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## Worker satisfaction with personal flotation devices (PFDs) in the fishing industry: Evaluations in actual use

Devin Lucas\*, Jennifer Lincoln, Philip Somervell, Theodore Teske

National Institute for Occupational Safety and Health, Alaska Pacific Regional Office, 4230 University Drive, Suite 310, Anchorage, AK 99508, USA

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### ABSTRACT

The purpose of this study was to determine which type of commercially available PFD resulted in the highest satisfaction among workers in the fishing industry. Fishing industry workers on four types of vessels wore and evaluated six different PFDs during their fishing seasons. Linear regression was used to test the differences in mean satisfaction scores, adjusting for clustered observations on vessels. The data were stratified by vessel type to determine the differences in PFD satisfaction within each vessel type. PFD D had the highest mean satisfaction score, but satisfaction with particular PFDs varied depending on the vessel type. Although the common objections by workers to wearing PFDs are that they are bulky and uncomfortable, some of the PFDs that were evaluated in this study received high scores for comfort and satisfaction. Given the availability of PFDs that are comfortable to wear while working, fishing vessel owners and operators should consider implementing policies mandating the use of PFDs on deck.

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### 1. Introduction

Commercial fishing is likely the most hazardous occupation worldwide (FAO, 2005). Global fatalities are estimated to be at least 24,000 deaths per year (FAO, 2005). In many countries, including the United States, commercial fishing has the highest fatality rate of any occupation (Bureau of Labor Statistics, 2009; Laursen et al., 2008; Roberts, 2004). Most of these fatalities are due to drowning after a vessel disaster (e.g. sinking, capsizing, etc.) or from a fall overboard (CDC, 2010). Primary prevention of vessel disasters and falls overboard are the most certain way to prevent these fatalities, but this is not always possible.

During 2000–2009, 155 workers in the fishing industry (crew-members on commercial fishing vessels) drowned after falling overboard in the United States (CDC, 2010). None of the victims were wearing a personal flotation device (PFD). Although the risk of drowning is high, most fishing industry workers do not wear PFDs while on the deck of the vessel. There are currently no mandates by regulatory agencies for these workers to wear PFDs. Research has found, however, that wearing a PFD greatly increases the probability of survival (Jones, 1999; National Institute for Occupational Safety and Health, 1993; National Transportation Safety Board, 1993).

After submersion in cold water, experts have identified four stages at which a person may perish. These are commonly referred to as cold shock, swimming failure, hypothermia and post-rescue collapse (Brooks et al., 2005). Cold shock occurs within 2–3 min of submersion. The victim appears to struggle and then gives up before sinking and drowning. Swimming failure occurs within 3–15 min of submersion. The victim is observed having increasing difficulty to stay afloat but has not been in the water long enough to bring the core body temperature to the level defined by hypothermia. In both of these stages, a PFD is vital for survival.

There is a lack of published articles or reports examining the barriers to PFD use among fishing industry workers. However, a recent study of recreational boaters in Alaska found that 38 percent cited discomfort as the primary reason for not wearing a PFD (McDowell Group, 2009). It is possible that fishing industry workers share the same opinion.

Several studies have examined barriers to wearing other forms of personal protective equipment (PPE) among different types of workers. Common reasons cited for non-use were discomfort, misperceptions of risk, and negative attitudes about the efficacy of PPE (Akbar-Khanzadeh, 1998; Forst et al., 2006; Salazar et al., 2001). An additional study stated that, “Improper fit, added weight, out-of-fashion style or color make much PPE undesirable” (Akbar-Khanzadeh et al., 1995). Among fishing industry workers, there may be similar perceptions and attitudes; they may feel that a PFD will be uncomfortable and encumber them in their work. There may also be concern that a PFD not designed for their working

\* Corresponding author. Tel.: +1 907 271 2382.  
E-mail address: [dlucas@cdc.gov](mailto:dlucas@cdc.gov) (D. Lucas).

conditions could be an entanglement hazard, or endanger them by restricting their movements. Many new types and styles of PFDs are now available that may overcome workers' concerns. It is unknown how many fishing industry workers are aware of these newer PFDs, or if those designs are in fact more satisfactory.

