
Mustang vest	9	77.8	0	0	22.2
Mustang belt pack	6	83.3	16.7	0	0
Kokatat foam vest	6	66.7	33.3	0	0
Stearns foam vest	5	80.0	20.0	0	0

The provision of padding and protection by a PFD could be considered advantageous for crab fishermen working on deck as the padding would absorb some of the force when handling crab pots, which are carried by resting the pot against the waist. However, too much padding can be cumbersome and restrict movement. The two Mustang inflatable PFDs were found to have less padding than the participants using the other three PFDs. All of the participants using the Regatta bib indicated this PFD was either somewhat padded or had a lot of padding, whereas some of the participants using the Kokatat and Stearns PFDs indicated these PFDs had no extra padding.

Overall, all of the PFDs were found to be easy to don, with a single participant using the Regatta bib and another using Kokatat foam vest indicating these PFDs were somewhat difficult to don. It should be noted that the Mustang belt pack PFD is not actually donned when it is attached to

the waist and that none of the participants assigned to assess this PFD actually wore the belt pack as an inflated PFD. Lastly, most participants found their assigned PFD easy to keep clean, with some of the participants who used the Mustang belt pack, Kokatat foam vest and Stearns foam vest indicating these PFDs were somewhat difficult to keep clean.

Participants were queried as to their overall satisfaction with the wearability of the PFD they were assigned. With the exception of the Kokatat foam vest, more than 50 percent of the fishermen assigned to assess the other four PFDs indicated they were satisfied or very satisfied (Table 18). However, only the Regatta bib and Mustang vest had more than one individual that was very satisfied with their assigned PFD. With the exception of the Mustang vest, for which all participants using this device indicated they were satisfied or very satisfied with the overall wearability of this PFD, some participants for the remaining four PFDs indicated they were neutral or dissatisfied. None of the participants indicated that they were very dissatisfied with the overall wearability of their assigned PFD.

Table 18: Overall Satisfaction of PFD Wearability

PFD type	N	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Overall Score[a]
Regatta bib	7	28.6	28.6	14.3	28.6	0	64.4
Mustang vest	9	55.6	44.4	0	0	0	88.9
Mustang belt pack	6	0	50.0	33.3	16.7	0	58.3
Kokatat foam vest	6	16.7	16.7	33.3	33.3	0	54.2
Stearns foam vest	5	0	80.0	20.0	0	0	70.0

a - Overall score based on a sum of weighting individual ratings as follows: very satisfied, 1.0; satisfied, 0.75; neutral, 0.5; dissatisfied, 0.25

Written comments provided by the PFD assessment study participants (Appendix F), as well as the design of the five PFDs, provide insight as to the participants' ratings for their assigned PFD. The nature of the work performed by crab fishermen, as described in the introduction is another important consideration regarding the impressions of the study participants. Under the arduous, physically demanding, continuous work crab fishermen conduct, light, low profile PFDs that are largely unnoticeable will be favored. This in large part explains the high comfort rating received by the Mustang inflatable vest, which as can be seen in Figure 1, has the lowest profile and is the least intrusive of the PFDs assessed. These observations are supported by the participants' comments, with five of eight respondents providing comments indicating this PFD was either comfortable or that they liked the PFD and would continue to wear it. There were no negative comments for this PFD regarding comfort, nor any recommended changes to improve the PFDs comfort.

Despite the high comfort and overall wearability ratings, a majority of the respondents indicated the Mustang inflatable vest interfered with their ability to work and was snagged by gear. Participant comments provided further insight, with four of eight respondents providing comments indicating that the pull tab for manually inflating the PFD located on the bottom right side of the vest, would get caught on the crab pots. A participant actually indicated that their PFD was accidentally activated after the pull tab was caught on a crab pot. Moving or covering the pull tab was the primary comment for improving this PFD.

The Mustang belt pack, another inflatable PFD, received favorable ratings for the various comfort attributes, although the overall comfort rating for this PFD was mixed. The few

comments received from fishermen that used this PFD indicate that the device was not uncomfortable, but it was not easy to work while it was worn. A participant noted that when worn conventionally in the front, the belt pack was "….right where crab pots rested on my body when moving them". The study participant ameliorated this issue by wearing the belt pack PFD on the back, but noted that the PFD was now in the way in tight spaces. Study participants (2) also indicated that they sometimes wore it under their clothing to keep the hip worn device from getting in the way. It should be noted that wearing the device anywhere but the front, outside of clothing, the location needed to properly deploy and don the PFD, would compromise an individual's ability to use this PFD, especially if they are in heavy seas. The pull-tab for activating this device was also observed to have been caught on fishing gear by two fishermen.

The contrast in the participants' ratings between the Kokatat and Stearns foam vests is interesting given the relative similarity between these two PFDs. Overall, the Stearns received more favorable ratings from the participants than the Kokatat, despite their similarity. The difference in the how these PFDs are rated by the study participants appears to be a result of how they are cut and their resulting profile. The Kokatat, designed for kayakers, is cut higher than the Stearns vest to allow kayakers to sit comfortably inside of a cockpit of their boat. As a result of the higher cut, flotation is placed in the upper chest and shoulder portion of this PFD and the flotation is also noticeably thicker than that of the Stearns. The Stearns PFD, which is designed for industrial use, is longer than the Kokatat allowing for flotation to be placed lower around the waist, thereby eliminating the need for flotation around the upper chest and shoulders. Participant comments support this observation with four of five Kokatat PFD individuals, that provided written comments, indicating the PFD needed to be less bulky and thinner, whereas only one participant that used the Stearns vest mentioned this PFD was bulky. Few comments received for these PFDs specifically addressed any work interference issues, although one respondent suggested that the mesh material used for the upper chest and shoulders of the Stearns PFD should be "….changed as it snags on gear/crab pots".

The Regatta bibs are quite different from the other four PFDs that were assessed in this study as this PFD is an essential piece of gear that has floatation built into it as opposed to a device that is strictly used for flotation. This is an innovative idea that could ensure PFD use, as waterproof, polyurethane constructed bib overalls are typically worn by fishermen, including crab fishermen, to keep dry while working on deck. Given bib overalls are often worn while crab fishermen work on deck, the low comfort ratings for this PFD seem anomalous.

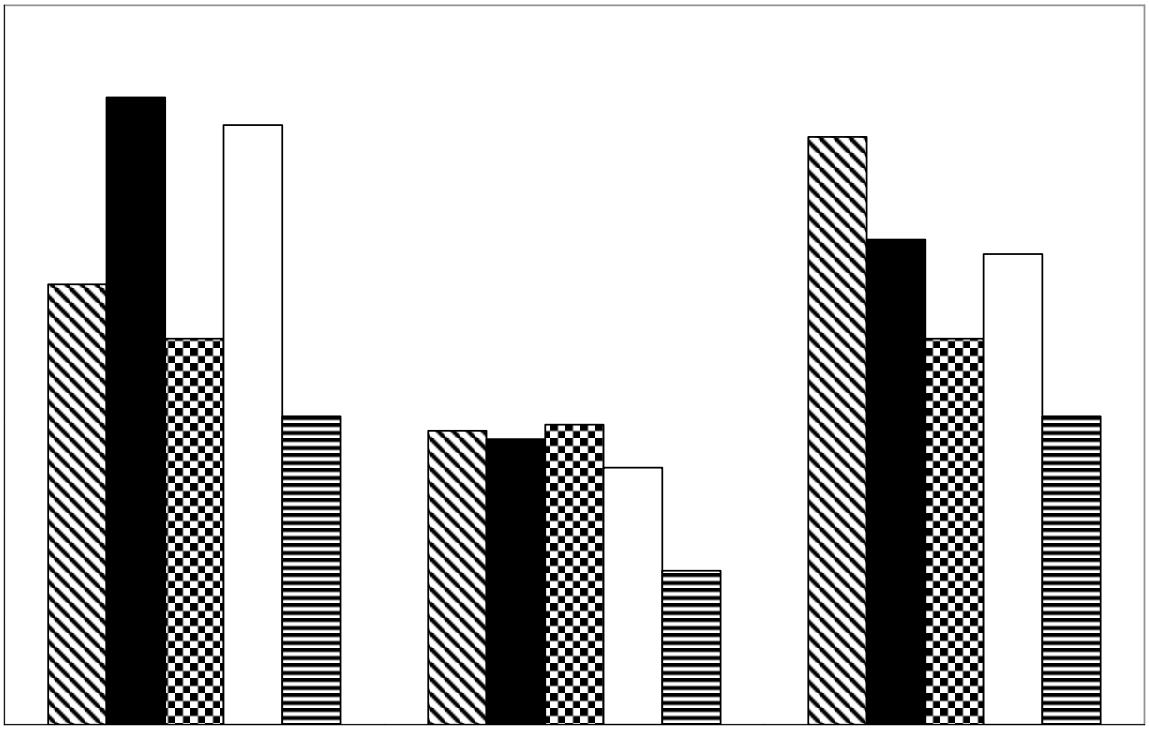
The low comfort ratings provided by fishermen that used this PFD appear to be largely associated with the how the bibs fit, based on comments provided by the study participants. A participant indicated the bib was not cut correctly for their body and that the bibs rubbed and chafed the shoulders, the crotch was cut too short and that the bibs inhibited their mobility. Another respondent indicated that the pants came up too high on the sides, which they found restricting and limited their mobility. Another pair of study participants indicated that their assigned bibs were too large, although one of these individuals gave the PFD high comfort ratings. The study participants who made these comments also made suggestions for addressing these issues such as improve the cut, and cut the pants down the sides. Other individuals (2) suggested that the padding (flotation) be made thinner and less bulky or be replaced with inflatable air bladders. A single respondent indicated that padding on the sides of the legs would

be useful for workers who are leaning on and over the sides of the boat. There were no comments regarding this PFD being snagged by gear.

