SESSION FOUR:
DECK SAFETY

Faroese fishermen at work (Photo courtesy of Anna Maria Simonsen)

USE OF OPERATING HAZARD ANALYSIS TO REVIEW ON-DECK PROCEDURES IN COMMERCIAL CRAB FISHING

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Introduction

Information from 1991-1998 indicates that commercial fishing in Alaska has an occupational fatality rate approximately 28 times the rate for US workers in general (Thomas, Lincoln et al. 2001). Lincoln notes that within the commerical fishing industry, the Alaska shellfish fishery has the highest fatality rate, which is approximately twice as high as the rate for herring, the fishery with the next highest rate.

Until recently, when surpassed by construction, commercial fishing has also resulted in the largest number of work-related injuries in Alaska industry (Husberg, Lincoln et al. 2001). In 1983, injury rates for the Dungeness, tanner, and king crab fisheries were among the highest of all fisheries (Bender 1992). Being struck by crab pots has been found to be the single most common cause of injury due to equipment (Thomas, Lincoln et al. 2001).

One result of the Second National Fishing Industry Safety and Health Workshop held in 1997 was the recommendation to "perform job hazard analysis on those tasks associated with increased injuries" (Klatt and Conway 2000). Tomasson (2002) proposed a review of all work procedures on board ships to reveal which work procedures were hazardous. Thomas et al. (2001) suggested that efforts are required to "better define the relationship between the vessel, fishing equipment, and the fishermen" and noted that while data were lacking on the human aspect of the system, "additional strategies to improve safety need to address the interaction between the vessel, its equipment and machinery, and the worker." Husberg, Lincoln, et al. (2001) emphasized that there was a need to examine the deck environment from a "mechanical and safety engineering perspective." They also noted the use of "cranes, 'power blocks,' pulleys, winches, lines, nets, crab pots, and crab pot launchers" is an issue requiring attention.

Operating hazard analysis

This paper uses operating (and support) hazard analysis (OHA) to analyze systematically the job hazards in several on-deck tasks in commercial crab fishing. Examples from cod fishing with pots are also used. OHA is a systems safety technique often used to (1) describe and quantify (to the extent possible) the hazard associated with processes that are inherently dangerous or in which human error is likely to cause injury or property damage and (2) provide recommended risk reduction alternatives during all phases of tasks or operations. OHA concentrates on the performance of people and their relationships to potential task hazards. For a particular on-deck operation, severity and probability can be quantified (to some extent) through the use of epidemiological and historical data and from estimates by knowledgeable personnel. The OHA procedure presented here is a modification of that presented by Vincoli (1993). It should be noted that in this paper, "hazard" is defined as a condition with the potential to cause injury or property damage. The existence of a hazard does not imply an inevitable result. The factors appearing frequently in marine casualty literature are listed below (National Research Council, Marine Board Committe on Fishing Vessel Safety 1991).

- Fatigue/stress.
- Improper or inadequate procedures (including inadequate or unsafe loading and stability practices and inadequate watchkeeping).
- Improper maintenance.
- Inattention (including carelessness).

- Inadequate human engineering in design.
- Inadequate physical condition.
- Incapacitation through use of alcohol and drugs.
- Inexperience (including inadequate knowledge and skills and insufficient familiarity with the vessel or fishing activity).
- Judgmental errors (including risk-taking and faulty decision-making).
- Navigational/operator error (including inexperience and errors in judgment).
- Neglect (including willful negligence).
- Personnel relationships.
- Working conditions.

The intent of this paper is to provide a starting point for the use of systems safety procedures to analyze systematically on-deck commercial fishing operations. The commercial crab fisheries are featured in this study. The methods may be used in other fisheries making up the commercial fishing industry. Abatement recommendations are presented; however, some are the result of previous studies and are not the primary intent of this paper.

A form (Figure 1) to facilitate the application of OHA is illustrated. This form is an expansion of one presented by Vincoli (1993).