Schilling (1971) was the first to publish research on protective clothing for fishing industry workers. Workers wore a polyvinyl chloride smock whose rough edges caused skin lesions from chafing at the wrist. It was bulky and heavy, hampering quick movements and provided no buoyancy protection. The desire was to design a garment that improved mobility and provided buoyancy.

In general, PPE may be more acceptable to workers when they are directly involved with the design, and if they can evaluate the PPE in actual work conditions (Mayer and Korhonen, 1999). Akbar-Khanzadeh et al. (1995) pointed out that "The comfort and fit of PPE can be considerably improved when employees actively participate in the selection and testing of PPE." If true, then fishing industry workers may be able to provide important input into the comfort and functionality of PFDs and identify PFDs that are appropriate for the specific demands of commercial fishing.

The purpose of this study was to determine which type of commercially available PFD resulted in the highest satisfaction in actual working conditions in the fishing industry.

## 2. Materials and methods

### 2.1. Study design and sample selection

Fishing industry workers are a challenging group of workers to study. Fishing is often seasonal and part-time. Crewmembers are generally treated as self-employed contractors. They may be hired shortly before a fishing season begins, and arrive at the vessel only days before it departs for sea. Turnover is high from season to season. The result of these circumstances is meager recordkeeping for crewmembers, and insufficient data to compile a sampling frame. It is difficult even to estimate the number of workers in any particular port. In addition, once a fishing season begins, the workers are at sea and largely out of contact, whether by telephone, mail, or email.

In addition, crews fish on various types of vessels using different types of fishing gear operating at different times of the year. For example, most crab fishing vessels operate in the winter, while vessels using gillnets usually fish for salmon during the summer. Because the deck activities and weather conditions differ across vessel types and seasons, workers may have different preferences for PFDs.

The study population included fishing industry workers on four vessel types: crabbers (vessels dropping baited pots to catch crab on the ocean floor), longliners (vessels anchoring strings of baited hooks on the ocean floor to catch a variety of bottom fish), gillnetters (vessels towing gillnets to catch primarily salmon), and trawlers (vessels towing large trawl nets to catch groundfish and some pelagic fish) operating in the Southwest and Southcentral regions of Alaska. These two regions include the Alaska Peninsula, Bristol Bay, the Bering Sea, and the Gulf of Alaska. The regions and vessel types were selected based on prior research that showed that they had the highest risk of fatal falls overboard in Alaska (Lucas and Lincoln, 2007).

To raise awareness of the study and to encourage participation, a targeted communication campaign was developed prior to visiting each port. The campaign used theories of social marketing and was largely based on prior experience in communicating with complicated occupational cultures (such as mining and oil and gas extraction). A series of informative posters and flyers was produced and targeted to each of the vessel types and fishing ports. They

were displayed in various locations around the harbors, in marine supply retailers, at local restaurants, and social gathering spots. Concurrently, research staff contacted print and broadcast media outlets in each port to set up on-air announcements and interviews.

Research teams traveled to five fishing ports several days prior to the start of a fishing season to recruit participants. Crabbers were enrolled in October 2008, trawlers in January 2009, longliners during March–April 2009, and gillnetters in June 2009. The research teams walked the docks and boat yards, contacted workers onboard vessels, and enrolled participants until 54 participants were enrolled for each of the four vessel types for a total of 216 total participants. Participants were randomly assigned to evaluate one of six PFD models, and asked to wear their assigned PFD each time they went on deck. Workers were allowed to keep the PFD after the evaluation period.

### 2.2. PFDs

The six PFD models that were included in the study were selected based on their potential for out-of-water comfort and functionality with input from fishing industry workers, marine safety experts, and PFD manufacturers. The PFDs varied widely in their styles and features.

PFD A was a closed-cell foam vest with a nylon shell (Fig. 1). The foam flotation was concentrated in the mid to lower back and front, keeping the upper back and shoulders area light and ventilated with nylon mesh material.