The fit issue regarding this product is in part due to the bib extending higher across the chest in order to accommodate the rectangular piece of foam flotation. The foam flotation needs to be located in the upper chest area to maintain a high center of gravity to assure upright floatation and is also deemed more comfortable than if the flotation was closer to the waist. This product is also intended for fishing in cold climates as it is sized to accommodate bulky clothing underneath. A vendor of this product indicated that most fishermen notice the bibs fit differently than the type of bibs typically used and that fishermen become accustomed to the different fit.

The PFD assessment survey queried the participant to indicate their PFD usage under three distinct operating conditions: crossing river bars, in transit, and while working on deck (Figure 3). In order to better interpret this information, a weighted average PFD frequency of use was calculated by weighting the five PFD use choices as follows: always = 1; usually = 0.75; about half the time = 0.5; sometimes = 0.25; never = 0. These weightings can be seen as an approximate measure of how often the participant wore the PFD under the prescribed operating conditions.

Figure 3: Frequency of PFD Use Under Different Conditions



The overall frequency of PFD use is noted to be the lowest during transit and approximately the same when crossing the river bar and while working on deck. There is minimal difference

between the reported use of the different PFDs while in transit, with the exception of the Stearns PFD which had a weighted frequency use score that was about one-half that of the other PFDs. Lower PFD use while in transit could be a result of the fishermen being inside the vessel where PFDs are not typically worn.

The Mustang inflatable vest PFD had the highest reported use while crossing river bars, followed closely by the Kokatat PFD. When working on deck, the Regatta bib had the highest reported frequency of use, perhaps reflecting that bibs are an essential piece of gear when working on deck. The Mustang inflatable vest and Kokatat foam vest had similarly high reported use while on deck. The high reported use of the Kokatat PFD both crossing river bars and while working on deck, as compared to the other PFDs, is counter to the low ratings this PFD received. The Stearns PFD consistently had the lowest reported use for all three fishing vessel operating scenarios.

The PFD assessment entailed the distribution of five different types of PFDs to 50 commercial crab fishermen who were asked to complete and return a survey addressing the suitability of the PFD for crab fishing. A total of 33 fishermen completed PFD assessments surveys, with a little over half completing the survey as a phone interview. It should be emphasized that the information obtained in this study represents the opinions of a small number of crab fishermen all working in the same geographic region. Consequently, these opinions may not reflect those of the larger commercial crab fishing community. Nonetheless, the results do present a valuable insight as to the types of PFDs and features that are most desirable for commercial crab fishing.

The survey results, as well as comments received from a survey question that asked "what features you would like to see in an ideal PFD for crab fishermen", provide a basis for identifying suitable PFDs. Clearly, this fishery would like a PFD with a low profile and limited amount of bulk, or as one respondent stated, "something less cumbersome". Mobility while working on deck is critical aspect of commercial crab fishing. Many participants also mentioned the addition of reflector tape and or lights or beacon as being a feature they would like to see in a PFD. None of the study participants expressed any issues or concerns regarding the durability of their assigned PFD, though getting snagged repeatedly would tend to reduce the durability over time.

As a point of discussion, the advantages and disadvantages of each PFD, based on the survey results, are summarized in Table 19 and are discussed in greater detail as follows. The Regatta Fishermen bibs were not as favorably received as the other PFDs with respect to comfort and mobility. This may be a result of the bibs having a higher cut than bibs typically used by Oregon crab fishermen. Furthermore, crab fishing tends to be more physically active than other types of fishing, especially early in the season, which would not favor the Regatta bibs which are overall bulkier than those Oregon crab fishermen typically wear. Fishermen may also have framed their assessment of the Regatta bibs as a replacement for the bibs they currently use, whereas a more valid assessment would have the fishermen comparing the Regatta bibs to wearing the bibs they typically use and a PFD. Cost is another disadvantage of this product as bibs, which only last a season, or less, typically cost about $100, as compared to $185 for the Regatta bibs. The primary advantage of this product is that a fishermen working on deck wearing the Regatta bibs would

always be wearing an inherently buoyant PFD. This PFD was also noted to be the least likely, of those assessed, to get snagged on gear.

Table 19: PFD Assessment Summary

PFD Assessed	Advantages	Disadvantages
Regatta Fisherman bibs	• Inherently buoyant • Gear integrated PFD	• Uncomfortable for some
Mustang inflatable vest	• Low profile • Most comfortable	• Not inherently buoyant • Manual pull tab snags on gear
Mustang belt pack	• Relatively low profile • Suitable for use in wheelhouse	• Not inherently buoyant • Not worn as PFD, need to don • Bulky, interferes with work
Kokatat foam vest	• Inexpensive • Inherently buoyant	• Bulky • Interfered with work
Stearns foam vest	• Inexpensive • Inherently buoyant • Low profile for foam vest	• Somewhat bulky

Overall, the Mustang inflatable vest was regarded as the most favorable of the five PFDs assessed with respect to comfort and how much the PFD interfered with work. Many of the participants did indicate that the tab for manually activating the PFD to inflate did get snagged by gear. The manufacturer of this PFD does manufacture a similar model (Mustang MD2183-22) that has a beaded inflation lanyard located inside the PFD so it doesn't get caught on gear. However, this product is only available to US Coast Guard employees. In addition to the relatively high cost, another disadvantage of this PFD is that it is not inherently buoyant and the system must be in proper working order for the device to inflate and become buoyant.

The Mustang belt pack PFD was found to be comfortable, although fishermen who used this PFD found it did get in the way when working on deck. Another distinct disadvantage of this PFD is that it is not inherently buoyant. This PFD not only requires manual activation of the inflation system, but also needs to be donned. The combination of these tasks could be very difficult in cold, rough seas. An unconscious individual would not be able to deploy or don the PFD. An ideal application for this device would be the ship captain when operating the vessel inside the wheelhouse. As a general operating principle, the ship captain does not wear a PFD while in the wheelhouse as it would make escaping from the wheelhouse in the event of a capsizing very difficult. If a vessel capsizes, a ship captain wearing a Mustang belt pack could deploy the PFD once they are clear of the wheelhouse. As a final point, it is recommended that any fishermen using this device, practice deploying and donning it, preferably in water, prior to wearing it on board.

The Kokatat foam vest was overall the lowest rated PFD of the five PFDs assessed. The low rating for this PFD appears to be largely a result of its bulk and the ancillary effect on mobility. The thickness of this PFD around the chest is especially cumbersome for crab fishermen who are repeatedly moving 90 pound crab traps around the deck as they harvest their traps, re-bait them and set them back in the water. The low cost and inherent buoyancy of this PFD are advantages,

but other foam vest PFDs that are better designed for working, as opposed to water sports, would be better received by commercial fishermen.

The Stearns foam vest, despite being somewhat similar to the Kokatat foam vest, was much more favorably received. The Stearns PFD is noticeably less bulky than the Kokakat PFD using a thinner layer of foam and not placing any foam in the upper chest and shoulder areas. The Stearns PFD in addition to being inherently buoyant, is also the least expensive of the PFDs assessed in this study.

Each PFD assessed was found to have distinct advantages and disadvantages; none of the PFDs assessed were found to be the "perfect crab fishing PFD". The different opinions expressed by the study participants is an indication of personal preference being an important factor in an individual's selection and subsequent use of a PFD. Ideally, crab fishermen would have an opportunity to select the PFD they want to use, preferably after they have tried it under actual fishing conditions.