The initial entries on the form are a simple list of each procedure or task (with an identifying number) and a description of the potentially hazardous conditions in the task. The cause (if known) of this hazardous condition and possible effect are next noted. Completion of the form also requires an estimate of the frequency(Table 1), severity (Table 2), and detectability (possibility that the hazardous condition will be detected before it results in an adverse event) (Table 3) for each condition. A general measure of concern for the potentially hazardous condition can be estimated by combining frequency, severity, and detectability.

Frequency

The hazard frequency levels presented in Table 1 are based on those included in MIL-STD 882B (US Department of Defense 1984). The frequency levels represent a qualitative judgment of the likelihood that a mishap will occur if the hazard is not corrected.

MODIFIED OPERATING & SUPPORT HAZARD ANALYSIS

SYSTEM: On-Deck Commercial Crab Fishing

Operational Mode: ______ Performed By: BHB

Page ______ of ______ Date: ______

ITEM	PROCEDURE OR TASK	POTENTIALLY HAZARDOUS CONDITION	CAUSE	EFFECT	FREQ	SEV	DET	CONCERN LEVEL	ASSESSMENT	RECOMMENDATION AND STATUS

Figure 1: Form for operating and support hazard analysis

Table 1: Hazard probability categories

Description	Level	Definition
Remote	1	Unlikely, but may possibly occur in the life of an item
Occasional	2	Likely to occur sometime in the life of an item
Probable	3	Will occur several times during the life of an item
Frequent	4	Likely to occur frequently

Severity

In a similar fashion, hazard severity levels are presented in Table 2 (US Department of Defense 1984). The severity levels represent a qualitative judgment of the relative severities of the outcome of the uncorrected hazard.

Table 2: Hazard severity categories

Description	Category	Definition
Negligible	1	Less than minor injury, occupational illness, or system damage
Marginal	2	Minor injury, occupational illness, or system damage
Critical	3	Severe injury, occupational illness, or system damage
Catastrophic	4	Death or system loss

Detectability

The detectability metric is intended to reflect the probability that a hazard will be detected and corrected before it results in a mishap. The use of this metric assumes that detected hazards will be corrected, which is not necessarily a correct assumption. (A measure of detectability is sometimes included as part of the judgment of frequency or the likelihood that a mishap will result from a particular hazard.) Table 3 contains possible measures of detectability.

Table 3: Hazard detectability categories

Description	Level	Definition
Easy	1	Hazard obvious. Knowledge of hazard is "second nature.
Moderate	2	Hazard can be detected with usual effort. Operators generally aware of hazard.
Difficult	3	Hazard can be detected with unusual effort. Operators may be aware of hazard.
Improbable	4	Existence of hazard usually not detected. Operators generally unaware or unconcerned about hazard.

The evaluation of detectability is sometimes a critical component when evaluating the hazards of mechanical systems. In the case of on-deck crab fishing operations, this metric will also include a measure of the operator's likely awareness of the hazard. Frequency, severity, and detectability are combined to represent a concern level. The concern level is a general measure of how resources should be allocated to get the most "bang for the buck." The combination of frequency, severity, and detectability may be qualitative or quantitative through addition or multiplication of the three scores. In this paper, the three metrics are multiplied to accentuate potentially high-hazard procedures. The assessment column provides for any needed discussion of the concern level and the recommendation and status column allows for summary recommendations to be proposed and abatement status to be recorded.

General procedures in crab fishing

On-deck procedures during crab fishing, or other fishing operations utilizing pots, vary somewhat depending on the size and design of the boat on which the operations take place. However, several things must happen, regardless of boat size, that relate directly to the fishing operation. For example, the pots must be loaded onto the boat, moved to the launcher, prepared for launching, launched, retrieved, emptied, moved to on-deck storage, and unloaded from the boat. In addition, bait must be prepared, and the catch must be off-loaded from the hold. Support activities, such as loading supplies on board, general boat maintenance and repair, and galley operations, are not included. A sequential list of the general procedures in crab fishing is given below.