PFD B was an inflatable collar similar to a pair of suspenders, folded into a nylon cover fastened shut with hook and loop material. The inflation mechanism contained a dissolvable tablet which would release a spring-loaded pin into the CO<sub>2</sub> cartridge when immersed in water.

PFD C was a set of industrial strength rubberized neoprene rain gear with an inflatable collar integrated into the suspenders of the bibs. The cover for the inflation bladder was the same neoprene material as the bibs and was fastened shut with hook and loop material. The inflation mechanism was the same style as PFD B, a dissolvable tablet trigger.

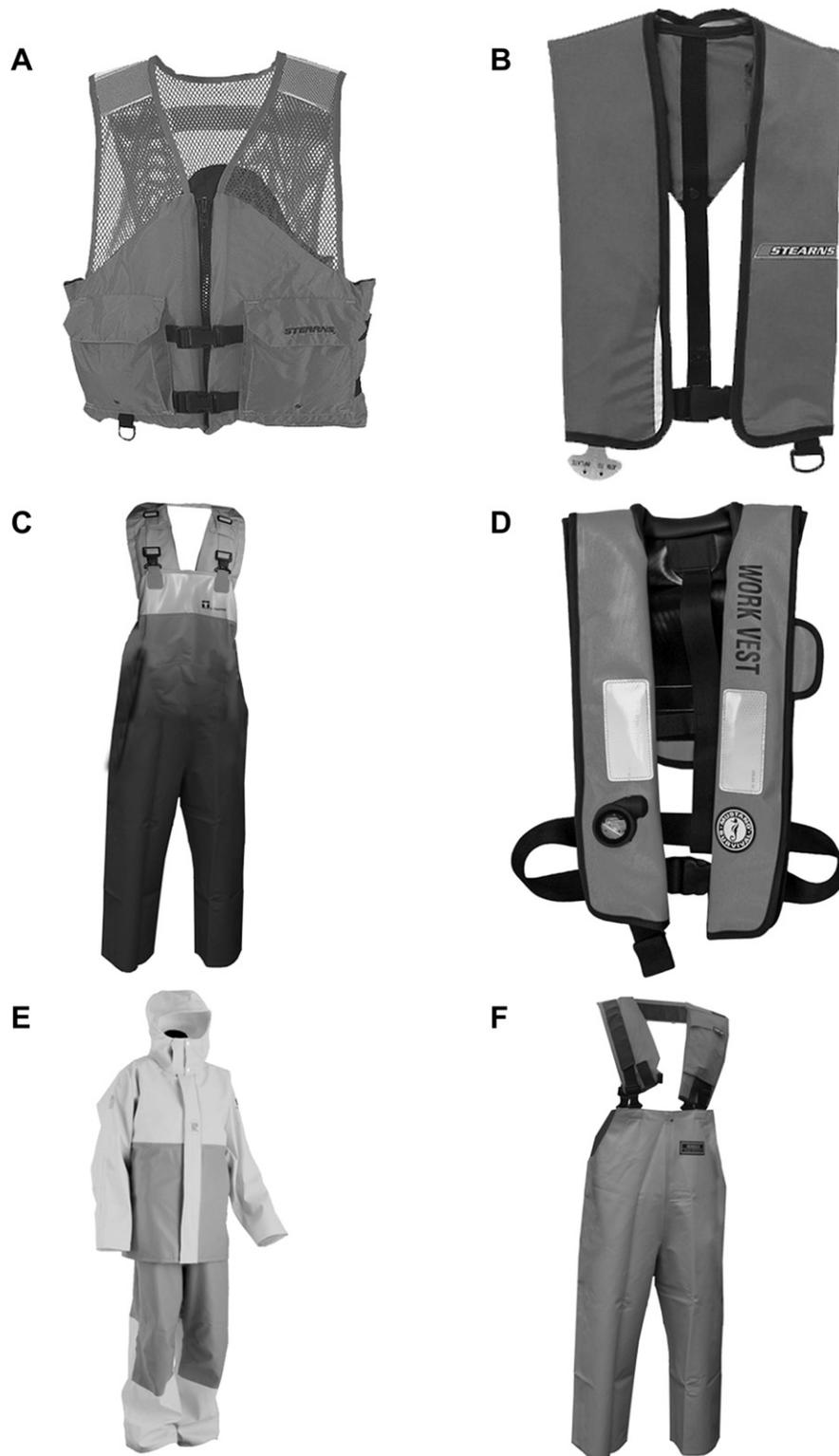
PFD D was an inflatable collar folded into a rubberized neoprene cover fastened shut with a zipper designed with a weak link which would part when the bladder inflated. The inflation mechanism was a hydrostatic trigger designed to fire at a pressure equivalent to immersion under six inches of water. The portion of the cover in contact with the wearer's neck was a soft padded neoprene material.