Study Summary and Recommendations

The primary study aim was to solicit information from commercial Dungeness crab fishermen on their views and experiences, and provide insight about the critical safety issues specific to the Oregon crab fishery, and contribute, with a local perspective, to future prevention-focused safety efforts in Oregon. The survey results clearly indicate that Dungeness crab fishermen are well aware of the risks involved in their livelihood. Additionally, crab fishermen, to varying degrees, make a concerted effort to both prevent fishing related accidents and be adequately prepared to respond to an accident or emergency situation if one occurs. There is some evidence that the degree of awareness and concomitant level of preparation regarding fishing safety has been increasing. Instructors for the AMSEA Drill Conductor Class have indicated that attendance levels have been increasing. In addition, personnel involved in Operation Safe Crab have indicated that the number of vessels that do not pass the dockside safety exam have been declining. Despite the efforts that have been made by the Oregon Dungeness fishery, the Oregon Crab Fishing Safety Assessment identified three important areas where additional efforts should be made: PFD use, safety training and onboard safety drills, and improved understanding of vessel stability. Both the justification for additional effort as well as recommendations for further enhancing these three areas are provided as follows.

PFD Use and Assessment

The dockside survey results indicated that PFD use among the survey participants was relatively low. Based on the weighted average score, fishermen reported that PFDs were worn on average about 30 percent of the time crossing river bars, and about 20 percent of the time during transit and while working on deck. When queried as to the conditions in which the participants would wear a PFD, only 50 and 60 percent indicated they would wear a PFD under emergency and storm/high sea situations, respectively.

The dockside survey results indicate that comfort and work interference are the primary reasons PFDs are not worn. About 30 percent of the participants indicated that they did not wear a PFD while working as it was uncomfortable and also increased the risk of entanglement. Moreover, almost 60 percent of the respondents indicated they did not wear a PFD as it interfered with movement while working. Less than three percent of the respondents indicated they did not wear a PFD due to peer pressure or that wearing a PFD made them look foolish. These results indicate that crab fishermen would be inclined to wear a PFD that was comfortable and didn't interfere with work.

There are basically three types of PFDs available for fishermen, the classic foam vest, inflatable type PFDs and gear integrated flotation that is a component of the outerwear. This study assessed two classic foam vest type PFDs (Stearns and Kokatat), two inflatable PFDs (Mustang vest and belt pack) and a gear integrated PFD (Regatta bibs). Each of these PFD types has distinct advantages and disadvantages. The classic foam vest is inexpensive and very reliable, but is bulkier than inflatable vests. Low profile inflatable PFDs, which are comfortable and easy to work in, are expensive and could fail to inflate as a result of an unseen puncture or malfunctioning inflation device. Gear integrated PFDs can be seen as an ideal solution in that a fisherman is wearing a PFD whenever they use their gear. However, for crab fishermen used to wearing relatively inexpensive low profile bibs, the bulkier Regatta bibs were found to interfere with work. There are many other commercially available PFDs, many that are very similar to those assessed in this study, that might also be compatible for crab fishing. Inflatable suspenders for example, a gear integrated, inflatable device, that was assessed in a similar study conducted in Alaska, may be favorably received by some crab fishermen.

The PFD assessment results confirmed that comfort and compatibility with work are the most important PFD attributes for crab fishermen. Interestingly, all of the PFDs assessed received both favorable and unfavorable comments regarding these attributes, indicating the importance of personal preference. Overall, the Mustang inflatable vest was most favored by the study participants with the primary drawback of this PFD being the tendency of the self-inflation tab to get caught on equipment and the cost. The Regatta bibs were also well received, although many respondents indicated the bibs were not comfortable as a result of the floatation being placed high across the chest of the bibs. The Stearns work vest was much more favorably received than the Kokatat kayak vest, largely a result of the Stearns vest foam floatation being better distributed around the body for working on a crab fishing vessel. It is anticipated that other life vests on the market, that do not place foam flotation around the upper chest and shoulders and also keep the thickness of the foam to a minimum of about an inch, as per the Stearns vest, might also be favorably received. The Mustang belt pack was overall received less favorably by the study participants, largely due to the devices profile when worn on the hip and how it would interfere with work. Another disadvantage to this PFD is that it not only needs to be manually inflated, but also needs to be donned, a difficult task in frigid, stormy sea conditions. The Kokatat kayak vest was the lowest overall rated PFD, as the placement of foam flotation high on the chest interfered with work and was uncomfortable.

Given that most fatalities in the Oregon crab fishery have occurred as a result of rapid capsizings in which the victims did not have time to don a PFD, there is a clear need to encourage greater PFD use in this fishery. Recommendations for encouraging PFD use are summarized as follows.

- ***Establish PFD policy by vessel owner/operator.*** It is recommended that vessel owners and operators develop a formal policy for PFD use on board crab fishing vessels. A formal policy of required personal protective equipment use is very common in land-based manufacturing industries providing both employee expectations and accountability. A PFD policy would establish the conditions under which PFD use by on board personnel is mandatory. Ideally PFDs should be worn whenever an individual is on board a fishing vessel; however, at minimum PFD use should be required when crossing river bars, in rough seas, operating near the coast line and surf breaks, under poor visibility or nighttime conditions, and when working on deck alone.

- ***Provide opportunity for fishermen to try-out PFDs.*** The study results indicate that personal preference is an important consideration regarding PFD selection. Accordingly, there would be some benefit for fishermen to be able to try out different PFDs while they were actually crab fishing. If funding was available, or if manufacturers provided PFDs as an in-kind contribution, a small supply of different PFDs could be purchased and the ODCC or marine supply stores could provide a clearinghouse for the PFDs. Fishermen could sign out a PFD they wanted to try for a several day period. Fishermen could then purchase the PFD that worked best for them.

- ***Develop campaign to encourage PFD use.*** Although PFD use among crab fishermen is encouraged by several groups including, the ODCC, USCG and AMSEA, a formal campaign with the participation and endorsement of stakeholder groups should be considered. Such a campaign could develop outreach materials that establish the need for PFD use, provide information on the types of PFDs that would work best for crab fishermen and locations where the PFDs can be purchased.

Safety Training and Readiness

The survey results demonstrate a critical gap in the number of fishermen who frequently engage in drills and receive training. Almost 70 percent of the participants do not regularly practice onboard safety drills, and nearly half of crewmembers have not received safety training. Data from NIOSH and AMSEA both indicate that frequent onboard drills and safety training are effective in reducing the total number of fishing fatalities (Dzugan, 2010; Lincoln, 2011). Furthermore, the retention of safety knowledge is dependent on the quality and frequency of training. From the survey results, it is difficult to ascertain the reason for the low rates of participation in safety training and onboard drills, because the respondents indicate favorable opinions regarding safety training and crew readiness drills. All but three participants expressed that safety training improves safety, and all but four respondents answered that safety classes are valuable and necessary to ensure safety. Research indicates several possible explanations for low training rates among fishermen. As fishermen gain more work experience, the less likely they are to receive ongoing safety training and voluntary training is not effective unless the individual is personally motivated to attend (Kristinsson as cited in Petursdottir et al, 2001).

The additional measures of safety readiness the survey queried were USCG Voluntary Dockside Examinations (VDE) and the use of the USCG "Ready for Sea" checklist. The survey results

indicate the USCG examined the majority of vessels (74%) in the same year the survey was administered (2010). The favorable views of the VDEs might explain the high rate of participation: over 70 percent of the participants believe VDEs improve safety and all but four participants believe the examinations are valuable and necessary to ensure safety. The regular use of the "Ready for Sea" checklist is low; where over 60 percent of the participants only use it once or a few times a season. The survey did not query the participants regarding their opinion of the effectiveness or quality of the checklist.

It is the responsibility of the captain to ensure their crew has access to high-quality safety training, and that onboard drills are conducted on a regular basis. In addition, in order to promote survival, safety training alone is inadequate unless regular onboard drills are included in the vessel's overall safety program. The survey results demonstrate that considerable efforts have been focused on fatality prevention and safety; though, the results also identify additional areas for improvement. Recommendations for increasing safety training and readiness are summarized as follows.

- ***Promote a culture of safety***. Data suggest that leaders who actively support and talk about safety increase safety compliance and reduce injuries (Barling, Loughlin & Kelloway, 2002; Kelloway, Mullen & Francis L, 2006). Fishing safety initiatives should consider the significant influence that captains have on the overall health and safety of their crew, and encourage them to become involved in implementing and sustaining safety programs on their vessels.