1. Load/off-load crab pots to/from on-deck storage; stack and secure on boat.
2. Move pots from on-deck storage stack to launcher.
3. Prepare pot for initial launching, coil line, bait pot, secure door.
4. Launch pot and throw out line and buoys.
5. Retrieve buoys, connect line to power block, bring in pot.
6. Attach pot to picking boom crane and move pot to launcher.
7. Move sorting table, transfer catch from pot to table.
8. Sort and move crab to hold.
9. Prepare pot for repeat launching (approximately the same as procedure 3) and repeat steps 4-8.
10. Move pots from launcher to on-deck storage.

Major items not in the above sequence include chopping bait and general on-deck movement. These procedures are illustrated in Figures 2 through 12 by number. Estimates of frequency, severity, and detectability are based on entries into ATR for 1991-1998 (n = 80) and the best initial estimates by a small group of professionals with experience in commercial on-deck crab fishing activities. It is anticipated and desirable that the identification of potentially hazardous conditions, as well as estimates of frequency, severity, and detectability, will be modified with further review of existing epidemiological data, the use of additional years of trauma registry data, and additional input from interested parties. The concern levels are intended to represent a relative ranking of the hazardous conditions in the included procedures and tasks. As noted earlier, the intent of this paper is to provide a starting point for the use of systems safety procedures to analyze on-deck commercial crab (or other) fishing operations systematically. While draft recommendations are sometimes presented, they are generally the result of previous studies and intended to stimulate discussion. They are not intended to be the primary result of this paper.

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Figure 2 : Load/off-load crab pots

Figure 3. Move pots from on-deck storage stack to launcher

Figure 4: Prepare pot for initial launching

Figure 5: Lauch pot and throw out line and buoys

Figure 6: Retrieve buoys, connect line to power pot, bring in pot

Figure 7: Attach pot to picking boom crane and move pot to launcher

Figure 8: Move sorting table, transfer catch from pots to table

Figure 9: Move and sort crab to hold

Figure 10: Move pots from launcher to on-deck storage

Figure 11: Chop bait

Figure 12: General on-deck movement

	PROCEDURE OR TASK	POTENTIALLY HAZARDOUS CONDITIONS	CAUSE	EFFECT	FREQ.	SEV	DETECT.	CONCERN	RECOMMENDATIONS
1	Load/unload pots to/from boat	High hand forces and awkward postures	Push/pull pots Climb on pots	Musculoskeletal injury/illness	1	2	2	**4**	Worker Training
		Moving pots/caught between	Pots move without worker knowledge Pots move too fast Pots shift due to boat movement	Crushing injury	2.5	3	2	**15**	Worker Training Increase communication between worker and crane operator/captain Improve control layout on crane More secure tie-off to dock
		Fall from height	Work above deck on stack of pots Slippery work surface	Contact trauma	1	4	1	**4**	Worker Training Footwear PPE?
		Fall on same level	Slippery work surface	Contact trauma	1	2	2	**4**	Worker Training Footwear
		Pot fall from overhead	Crane/gear failure Crane operator failure	Contact trauma	1	4	3	**12**	Crane maintenance Operator training Improve control layout on crane
2	Move pots from on-deck storage to launcher	High hand forces and awkward postures	Push/pull pots	Musculoskeletal injury/illness	1	2	3	**6**	Worker Training
		Caught between pot or other obstruction or struck by pot	Pot moves without worker knowledge Pot moves too fast Pot swings due to boat movement	Crushing/contact trauma injury	2.5	3	2	**15**	Worker Training Increase communication between worker and crane operator/captain Improve control layout on crane
		Pinch point at feet	Front edge of launcher moves toward deck	Foot caught between launcher and deck, crushing injury	1	3	2	**6**	Worker Training Identify pinch point area with bright paint Launcher "feet" or "pads" on deck (stumble hazard?)
		Fall from height	Work above deck Slippery work surface	Contact trauma	1	4	1	**4**	Worker Training Footwear PPE?
		Fall on same level	Slippery work surface	Contact trauma	1	2	2	**4**	Worker Training Footwear
		Pot fall from overhead	Crane/gear failure Crane operator failure	Contact trauma	1	4	3	**12**	Crane maintenance Operator training Improve control layout on crane
3	Prepare pot for initial launching	High hand forces and awkward postures	Open/close pot door	Musculoskeletal injury/illness	1	2	2	**4**	Worker Training
		High hand forces and awkward postures	Remove buoys and rope Hang bait	Musculoskeletal injury/illness	1	1	2	**2**	Worker Training