PFD E was a set of industrial strength rubberized neoprene rain gear with closed-cell foam integrated into the chest and back of the bibs. The foam was fairly thin being spread out over the whole chest and back region. The total flotation provided was approximately the same as PFD A, the other foam PFD in the study.

PFD F was a set of industrial strength rubberized neoprene rain bibs with an inflatable collar integrated into the suspenders. The cover was nylon folded so that it was wide and flat. The inflation mechanism was the dissolvable tablet style.

### 2.3. Survey instrument

Participants were interviewed at the time of recruitment to collect demographic and other background data. Participants were then given two evaluation forms to rate various aspects of PFD satisfaction. The forms were completed twice during the evaluation period, once after the first day, and again after 30 days. Evaluation forms were returned by mail to research staff via pre-addressed postage paid envelopes. Data collection activities spanned approximately one year. Evaluation forms not received by mail in a timely manner were solicited through email and telephone



**Fig. 1.** PFDs evaluated by workers. (A) Foam-core vest. (B) Inflatable suspenders with tablet inflation mechanism. (C) Rain bibs with attached neoprene inflatable suspenders. (D) Inflatable suspenders with hydrostatic inflation technology. (E) Rain bibs with built-in foam flotation. (F) Rain bibs with attached nylon inflatable suspenders.

follow-up. The study protocol and survey instruments were reviewed and approved by the National Institute for Occupational Safety and Health Human Subjects Review Board as well as the Office of Management and Budget (OMB approval #0920-0787).

PFD satisfaction was measured by a nine item scale on the PFD evaluation forms. Each item asked the participants to rate how much

a particular PFD attribute bothered them on a four point response scale: very much (1), somewhat (2) very little (3), not at all (4). The nine PFD attributes evaluated were: weight, tightness, constricting motion, chafing skin, bulkiness, snagging gear, interfering with work, donning and cleaning. The nine item scale was examined for cross-attribute reliability using Cronbach's alpha test. Because the

items demonstrated a high cross-attribute reliability (Cronbach's alpha = 0.87), the mean of all nine items was used as an overall or composite PFD satisfaction score. This composite score was used as the outcome measure for testing the research hypotheses.

#### 2.4. Analysis

The statistical analysis tested two main research hypotheses:

1. Average PFD satisfaction scores will vary by PFD type due to differences in PFD features, and will differ across vessel types due to differences in worker activities and environmental conditions.
2. PFD satisfaction will increase as time worn increases.

Descriptive statistics were performed on all variables to examine their distributions and to inform the analysis.

The first research hypothesis of differential PFD satisfaction between PFD types and vessel types was tested by fitting a linear regression model for each vessel type. The models tested the difference in mean PFD satisfaction scores at day 30 for each PFD type within each vessel type.

Post-estimation diagnostic tests were used to evaluate model assumptions and fit, including plots and tests of the distribution of residuals (normality of residuals and homogeneity of variance).

An important consideration regarding the nature of these data was that participants were grouped or clustered on fishing vessels, making their evaluations of PFDs not strictly independent. To account for the potential intragroup correlation, the standard errors of the parameter estimates were adjusted using robust variance estimates (Rogers, 1993; Williams, 2000).