- ***Increase crew participation in safety training classes***. Several reputable fishing and marine safety training programs exist and the prices vary from free to nearly $900. The classes are typically promoted and held before the start of the crab fishing season, with a limited number offered throughout the season. Through personal contact, several crewmembers indicated that their captains require them to take training classes, but overall involvement in training remains voluntary and low. To increase crew participation in safety training classes, it is recommended that all captains encourage their crew to take a safety class and the relevant groups continue their efforts to make the classes accessible and affordable.

- ***Encourage crew involvement in onboard training***. Training programs are likely to be resisted unless implemented with the involvement and support of fishermen (Petursdottir et al, 2001). It is recommended that captains develop their onboard training programs with the feedback from their crew on the types and formats of training they prefer. Crewmembers, who are actively engaged in the decisions that affect their safety and health, benefit the entire ship.

- ***Increase the frequency of safety drills***. As one crewmember indicated in the survey, "Drills, drills, drills!" are essential for fishing safety. Drills are critical for survival because they provide the opportunity for everyone onboard to think about safety on their own vessel, train on the equipment that is available to them, and correct safety issues in advance of an emergency. Drills should be functional, where the fishermen have to demonstrate their competence performing specific tasks, and hands-on, with a focus on personal and crew survival techniques during a vessel capsizing and fall overboard, first aid, and safety

onboard. It is recommended that captains and crewmembers take a drill conductor course and implement drills on their ships on a monthly basis.

- ***Continue to expand the accessibility of safety training information.*** NIOSH, in cooperation with AMSEA and Alaska Sea Grant, developed a man overboard prevention and recovery training video in 2011. This video is available to view at no cost online, and is an example of the kind of high-quality and accessible safety information that can be used to augment onboard training and refresh fishermen's safety knowledge. It is recommended that additional multimedia training materials, of a similar quality as the NIOSH video, are developed and disseminated to fishermen.

Vessel Stability

Overall, the dockside survey results support the need for an increased understanding and awareness of vessel stability among fishing vessel captains. Slightly less than 40 percent of the respondents indicated they possessed a stability report for their vessel with about three quarters of those captains possessing one indicating they actually use the stability report. Although 68 percent of the respondents indicated stability reports were valuable, and none of the respondents thought they were not valuable, 30 percent indicated stability reports were not technically practical. A relatively small fraction of the respondents (8.7%) thought stability reports were not expensive, an apparent anomaly given that the fee for developing a vessel stability report is on the order of $10,000. For many vessels for which architectural drawings are not available, the expense is even greater. It is possible that many vessel captains answering this question were unaware of the cost of a stability report.

Given the lack of fishing vessels that have a stability report, and the likelihood that most smaller vessels will never obtain a stability report due to the expense, additional efforts to improve fishing vessel captain's understanding of vessel stability are warranted. The large number of fatalities associated with vessel capsizings further supports this recommendation. A fishing vessel captain having a functional understanding of their vessel's stability as it relates to outfitting, loading and operating the vessel, is crucial to reducing the potential for capsizing. As follows are some recommendations for improving vessel stability knowledge in the Dungeness crab fishery.

- ***Vessel stability training class.*** Both AMSEA and the NPFVOA currently offer a one-day vessel stability class. In addition, the USCG has 1/16 scale model fishing vessels that are used to demonstrate vessel stability concepts in a portable water tank. The model is currently used in most of the AMSEA Drill Conductor Training Classes conducted in Oregon to briefly introduce concepts such as improper loading and free surface effects. Developing a course specifically for the crab fishermen and other fisheries that use small vessels might be considered. As a model for such a program, the four day stability class developed by Fishsafe, an organization based in British Columbia, might be considered. The USCG 13 District has also developed a more rigorous one-day training program for fishing vessel captains that uses the model, although the class is not currently being offered. Offering this class to small fishing vessel operators, especially those operating vessel without a stability report, should be considered.

- ***Best practice guidelines for crab vessel stability.*** Some vessels that do not have a stability report will post and use a one page "Stability Notice" specific to their vessel, for guidance (see Appendix G for example). The stability notice depicts the effect of loading different holds on vessel stability and also lists several general guidelines for maintaining vessel stability. The development and dissemination of stability notice documents for the types of vessels used in the Oregon crab fishery should be considered.

- ***Develop website for disseminating information.*** A number of documents regarding vessel stability have been developed for the commercial fishing industry. Some are available through the Internet, albeit at different sites. To enhance effective dissemination of this information, the development of a small fishing vessel stability website page might be considered.

- ***Develop campaign to promote vessel stability awareness.*** A common comment made by USCG safety training personnel is the relatively low attendance at many of the safety classes. A campaign for improving vessel stability awareness might be considered as a means of encouraging fishing vessel captains to take a one-day vessel stability class and to review the various documents on vessel stability.

Additional Recommendations

Captains express that ocean conditions greatly influence when they choose to cross a river bar, and acknowledge that crossing the river bars, and extreme coastal weather present unique environmental and occupational hazards for commercial crab fishermen. Research also clearly indicates the dangerous conditions commercial fishermen face. In late November 2008, the OR-FACE program (2011) received notice of the death of two commercial crab fishermen who were killed when their 45-foot-long boat, loaded with 97 crab pots and 400 gallons of fuel, was swamped by large waves while exiting the bar at Tillamook Bay. The boat capsized in the middle of the bar and the two crewmembers, who were not wearing PFDs at the time of the incident, drowned. To prevent similar fatal incidents, recommendations for improving weather and river bar reports follow.

- ***Provide live Internet images of bar conditions***. Presently, the National Weather Service website displays images of the river bars in Oregon (http://www.wrh.noaa.gov/pqr/marine/bars.php). The images are updated throughout the day, but do not provide a live view of the bars. The majority of respondents (71%) agree that a live feed would be useful, and it is recommended that the USCG, or a similarly well-known agency, explore the development of a live Internet feed of bar conditions that also includes the weather forecast and ocean conditions in a text format. Australia currently has a live web-cam of a selection of coastal bars, and other sites, to help boat owners in preparing for a voyage, which Oregon can use as a model for the design and implementation of live feed images of the river bars.

Intervention Implementation Recommendations

Davis (2012) explored the perceptions of occupational risk by US commercial fishermen and suggests that fishermen fail to understand the importance of safety equipment and training in mitigating these risks. The dockside safety survey results, however, illustrate that crab fishermen are aware of hazards specific to their industry and positively view risk prevention strategies and controls, but do not consistently practice safe work behaviors. For example, the frequent use of a PFD under dangerous conditions is remarkably low among both captains and crewmembers (all responses are between 0 and 9 percent) and 48 percent of the crew has not received safety training. Davis (2012) also suggests that fishermen undervalue their true occupational risk, and the dockside survey results are consistent with this finding. Despite over 61 percent of participants personally knowing someone who has been on a vessel that has capsized or sank, 59 percent of respondents are not concerned about capsizing. Furthermore, 94 percent of the participants feel that they can control whether they can survive a capsizing. The dockside safety survey also indicates that external factors influence safety behavior and risk-taking; notably, economic conditions. A 2004 study by Hakan and Martinsson conclude that fishermen are more risk-neutral the higher the fraction of their household's income comes from fishing. The results from the safety survey support this conclusion: 78 percent of captains indicated time since pots last tended as "somewhat/very important", 83 percent indicated time of season as "somewhat/very important", and 67% indicated amount of crab caught during season as "important/very important" as critical factors that influence when they choose to cross the bar.

As with other small industries, the prevention of occupational injuries and fatalities in crab fishing is difficult because of the limited resources devoted to health and safety. Devising an appropriate intervention for crab fishermen is made more difficult by overlapping policy domains. Unlike other Oregon workplaces subject to Oregon OSHA or other state supervision, safety at sea is regulated by the U.S. Coast Guard. Oregon Department of Fish and Wildlife has jurisdiction over harvest rules and fishing permits. Oregon OSHA has a "line on the dock" (as field agents describe it) where jurisdiction ends. Federal OSHA has virtually no presence in Oregon and only theoretical application to ocean fishing vessels, and only where other agency jurisdictions do not apply. As follows are additional recommendations to consider during the design and implementation of a safety intervention in the Oregon Dungeness crab fishery.

- ***Size and location of workforce***. Using the average crew size (3.5/vessel), and percentage of total crab landings in Oregon in 2010, Newport, Charleston, and Astoria, respectively, are estimated as the largest crab ports in Oregon. Also, most (94%) of the study respondents either live in Oregon or Alaska; all use ports along the West Coast, and fish for Dungeness crab out of these ports roughly five months per year. While this sample of fishermen is only representative of Newport, it provides a reasonable estimate of where a significant number of Oregon crab fishermen work and live. In order to reach a large number of crab fishermen, effort should be targeted at the largest ports in Oregon.

- ***Engage the fishermen in the design and implementation of an intervention***. Past research shows that fishing safety initiatives are often faced with distrust and resistance unless the interventions focus on particular problems and practical solutions for the industry (Petursdottir et al, 2001). A crab fishing safety intervention requires a specialized knowledge

of the industry that addresses safety concerns expressed by those who are impacted the most. The study participants were a responsive group to work with and took their involvement in the study seriously. Several participants even indicated in their open-ended comments how grateful they were to be included in the study and thanked the study team for addressing such an important issue. The safety survey provided the opportunity for the crab fishermen to provide thoughtful feedback, and share their perceptions about the value and utility of safety initiatives. It is recommended that future interventions continue to seek the participation of fishermen in the design and implementation phases, because their involvement will likely develop a meaningful intervention with impactful results.

- ***Social support and health promotion***. The community members of large port towns, such as Newport, are highly engaged in local fishing activities and reliant on the fishing economy. Several concepts in health promotion recognize that community involvement is necessary to improve the health status of its residents. Crab fishing has strong community support, and this support is a unique asset that future interventions can utilize to improve the safety and health of fishermen. Future interventions might consider the direct participation of fishing families, interest groups, and the community at large in health promotion and education campaigns.

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Appendix A
Ready for Sea Checklist

U.S. COAST GUARD

Thirteenth Coast Guard District
Commercial Fishing Vessel Safety
Ready for Sea Checklist

- ❑ **Weather: Evaluated weather forecast & bar conditions. Vessel & crew can handle safely! Can monitor weather reports at sea.**
- ❑ **Crew: Trained & drilled in operation of vessel & safety equipment. Work schedule minimizes fatigue.**
- ❑ **Stability: Scuppers & freeing ports clear. Gear, catch & hatches secured. Vessel not overloaded.**
- ❑ **EPIRB & Communications: Equipment tested. EPIRB armed & mounted properly. Back up communications ready to go.**
- ❑ **Immersion Suits: Crew has donned suits to ensure proper fit & good condition. Suits accessible & lights attached.**
- ❑ **Survival Craft: Capacity for entire crew. Serviced, properly installed, & crew trained to launch.**
- ❑ **PFDs Worn on Deck: Crew knows to wear PFDs or inflatable suspenders when working on deck.**
- ❑ **Damage Control: Bilge pumps work. Damage control equipment on board & crew trained in use.**
- ❑ **Fire Fighting: Adequate number of serviced fire extinguishers on board & crew trained in fire fighting.**
- ❑ **Safety Exam: I conducted "Ready for Sea" deck walk/safety inspection & determined vessel safe to sail.**

Amplifying Details on Reverse Side

For additional information, contact:
Dan Hardin, 13th District Fishing Vessel Safety Coordinator
(206) 220-7226 or dhardin@pacnorwest.uscg.mil

Ready for Sea Safety Factors

WEATHER
- ❑ Weather checked and evaluated. Vessel and crew can handle conditions.
- ❑ Operable weather forecast comms equipment on board. Forecasts monitored.

CREW
- ❑ Drills conducted with every person on board (monthly).
- ❑ Work scheduled to minimize fatigue.
- ❑ Experienced crewmember checked & corrected deck/pot/fishing hazards.
- ❑ Crew knows where the safety gear is and how to use it.

STABILITY/OVERLOADING
- ❑ Hatches operable and secured to ensure the vessel is watertight.
- ❑ Freeing ports unblocked to allow free flow of water off deck.
- ❑ Deck loads & bait shacks properly secured so that they won't break loose.
- ❑ Bin boards in place to keep the load from shifting.
- ❑ Vessel tanked to reduce free surface effect (fuel, water and catch not freely moving in tank).
- ❑ Stability book up-to-date and vessel operated in accordance with guidelines.

EPIRBS & COMMUNICATIONS EQUIPMENT
- ❑ 406 MHz EPIRB tested within past 30 days, properly mounted and in the ARMED position.
- ❑ Communications equipment operable and adequate for voyage.
- ❑ Every person on board knows how to make a distress call and the frequencies to be used.
- ❑ Emergency power for communications equipment and/or back up handheld VHF radio on board.

IMMERSION SUITS
- ❑ One for every person on board. Stowed in readily accessible location.
- ❑ Each person donned to ensure proper fit and able to quickly don in an emergency.
- ❑ Suits serviceable--zippers waxed and operable, inflation bladder & lights attached.

SURVIVAL CRAFT
- ❑ Large enough to carry every person on board.
- ❑ If craft is a liferaft, serviced within the past 12 months.
- ❑ Every person on board knows how to launch the survival craft.
- ❑ Properly installed so it will deploy in an emergency.

PFD/WORK VEST
- ❑ Crewmembers wear flotation [suspenders, float coats, etc.] when on deck in hazardous condition.
- ❑ Personal marker lights [strobe, fixed bright, etc] attached to the flotation devices.

DAMAGE CONTROL
- ❑ Damage control kits with plugs, wedges, etc. on board and crew trained in use.
- ❑ High water alarms operable. Bilge pumps adequate and operable.
- ❑ Shaft and rudder post(s) checked to ensure no or only minimal leakage.

FIRE FIGHTING
- ❑ Adequate number of serviceable fire extinguishers on board.
- ❑ Crewmembers trained to extinguish a shipboard fire.

SAFETY EXAM
- ❑ Vessel examined by a Coast Guard dockside examiner or third party organization to ensure vessel is **READY FOR SEA!!!**
- ❑ Pre-sail **READY FOR SEA** exam conducted.
- ❑ Safety deficiencies corrected and vessel safe to sail.

Appendix B

Dockside Survey Form

OREGON HEALTH & SCIENCE UNIVERSITY

UNIVERSITY of WASHINGTON

IRB#: ******

Protocol Approval Date: *****

You must be an

Oregon crab fisherman

and at least 18 years old

to participate in this study.

Questionnaire should take

Oregon Crab Fishing Safety Survey

This questionnaire asks about your fishing experience and your views on safety for crab fishermen. We want to know what you think! The information collected in this study may help improve safety readiness according to what you think works.

You will remain anonymous. Please do not write your name on your questionnaire. None of your responses will be connected to you. Your participation is voluntary and you may stop at any time.

WE APPRECIATE YOUR HELP!

Your participation in this study will not affect any care you might receive at OHSU or the University of Washington.

For complaints or comments about this survey contact the project coordinators Janice Camp at 206-543 9711 or Dr. Gary Rischitelli at 503-494-4398

OREGON CRAB FISHING SAFETY SURVEY

BACKGROUND

1. How many years have you worked in commercial crab fishing? _____ year(s)

2. What is your home port? _____

   2a. Do you use other ports?

   ❑ No
   ❑ Yes (write name) _____

3. What is the length of your vessel? _____ feet

4. What is your current position onboard the vessel? (check all that apply)

   ❑ Captain/Skipper
   ❑ Crew Member
   ❑ Other _____

5. How many months per year do you usually fish for crab? _____ months

   5a. How often do you go out during the first 2 months of the season – to Feb. 1?

   Average _____ times per week ❑ Don't know

   5b. How often do you go out during the rest of the season – after Feb. 1?

   Average _____ times per week ❑ Don't know

   5c. How many days do you go out when crab fishing?

   Average _____ day(s) ❑ Don't know

6. Out fishing, how many people in total are usually on your boat? _____ people

7. How many crab pots do you usually carry? _____ pots

8. Have you ever fallen overboard?

   ❑ Yes
   ❑ No

9. Have you ever been on a crab boat that capsized or sank?

   ❑ Yes
   ❑ No

   9a. Have any fishermen you know personally ever capsized?

   ❑ Yes
   ❑ No

9b. How concerned are you regarding your boat capsizing?