The percent change of the PFD satisfaction score from day 1 to day 30 was calculated for each participant to test hypothesis 2. Mean estimation of the percent change with 95% confidence intervals was completed for all PFD types, and analysis of variance was used to test the difference in mean percent change between PFD types. Statistical analyses were performed using Stata version 11.2 (StataCorp, 2009).

### 3. Results

Of the 216 fishing industry workers enrolled in this PFD evaluation study, 145 (67%) completed and returned both the day 1 and day 30 evaluation forms. As self-reported on the day 30 evaluation form, participants wore the study PFDs an average of 65% of their time on deck during the evaluation period. Participants had a mean age of 38 years, 18 years experience in the commercial fishing industry, and fished 6 months per year (Table 1). Deckhands made up the majority of the sample (102, 70%) followed by vessel captains (31, 21%). Trawlers had the highest use of PFDs prior to the study (51% always used a PFD) while longliners had the lowest prior use (0% always used a PFD).

The composite PFD satisfaction score for the day 30 evaluation had a mean of 2.83 (SD = 0.64) and followed a normal distribution. Trawlers had the highest mean PFD satisfaction score (Table 2). PFD D had the highest mean satisfaction score pooled across all vessel types, and was assigned as the reference group in the subsequent linear regression models.

The four linear regression models (Table 3) showed that PFD satisfaction differed both by PFD type and by vessel type. For crabbers, only PFDs C and E had satisfaction scores significantly lower than PFD D. Gillnetters scored PFD A lower than PFD D, but in stark contrast to crabbers scored PFD E significantly higher than PFD D. Longliners were less satisfied with PFDs A, B and F than PFD D. Finally, trawlers scored PFDs A and C lower than PFD D.

**Table 1**  
Characteristics of participants in the study ( $n = 145$ ).

Categorical variables	<i>n</i>	%
PFD type		
PFD A	26	17.9
PFD B	25	17.4
PFD C	24	16.6
PFD D	25	17.4
PFD E	24	16.6
PFD F	21	14.5
Vessel type		
Crabber	38	26.2
Gillnetter	36	24.8
Longliner	24	16.6
Trawler	47	32.4
Position		
Captain	31	21.4
Deckhand	102	70.3
Other	12	8.3
Prior PFD use		
Never	39	26.9
Sometimes	53	36.6
Frequently	27	18.6
Always	26	17.9
Continuous variables	Mean	SD
PFD satisfaction score	2.8	0.6
Age	37.6	10.7
Years fishing	17.9	10.4
Months fish per year	6.1	2.4
Length of vessel (ft)	94.8	49.8
Workers onboard	5.0	1.4

The models for crabbers and gillnetters fit the data quite well ( $R^2 = 0.53$  and  $0.54$  respectively), while model fit for longliners and trawlers was lower but still moderately strong.

The PFD satisfaction score was created from the mean of the nine-item scale of satisfaction with PFD attributes. Scores on the individual items showed how different PFD attributes contributed to the overall satisfaction score for each PFD. Nearly all of the nine items had statistically significant differences in scores across PFD types (Table 4).

Hypothesis 2 stated that PFD satisfaction will increase as time worn increases. The mean percent change from day 1 to day 30 ranged from  $-7.2\%$  for PFD F to  $1.7\%$  for PFD E, but none were statistically significantly different from zero. There was also no significant difference in mean percent change between PFD types:  $F(5, 59) = 1.33$ ;  $p = 0.266$ .