- ❑ A lot
- ❑ Some
- ❑ Not much

10. Has your boat ever required assistance from the U.S. Coast Guard?

- ❑ Yes
- ❑ No

11. What is your state of residence? _____

12. What is your age? _____ years old

BAR CROSSING

13. What is your experience crossing the bar during a typical crab fishing season?

a. Not very concerned, crossing is routine:

- ❑ Always
- ❑ Usually (about 75% of the time)
- ❑ About half the time
- ❑ Sometimes (about 25% of the time)
- ❑ Never

b. Concerned, crossing is treacherous:

- ❑ Always
- ❑ Usually (about 75% of the time)
- ❑ About half the time
- ❑ Sometimes (about 25% of the time)
- ❑ Never

c. Very concerned, crossing is very treacherous:

- ❑ Always
- ❑ Usually (about 75% of the time)
- ❑ About half the time
- ❑ Sometimes (about 25% of the time)
- ❑ Never

14. Would you find it useful to have an internet live-feed weather camera showing weather conditions at the bar?

- ❑ Yes
- ❑ Maybe
- ❑ No

PERSONAL FLOTATION DEVICES (PFDs)

15. What type of PFD do you wear out crab fishing? (check all that apply)

❑ Type I: Offshore lifejacket

❑ Type I: Inflatable suspenders (offshore)

❑ Type II-IV: Inflatable suspenders (near shore)

❑ Type II: Buoyant vest

❑ Type III: Bladder jacket or other float aid

❑ Type V: Flotation Coveralls

❑ Other (please describe)

_____

❑ None

❑ Don't know

16. How often do you wear a PFD when crossing a bar?

❑ Always
❑ Usually
❑ About half the time
❑ Sometimes
❑ Never ❑ Does not apply – do not cross a bar

17. How often do you wear a PFD at other times in transit?

❑ Always
❑ Usually
❑ About half the time
❑ Sometimes
❑ Never

18. How often do you wear a PFD while working on deck?

❑ Always
❑ Usually
❑ About half the time
❑ Sometimes
❑ Never ❑ Does not apply – do not work on deck

19. What conditions prompt you to wear a PFD? (check all that apply)

- ❑ Anytime on deck
- ❑ Anytime on deck in transit
- ❑ When crossing a bar
- ❑ Storm or high sea
- ❑ Darkness
- ❑ Emergency
- ❑ None ❑ Don't know
- ❑ Other (please write) _____

20. What conditions prompt you to not wear a PFD? (check all that apply)

- ❑ Uncomfortable (please describe) _____
- ❑ Interferes with movement when working.
- ❑ Increases risk of entanglement.
- ❑ Makes me feel foolish.
- ❑ Peer pressure
- ❑ Emergency (use survival suit instead)
- ❑ None ❑ Don't know
- ❑ Other (please write) _____

21. How much would you be willing to spend on the ideal PFD – a PFD you found to be comfortable and didn't constrain deck operations?

- ❑ $50 – 100
- ❑ $100 – 150
- ❑ $150 – 200
- ❑ $200 - 250

22. How much would you be willing to spend on the ideal PFD; A PFD that you found to be comfortable and didn't constrain deck operations?

- ❑ $50 – 100
- ❑ $100 – 150
- ❑ $150 – 200
- ❑ $200 - 250

23. Please write any other comments you may have about use of PFDs on crab boats.

_____

_____

_____

U.S. COAST GUARD DOCKSIDE SAFETY EXAMINATION

What are your views on the voluntary USCG dockside safety exam?

24. Does your vessel have a safety decal from a U.S. Coast Guard dockside examination?

- ❑ Yes
- ❑ No ❑ Don't know

24a. If yes, what year was the most recent examination? _____

25. The inspections help to improve crew safety:

- ❑ Yes
- ❑ Maybe
- ❑ No ❑ Don't know

26. I think USCG dockside safety exams should be … (check one only)

- ❑ voluntary as in current rules.
- ❑ required for vessels with particular problems.
- ❑ required for all crab boats.

27. I think USCG dockside safety exams … (check all that apply)

- ❑ are valuable.
- ❑ are necessary to ensure safety.
- ❑ are too much hassle.
- ❑ are too expensive.
- ❑ are unnecessary. ❑ Don't know

Other (please write) _____

Please write any other comments you may have about dockside safety inspections.

_____

_____

_____

SAFETY TRAINING AND READINESS

28. Have you taken a fishing safety or marine safety class?

- ❑ Yes, AMSEA (Alaska Marine Safety Education Association)
- ❑ Yes, NPFVOA (North Pacific Fishing Vessel Owners' Association)
- ❑ Yes, USCG (United States Coast Guard)
- ❑ Yes, other (please write) _____
- ❑ No

28a. If yes, what year was the most recent class? _____

29. Safety training helps improve crew safety:

- ❑ Yes
- ❑ Maybe
- ❑ No ❑ Don't know

30. I think safety classes … (check all that apply)

- ❑ are valuable.
- ❑ are necessary to ensure safety.
- ❑ are too much hassle.
- ❑ are too expensive.
- ❑ are unnecessary. ❑ Don't know

Other (please write) _____

31. Does your crew conduct "abandon ship" or other safety drills?

- ❑ Yes
- ❑ No ❑ Don't know

31a. If yes, how often do you conduct safety drills? (check one only)

- ❑ Once at the beginning of the season
- ❑ A few times each season
- ❑ Regularly, about every _____ weeks
- ❑ Each time before getting underway for fishing
- ❑ Other (specify) _____
- ❑ Don't know

32. Are you familiar with the U.S. Coast Guard "Ready for Sea" checklist?

- ❑ Yes
- ❑ No

32a. If yes, how often is the checklist used onboard your vessel? (check one only)

- ❑ Once at the beginning of the season
- ❑ A few times each season
- ❑ Regularly, about every _____ weeks
- ❑ Each time before getting underway for fishing
- ❑ Other (specify) _____
- ❑ Don't know

33. How much do you think an individual fisherman can do to survive a capsizing event?

- ❑ A Lot
- ❑ Some
- ❑ Not much

34. Please write any other comments you may have about marine fishing safety readiness.

_____

_____

= CREW MEMBERS =

YOU'RE DONE!  THANKS FOR PARTICIPATING IN THE SAFETY SURVEY!

= SKIPPERS! =

PLEASE ANSWER THE FOLLOWING FEW QUESTIONS

VESSEL STABILITY REPORTS

35. Does your vessel have a stability report? (check one only)

- ❑ Yes, and use it.
- ❑ Yes, but don't use it.
- ❑ No, but intend to get it.
- ❑ No, not technically practical.
- ❑ No, too expensive. ❑ Don't know
- ❑ Other (please describe) _____

36. I think stability reports should be … (check one only)

- ❑ required only for crab boats over 79 feet in length as in current rules.
- ❑ required for crab boats over 50 feet in length.
- ❑ required for all crab boats.
- ❑ not required for any crab boats. ❑ Don't know
- ❑ Other (please describe) _____

37. I think stability reports … (check all that apply)

- ❑ are valuable.
- ❑ are not valuable.
- ❑ are necessary to ensure safety.
- ❑ are not needed for small vessels.
- ❑ are too expensive.
- ❑ should be subsidized for small crab boats.
- ❑ need to be easier to understand.
- ❑ need to have clear models to apply to work conditions.
- ❑ Don't know

38. Please write any other comments you may have about vessel stability reports.

_____

_____

BAR CROSSING

39. How useful are the following factors and information when you make a decision to cross the bar to head out to fish?

❑ Does not apply – do not cross a bar

a. Weather report

❑ Not important ❑ Somewhat important ❑ Very Important

b. Number of days since pots were last tended

❑ Not important ❑ Somewhat important ❑ Very Important

b. Time of season

❑ Not important ❑ Somewhat important ❑ Very Important

c. Time of high and low tide

❑ Not important ❑ Somewhat important ❑ Very Important

d. Height of high and low tide

❑ Not important ❑ Somewhat important ❑ Very Important

e. Bar crossing closed by USCG for recreational vessels the length of your vessel

❑ Not important ❑ Somewhat important ❑ Very Important

f. Amount of crab caught during current season

❑ Not important ❑ Somewhat important ❑ Very Important

g. Crew concerns

❑ Not important ❑ Somewhat important ❑ Very Important

40. In a typical fishing season, about how many times do you head back early due to deteriorating weather and concerns about crossing the bar to reach port?

____ times

41. Are you more inclined to assume a greater level of risk crossing the bar early in the season than later in the season?

❑ Yes
❑ No

WEATHER REPORTS

42. What are your main sources for obtaining weather reports?
(please list)_____
_____
_____

43. How often do you check weather reports?

____ times per day

44. How could weather information be improved?
(please describe)_____
_____
_____

45. Are weather reports updated frequently enough?

- ❑ Yes
- ❑ No
- ❑ Don't know

SKIPPERS - YOU'RE DONE!  THANKS FOR PARTICIPATING IN THE SAFETY SURVEY!

Appendix C

PFD Assessment Survey Form

OREGON HEALTH & SCIENCE UNIVERSITY

UNIVERSITY of WASHINGTON

IRB#: 39534

Protocol Approval Date: *****

Questionnaire should take 5-30 minutes.

If you have questions regarding this PFD evaluation, please contact Gerry Croteau at 206-543-5711

Return address: FRCG
University of Washington
4225 Roosevelt Way, NE, Ste 100
Seattle, WA 98103

Oregon

Crab Fishermen

PFD Evaluation Form

Information you provide on this form will be used to evaluate the usability of your personal flotation device (PFD) for commercial crab fishermen.