### 4. Discussion

The response from fishing industry workers to this study was very positive. Although these workers are a challenging population to reach, their enthusiasm, willingness to participate, and support of the study's purpose was evidenced by their willingness to

**Table 2**  
Mean satisfaction score (SD) for six PFD types by vessel type ( $n = 145$ ).

Vessel type	Crabber	Gillnetter	Longliner	Trawler	Total
PFD A	2.83 (0.50)	1.91 (0.28)	2.06 (0.37)	2.99 (0.35)	2.55 (0.60)
PFD B	3.19 (0.37)	3.10 (0.63)	2.74 (0.23)	3.29 (0.48)	3.15 (0.48)
PFD C	2.00 (0.34)	2.63 (0.65)	2.86 (0.43)	2.09 (0.56)	2.39 (0.60)
PFD D	3.14 (0.32)	2.93 (0.51)	3.08 (0.14)	3.40 (0.23)	3.16 (0.36)
PFD E	2.26 (0.65)	3.63 (0.32)	2.85 (0.71)	3.22 (0.33)	2.97 (0.71)
PFD F	2.73 (0.43)	2.76 (0.69)	2.50 (0.24)	2.82 (1.02)	2.75 (0.68)
Total	2.72 (0.61)	2.80 (0.69)	2.72 (0.53)	3.01 (0.66)	2.83 (0.64)

**Table 3**

Linear regression models for PFD satisfaction score stratified by vessel type.

Predictor	Crabbers		Gillnetters		Longliners		Trawlers	
	<i>b</i>	<i>t</i> <sup>a</sup>	<i>b</i>	<i>t</i> <sup>a</sup>	<i>b</i>	<i>t</i> <sup>a</sup>	<i>b</i>	<i>t</i> <sup>a</sup>
PFD A	−0.31	−1.53	−1.02	−4.74***	−1.03	−4.52***	−0.42	−2.94**
PFD B	0.05	0.26	0.18	0.47	−0.34	−2.59**	−0.11	−0.62
PFD C	−1.14	−5.75***	−0.29	−0.89	−0.22	−1.46	−1.31	−4.93***
PFD D	Ref	—	Ref	—	Ref	—	Ref	—
PFD E	−0.88	−3.56**	0.71	3.16**	−0.23	−0.63	−0.18	−1.30
PFD F	−0.41	−1.73	−0.17	−0.56	−0.58	−8.06***	−0.58	−1.45
Constant	3.14	25.10***	2.93	16.82***	3.08	16.82***	3.40	46.26***
<i>n</i>	38		36		24		47	
<i>F</i> ( <i>df</i> )	21.13(5, 9)***		20.32(5, 21)***		15.76(5, 11)***		5.67(5, 15)**	
<i>R</i> <sup>2</sup>	0.53		0.54		0.40		0.38	
Adj. <i>R</i> <sup>2</sup>	0.46		0.46		0.23		0.30	

\**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001.<sup>a</sup> Standard errors adjusted for intragroup correlation of observations clustered on fishing vessels.

participate and the high response rates found in this study. Many workers commented positively on the value of the study, in person and/or on the returned evaluation forms. This acknowledgement from the study participants indicates that these workers are willing to actively participate in testing PPE.

The analysis revealed that workers on each vessel type had different preferences for PFDs. This may be explained by differences such as weather conditions during the fishing season, physical intensity of the work, and fishing method. For example, PFD A received fairly high satisfaction scores by crabbers (not significantly different than the highest rated PFD), but lower scores by the other three vessel types. Workers were most bothered by its bulkiness and interference with work.

The average PFD satisfaction score for PFD B was not significantly different than the score for PFD D among crabbers, gillnetters, and trawlers. PFD B is similar to PFD D in that it is a stand-alone set of inflatable suspenders. The main differences between the two are the cover material and inflation mechanism. Few workers were bothered very much by any of the individual attributes of PFD B. These findings suggest that the common style of PFDs B and D may be the most preferred among most commercial fishing crewmembers.

Crabbers and trawlers were less satisfied with PFD C than PFD D; however, PFD C received somewhat better satisfaction scores by longliners and gillnetters. Workers reported that they were most commonly bothered by PFD C's weight, bulk, chafing, and constricting. This PFD is an inflatable style built into a set of rain gear. Although the concept of a PFD as an integral part of work-wear is applauded by workers and safety professionals, more research appears to be needed to make the system of PFD C comfortable and acceptable to workers.

Overall, PFD D received the highest score for satisfaction; although gillnetters had a significantly higher level of satisfaction

with PFD E than PFD D. Analysis of the individual PFD attributes showed that PFD D had the lowest percentage of workers bothered by six of the nine attributes compared to the other PFDs (as shown in Table 4). For PFD D, the attribute which had the highest percentage of workers bothered somewhat to very much was snagging.

Among gillnetters, satisfaction with PFD E was significantly higher than PFD D, and for longliners and trawlers it was not significantly different than PFD D. PFD E is a PFD built into rain gear. It has foam flotation built into the chest and back, rather than inflatable suspenders like PFD C and F. This appears to be a preferred system by workers for an integrated PFD. It was rated highly for being lightweight, non-chafing, non-snagging, and easy to keep clean.

The other inflatable PFD built into rain gear was PFD F. Workers reported that PFD F was bulky, tight, and interfered with work. Although it was more satisfactory overall to workers than the similar style PFD C, there still appears to be more work needed to make it ideal for the fishing industry.

PFD satisfaction did not change significantly with use over time during the study. This finding suggests that workers' initial impressions (after one day of wear) were stable for at least one month. It is unknown if satisfaction would increase or decrease over a longer period of time wearing a particular PFD.

One limitation of this study was the use of a convenience sample to collect data from fishing industry workers. This methodology was unavoidable, given the difficulties of sampling from this population of workers. However, it requires a degree of caution in generalizing the results. Another limitation may have been the reliance on self-report. Although self-report is completely appropriate for data on personal satisfaction, it may lead to inaccuracy in regard to other items; e.g., how often the PFDs were actually worn on deck during the evaluation period. A further limitation is that there may be differences between participants who completed the evaluations and those who did not, although non response was low and equally distributed across all six PFDs. Finally, in some cases it was not possible to verify whether each day 1 evaluation form was filled out after just 1 day as instructed, or at some later time during the one-month evaluation period. This suggests the possibility that some findings on the differences between workers' early and late assessments of PFDs may be conservative, that is, may understate the actual changes.

## 5. Conclusions

This study engaged fishing industry workers in evaluating a variety of commercially available PFDs in actual working conditions. Although the common objections by workers to wearing PFDs are that they are bulky and uncomfortable, some of the PFDs

**Table 4**Number (%) of participants bothered "somewhat" to "very much" by PFD attributes.<sup>a</sup>

PFD attribute	PFD A	PFD B	PFD C	PFD D	PFD E	PFD F	$\chi^2$ <sup>b</sup>
Weight	7 (27)	4 (16)	16 (67)	4 (16)	5 (21)	7 (35)	21.4***
Tightness	11 (42)	3 (12)	11 (46)	4 (16)	9 (38)	8 (40)	11.8*
Constricting	13 (50)	5 (20)	13 (54)	5 (20)	9 (38)	7 (35)	11.2*
Chafing	9 (35)	5 (21)	15 (63)	4 (16)	4 (17)	8 (38)	17.8**
Bulkiness	18 (69)	5 (20)	20 (83)	4 (16)	9 (38)	10 (50)	35.8***
Snagging	13 (50)	3 (12)	7 (29)	7 (28)	5 (21)	4 (20)	10.8
Interfere	14 (54)	7 (28)	13 (54)	4 (16)	5 (21)	8 (40)	14.7*
Donning	3 (12)	5 (21)	14 (58)	0 (0)	6 (25)	5 (25)	26.4***
Cleaning	11 (46)	4 (16)	3 (14)	3 (12)	1 (4)	3 (17)	16.6**

\**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001.<sup>a</sup> Four point scale with options: "not at all," "very little," "somewhat," and "very much".<sup>b</sup> Chi-square test for independence.

that were evaluated in this study received high scores for comfort and satisfaction. Given the availability of PFDs that are comfortable to wear while working, fishing vessel owners and operators should consider implementing policies mandating the use of PFDs on deck.