WE APPRECIATE YOUR HELP!

Instructions

– You will be given two identical evaluation forms, each with a postage-paid envelope to return the completed form.

Step 1: Complete one evaluation form after 1 day using the PFD.

Step 2: Complete the second form after 1 month using the PFD.

Step 3: Please keep and wear the PFD with our compliments!

– Only you should wear the PFD and complete the form.

– Please answer the questions as accurately as possible; place check marks in the boxes and fill in blanks as appropriate.

Your participation is voluntary and you may stop at any time. Your responses are completely confidential and will not be used in enforcement actions against you. Contact information you provide will be used only to remind you to return your forms, and will then be destroyed. Survey results will be circulated to industry, safety organizations, federal agencies, and other interested parties in summary format without any personal identifiers.

Purpose of this study

- This study will field test 5 model PFDs to evaluate features and suitability for Oregon commercial crab fishermen.
- Findings from this study may help manufacturers design PFDs that better meet the needs of the fishing industry.
- Study results may help ocean fishermen choose a favorable PFD.
- Study results may encourage commercial crab fishermen to wear

All the questions below refer to the PFD you were given for the field test.

ABOUT YOUR PFD

1. What is the ID number on your PFD? _____

2. How often did you wear the PFD when crossing a bar?

- ❑ Always
- ❑ Usually
- ❑ About half the time
- ❑ Sometimes
- ❑ Never
- ❑ Does not apply – do not cross a bar

3. How often did you wear the PFD at other times in transit?

- ❑ Always
- ❑ Usually
- ❑ About half the time
- ❑ Sometimes
- ❑ Never

4. How often did you wear the PFD while working on deck?

- ❑ Always
- ❑ Usually
- ❑ About half the time
- ❑ Sometimes
- ❑ Never

5. Did you fall overboard during this fishing season?

- ❑ Yes
- ❑ No

5a. IF YES, were you wearing your PFD when you fell overboard?

- ❑ Yes
- ❑ No

5b. IF YES, how did the PFD perform?

- ❑ Well
- ❑ Not well
- ❑ Don't know

(Any other comments about falling overboard?)_____

_____

_____

YOUR PFD RATINGS

6. How did you experience the PFD weight?

- ❑ Hardly felt it
- ❑ Somewhat heavy
- ❑ Very heavy
- ❑ Don't know

7. How did you experience the PFD tightness?

- ❑ Hardly felt it
- ❑ Somewhat tight
- ❑ Very tight
- ❑ Don't know

8. How did you experience the PFD in terms of constricted or limited motion?

- ❑ Free range of motion
- ❑ Somewhat restrictive
- ❑ Very restrictive
- ❑ Don't know

9. How did you experience the PFD in terms of rubbing or chafing your skin?

- ❑ No rubbing
- ❑ Rubbed somewhat
- ❑ Rubbed a lot
- ❑ Don't know

10. How did you experience the PFD bulkiness?

- ❑ Wasn't bulky at all
- ❑ Somewhat bulky
- ❑ Very bulky
- ❑ Don't know

11. How did you experience the PFD warmth?

- ❑ No extra warmth
- ❑ Somewhat warm
- ❑ A lot of warmth
- ❑ Don't know

12. How did you experience the PFD padding/protection?

- ❑ No extra padding
- ❑ Somewhat padded
- ❑ A lot of padding
- ❑ Don't know

13. How did you experience the PFD comfort?

- ❑ Comfortable
- ❑ Depends – both comfortable and uncomfortable
- ❑ Uncomfortable
- ❑ Don't know

14. How often did the PFD get snagged by gear?

- ❑ Never
- ❑ Sometimes
- ❑ Very often
- ❑ Don't know

15. How much did the PFD interfere with your work?

- ❑ Never
- ❑ Sometimes
- ❑ Very often
- ❑ Don't know

16. How was it donning the PFD?

- ❑ Easy
- ❑ Somewhat difficult
- ❑ Very difficult
- ❑ Don't know

17. How was it to keep the PFD clean?

- ❑ Very easy
- ❑ Somewhat difficult
- ❑ Very difficult
- ❑ Don't know

18. Overall, how satisfied are you with the wearability of the PFD you were assigned?

- ❑ Very satisfied
- ❑ Satisfied
- ❑ Neutral
- ❑ Dissatisfied
- ❑ Very dissatisfied
- ❑ Don't know

Other comments on your PFD?
(Please describe)_____

_____

Any ideas how your PFD might be improved for use by commercial crab fishermen?
(Please describe)_____

_____

_____

Any other features you would like to see in an ideal PFD for crab fishermen?
(Please describe)_____

_____

_____

YOU'RE DONE! THANKS FOR PARTICIPATING IN THE OREGON PFD EVALUATION!

PLEASE USE THE PROVIDED POSTAGE-PAID ENVELOPE TO RETURN THE COMPLETED SURVEY

Appendix D

Project Press Release, Poster, Reminder Post-Card

PRESS RELEASE

CRAB FISHERMEN!

Researchers from Oregon Health and Science University and the University of Washington

invite you to participate in the

Oregon Commercial Crab Fishermen Safety Survey and PFD Evaluation

Interviewers for this safety study will be on the docks in late November at Newport and Garibaldi.

The interviewers want to reach as many fishermen at Newport and Garibaldi as possible. While you're gearing up for the new season, they hope you will be able to take 15-20 minutes to complete the safety survey. With another few-minute investment, 50 crewmembers on crab boats will receive a new state-of-the-art personal flotation device to evaluate. Those crewmembers who use one of five different PFD models will be asked to return a "PFD evaluation form" after one month – then keep the PFD with the compliments of the research team.

The recent record of worker fatalities in Oregon crab fishing spurred this safety research project. Over 7 years, 2003-2009, the Oregon Fatality Assessment program recorded 8 incidents and 14 worker fatalities involving commercial crab boats along the Oregon Coast.

- 3 incidents involved a worker falling overboard at sea;
- 5 incidents involved capsized boats while crossing a bar, or in the surf near shore;
- 3 of the 5 capsized vessels were at the Tillamook Bay bar;
- In many capsizing incidents, multiple lives were lost.

This Oregon study of commercial crab fishermen was adapted from earlier research with crab fishermen in Alaska. The safety survey asks about the experiences and views of crab fishermen on critical safety issues – bar crossings, PFD use, safety training and readiness, and U.S. Coast Guard dockside examinations.

CRAB FISHERMEN!

At the ports of

NEWPORT and GARIBALDI

We invite you to participate in the

Oregon
Commercial Crab Fishermen

Safety Survey
and
PFD Evaluation

WE WANT TO KNOW WHAT YOU THINK!

- Researchers will be on the docks a few days at the end of November to record your experiences and views on safety issues. The survey takes 15-20 minutes.
- 50 participants will be invited to field test one of five model personal flotation devices – then keep the PFD with our compliments.
- This Oregon study was adapted from earlier crab fishing safety research in Alaska.

RESEARCH TEAMS FROM
Oregon Health & Science University
University of Washington
National Institute for Occupational Safety and Health

PROJECT FUNDED BY Pacific Northwest Agricultural Safety and Health Center

For more information, call Terry Hammond 503-494-2383 (OHSU) or Gerry Croteau 206-616-1907 (UW)

Seasons Greetings!

Thanks for completing our Crab Fishing Safety Survey and volunteering to evaluate the PFD we provided you. We appreciate your efforts. We want to remind you to use your PFD and complete the survey forms we provided after one day and 30 days of use.

We wish you a safe and prosperous crab fishing season and look forward to tasting your bounty!