This study also revealed that workers on different types of fishing vessels had varying preferences for PFDs. The unique conditions on each vessel type must be considered when selecting a PFD. Since there are no government regulations mandating the use of PFDs, manufacturers may have more success supplying PFDs to the fishing industry if they engage workers early in the design and testing as well as promoting the availability of newer, more comfortable PFDs. PFDs and messages about PFDs must be tailored to individual vessel types. If more attention is given to out-of-water comfort, workers will be more likely to wear PFDs consistently while working on deck.

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### References

- Akbar-Khanzadeh, F., 1998. Factors contributing to discomfort or dissatisfaction as a result of wearing personal protective equipment. *J. Hum. Ergon.* 27, 70–75.
- Akbar-Khanzadeh, F., Bisesi, M.S., Rivas, R.D., 1995. Comfort of personal protective equipment. *Appl. Ergon.* 26, 195–198.
- Brooks, C.J., Howard, K.A., Neifer, S.K., 2005. How much did cold shock and swimming failure contribute to drowning deaths in the fishing industry in British Columbia 1976–2002? *Occup. Med.* 55, 459–462.
- Bureau of Labor Statistics, 2009. National Census of Fatal Occupational Injuries in 2008. Available from: <<http://www.bls.gov/iif/oshcfoi1.htm>> (retrieved January 21, 2010).
- Centers for Disease Control and Prevention, 2010. Commercial fishing deaths – United States, 2000–2009. *MMWR Morb. Mortal. Wkly. Rep.* 59, 842–845.
- Food and Agriculture Organization of the United Nations, 2005. Fishing: the most dangerous occupation. In: FAO Fisheries and Aquaculture Department. Available from: <<http://www.fao.org/fishery/topic/12383/en>> (retrieved March 31, 2009).
- Forst, L., Noth, I.M., Lacey, S., Bauer, S., Skinner, S., Tetrea, R., Zanoni, J., 2006. Barriers and benefits of protective eyewear use by latino farm workers. *J. Agromed.* 11, 11–17.
- Jones, C.S., 1999. Drowning among personal watercraft passengers: the ability of personal flotation devices to preserve life on Arkansas waterways, 1994–1997. *J. Ark. Med. Soc.* 96, 97–98.
- Laursen, L.H., Hansen, H.L., Jensen, O.C., 2008. Fatal occupational accidents in Danish fishing vessels 1989–2005. *Int. J. Inj. Contr. Saf. Promot.* 15, 109–117.
- Lucas, D.L., Lincoln, J.M., 2007. Fatal falls overboard on commercial fishing vessels in Alaska. *Am. J. Ind. Med.* 50, 962–968.
- Mayer, A., Korhonen, E., 1999. Assessment of the protection efficiency and comfort of personal protective equipment in real conditions of use. *Int. J. Occup. Saf. Ergon.* 5, 347–360.
- McDowell Group, 2009. Boating Safety Pre-campaign Survey Results. McDowell Group, Anchorage, AK.
- National Institute for Occupational Safety and Health, 1993. Preventing Drownings of Commercial Fishermen. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH), Cincinnati, OH. Publication no. 94-107.
- National Transportation Safety Board, 1993. Safety Study: Recreational Boating Safety. National Transportation Safety Board, Washington, DC.
- Roberts, S.E., 2004. Occupational mortality in British commercial fishing, 1976–1995. *Occup. Environ. Med.* 61, 16–23.
- Rogers, W.H., 1993. Regression standard errors in clustered samples. *Stata Tech. Bull.* 13, 19–23.
- Salazar, M.K., Connon, C., Takaro, T.K., Beaudet, N., Barnhart, S., 2001. An evaluation of factors affecting hazardous waste workers' use of respiratory protective equipment. *Am. Ind. Hyg. Assoc. J.* 62, 236–245.
- Schilling, R.S.F., 1971. Hazards of deep-Sea fishing. *Br. J. Ind. Med.* 28, 27–35.
- StataCorp, 2009. Stata Statistical Software: Release 11. StataCorp LP, TX.
- Williams, R.L., 2000. A note on robust variance estimation for cluster-correlated data. *Biometrics* 56, 645–646.