If you need a survey form or other information please contact us:

Gerry Croteau, UW/FRCG
4225 Roosevelt Way NE, Suite 100
Seattle, WA, 98105-6099
(206) 616-1907

Appendix E: Dockside Survey - Respondent Comments

Other ports used	
ID #	
1	All
5	Coos bay
7	Newport
9	Tillamook Bay
10	Sitka, AK
11	Coos bay, Eureka, Newport, Willapa
14	Columbia River (Warrenton, Ilwaco, Astoria), San Francisco, Bodega Bay, Eureka, Crescent City, Brookings, Charleston
15	All
17	Coos bay, garibaldi
18	Astoria, Coos bay
19	Coos Bay/ Columbia River ports
21	Newport, Coos bay, garibaldi
23	Coos bay
25	Coos bay
27	Coos bay
29	Dutch harbor
31	Coos bay
33	Akutan, AK
34	Kodiak
35	Astoria, Kodiak
37	Akutan, AK and Newport
38	Newport and Charleston
39	Newport
40	Newport
41	Coos bay
42	Westport, WA
46	Astoria
47	Westport, WA
49	Dutch Harbor
54	Charleston
55	Florence
57	Charleston
58	Charleston/Coos Bay/Westport/Astoria
59	Dutch Harbor
60	Astoria, Westport, Crescent City, Charleston, Fort Brag, Halfmoon Bay, San Francisco
63	Kodiak
67	Newport
71	Fort Brag, CA
73	Westport to San Francisco
76	Pacific City
77	Coos bay
80	Newport, Westport and Akutan, AK

81	Cordova, Whittier, Valdez, AK

Other conditions that prompt you to wear a PFD	
ID #	
2	While crabbing
5	When was being towed. USCG required.
7	Setting gear
15	Would wear one if had one
16	Alone on boat
21	We have PFDs ready for use in bad bar crossings.
22	Setting anchor, dumping pots
27	Dumping gear
37	Setting gear
60	Hanging over the side working
61	When told to by Coast Guard
68	When setting gear
77	High danger tasks on big ocean

Additional comments about the use of PFDs on crab boats	
ID #	
4	Think it's a good idea when there are hazardous situations (on the bar) or at sea.
5	General awareness isn't great- who really wears one? Few people even have one. Big boats may use them but smaller fishermen don't use.
7	Been using them for years.
11	Least amount of resistance is best.
19	The issue of entanglement of the PFD while working a crabpot would be my main concern about using it regularly.
21	They need to be comfortable, and most of all, affordable. Otherwise, crew will never purchase them.
24	Survival suits are kept close to the back deck.
27	If it's available, safety first.
35	Hard to work in.
36	It seems smart and viable with a sleek design.
37	The PFDs I've used are bulky and interfere.
38	Every once in a while I would wear one in bad conditions. Alaska fishermen would wear them a lot.
39	Would try it later in season.
41	There should be at least one for everyone on the boat.
42	Don't know much about them.
47	I am very interested in them if I can work in it comfortably.
50	Never worn one before, had a buddy fall overboard last year. Made me realize the importance of one.
51	They need to be non-evasive.
52	I think it would get in the way and hold it up.
53	It would be nice to have the option to wear one.
57	Staying dry is the most important thing when it's cold, so rocking and rolling and water splashing.
61	Too hot, can't move as fast, and most of all, it's something else on your body that could get tangled or hooked on pots or line.
64	Just wear one in really bad weather.
67	They need to be comfortable and durable. Moving gear around deck could puncture or tear it.

69	Have to be very durable.
72	Very important to wear a PFD. I wear whatever is available.
74	The most valuable PFD is the one you wear. Very often they are inhibitive to movement and cause irritation to the wearer.
77	If there was a PFD tough enough or not restrictive of movement I would wear it.
78	Light weight, comfort, ease of movement
80	They can be a great inconvenience and a life saver.
82	The inflatable life vests look nice. Much less to wear while working and, if needed, can inflate quickly.

USCG dockside safety exams	
ID #	
5	Practical experience of fishermen most important. Shouldn't be required but good idea.
61	They are great for showing the gear and maintenance.

Additional comments USCG dockside safety exams	
ID #	
2	Should be for all vessels
5	Don't like young, inexperienced USCG telling him what to do.
13	Still get boarded at sea.
16	Need to be more accessible throughout the year
18	Good for overview on safety equipment. Good double check.
19	Consider the skipper's experience when looking at what the boat operates as. Bar crossings/foul winter conditions/working offshore, etc. Coast-wise fishing could use monetary help with safety equipment as it is with self-pay, we should have more input as to the quality or manufacturer of the equip.
23	I'm glad that they do it so a bunch of dip shits don't get hurt.
33	A must-needed for crew safety.
36	Also a good idea.
37	NA
42	We need them.
45	It a very good idea.
53	Good, makes everybody from captain down.
57	Thanks to the USCG for their time in volunteering.
61	Drills, drills, drills
78	None- good to always have them- improves safety.
80	Sometimes you don't have the time

Safety classes	
ID #	
5	Not necessary. Common sense best.

What would increase a fisherman's chance of surviving from a capsized vessel	
ID #	
1	Get in raft
2	Safety classes
3	The right equipment
4	Having a PDF on or survival suit ready to put on or "on"!

5	All safety equipment ready; wearing survival suit. Don't put self in unsafe situation; know how to work with crew; know where everything is.
8	Be wearing a PFD at time of capsizing. Have training on what to do.
10	Keep water tight hitches in good working order.
11	Hurry, survival suit on and detach life raft.
12	Marine safety classes
14	777
15	Don't lose your head. Know what you have to do.
16	training
17	Don't panic, stay together.
18	help close by
19	Prepared knowledge of where safety equipment is.
21	Be prepared with PFDs and knowledge.
22	Awareness of stability and weather conditions.
23	Don't panic, try to keep cool head.
25	Having loose line secured so peope in water are not tangled.
26	Be prepared; know where emergency equipment is and know how to use it.
27	Knowing how to escape in a flooding.
28	Ability to don a survival suit quickly.
30	Don survival suits and deploy raft.
31	Being prepared.
33	Smaller loads of gear. Dockside checks. Running drills so the crew is ready.
34	Having a survival suit or PFD on.
35	Put on his survival suit.
36	Mayday, epirb, survival suit, life raft, flares, etc.
37	Staying as calm as possible and staying with crew (in groups).
38	Having survival suits checked regularly and always ready and all deckhands aware of emergency procedures.
39	Practice the scenarios and survival suit.
40	Survival suit
41	Wearing a survival suit.
42	Keep mind in order.
44	Practice drills until they are second nature.
45	Making sure every crew member go to their station.
46	Know what to do.
47	Stay calm- keep your head on your shoulders and utilize all available survival gear.
50	PFD, survival suit, life raft.
51	Proper PFD and survival suit.
53	A chance to grab a PFD or a bouy
55	Having a PFD on all the time.
56	Using a PFD
57	Training drills.
58	PFD, training
59	PFD, survival suit, launching the raft, staying dry.
61	Practice and the will to live. Be calm and effective.
62	Luck :)
64	Life vest or survival suit and life raft.

65	Having a flotation device
67	Having time to don survival suit and being able to get in life raft.
68	Getting into a survival suit
69	Communication and survival suit
70	Safety meeting and drills.
72	Safety training.
73	Survival suit, raft
74	Being prepared and understanding the dangers of capsizing. AMSEA training is great.
77	Strength, endurance, a good PFD
78	Get survival gear
80	Depends on the way it capsized.
81	Wearing a PFD at all times, one deck and in transit. Capsizing could appear at anytime.
82	Have a safe, mechanically sound vessel.
83	PFDs, practice safety drills.

Additional comments about marine safety readiness	
ID #	
7	Be careful
19	If something doesn't work, don't wait to repair it.
23	It's a must.
27	Thanks for all the help.
36	Instructor training is vital.
37	NA
39	Access to experienced talk.
45	It's a very good program to know.
51	Stay away from swinging objects and always be aware of what is going on.
72	Ask if other crewmembers have safety training. If not, provide training and instruction.
77	Very happy to be considered for an interview.
78	Everyone should take survival safety training course.
80	Safety is no accident.

Additional comments about marine safety readiness	
ID #	
3	Recommended
5	Voluntary only

Additional comments about vessel stability reports	
ID #	
2	All vessels should have them
7	Are harder to do on small boats.
10	Don't always trust them.
16	Boats are always compromised by sea conditions and a standard would be hard to reach.

Additional comments about sea, dock, or work hazards	
ID #	

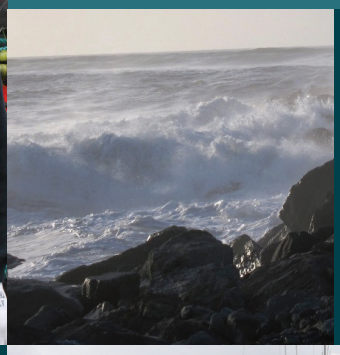
4	I DO NOT take risks (unknown) when making bar crossings.
11	Slippery docks on port dock 7 in Newport
24	Wind chop and wet conditions make it dangerous with a tired crew.

How can weather information be improved	
ID #	
4	Works pretty well with USCG help at the beginning of the season.
5	No
6	Updates 3 or 4 times a day.
7	More reports
8	Less weather info about land conditions. Takes too long to hear the marine part of the forecast.
11	Provide accurate forecasts.
15	More updated
16	Education about possible changes with weather.
17	more frequent updates
18	Current swell and wind from weather buoys not every hour.
19	It's pretty good at the moment. A good barometer would be an… help when working locally.
21	More updates, add bar conditions, and the video of bar conditions.
24	Honestly, not sure.











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