	PROCEDURE OR TASK	POTENTIALLY HAZARDOUS CONDITIONS	CAUSE	EFFECT	FREQ.	SEV	DETECT.	CONCERN LEVEL	RECOMMENDATIONS
4	Launch pot and throw out rope and buoys	Awkward postures while throwing	Bulky items	Musculoskeletal injury/illness	1	1	3	**3**	Worker Training
		Struck by launcher	Launcher movement	Contact trauma	1	1	1	**1**	N/A
		Moving rope	Uncoiling rope overboard	Man overboard	1	4	2	**8**	Training Warning sound PPE
5	Throw line, retrieve buoys, connect line to power block, bring in pot	Contact with hook	Hook movement	Contact trauma	1	1	1	**1**	N/A
		Awkward dynamic movement during throw	Hook weight Throw distance	Musculoskeletal stress at shoulder	1	1	3	**3**	
		Pull line in, high hand forces and awkward (hands at/above shoulder) postures		Musculoskeletal stress at shoulder	1	1	2	**2**	Worker Training
		Power block, caught in in-running nip point	Hand too close to in-running nip point Loose clothing	Crushing injury	1	3	2	**6**	Worker Training Tape sleeves Guarding?
6	Attach pot to picking boom and move pot to launcher, unhook from picking boom	Caught between pot and launcher or other obstruction	Pot moves without worker knowledge Pot moves too fast Pot swings due to boat movement Launcher tilts to deck	Crushing/contact trauma injury	1	3	2	**6**	Worker Training Increase communication between worker and crane operator/captain Improve control layout on crane
		Pinch point at feet	Front edge of launcher moves toward deck	Foot caught between launcher and deck	1	2	2	**4**	Worker Training Identify pinch point area with bright paint Launcher “feet” or “pads” on deck (stumble hazard?)
7	Relocate sorting table, transfer catch to table	Caught between table and launcher or other obstruction	Table moves without worker knowledge	Crushing/contact trauma injury	1	2	1	**2**	Worker Training
		Awkward posture and high repetition during catch transfer	Location of table with respect to pot	Musculoskeletal stress	1	1	2	**2**	Worker Training
8	Sort and move catch to hold	Awkward posture, high repetition, torso flexion	Need for speed, location of table with respect to hold	Musculoskeletal stress to shoulder and back	1	2	1	**2**	Worker Training
		Contact with sharp objects (crab, cod)	Catch characteristic, need for speed	Puncture wound	4	1	1	**4**	PPE (Gloves)
		Contact with sharp objects (crab, cod)	Catch characteristic, need for speed	Eye injury	1	3	1	**3**	PPE (Eye protection)

	PROCEDURE OR TASK	POTENTIALLY HAZARDOUS CONDITIONS	CAUSE	EFFECT	FREQ.	SEV	DETECT.	CONCERN LEVEL	RECOMMENDATIONS
9	Move pots from launcher to on-deck storage	High hand forces and awkward postures	Push/pull pots	Musculoskeletal injury/illness	1	2	3	**6**	Worker Training
		Caught between pot and other obstruction	Pot moves without worker knowledge Pot moves too fast Pot swings due to boat movement Launcher tilts to deck	Crushing/contact trauma injury	2.5	3	2	**15**	Worker Training Increase communication between worker and crane operator/captain Improve control layout on crane
		Fall on same level	Slippery work surface	Contact trauma	1	2	2	**4**	Worker Training Footwear
		Fall from height	Work above deck Slippery work surface	Contact trauma	1	4	1	**4**	Worker Training Footwear PPE?
		Pot fall from overhead	Crane/gear failure Crane operator failure	Contact trauma	1	4	3	**12**	Crane maintenance Operator training Improve control layout on crane
10	Chopping bait - mechanical	Nip point	Blades on bait chopper	Injury to hand	2	4	1	**8**	Worker Training Guarding Design of bait chopper to minimize perceived need to get hand close
	Chopping bait – manual (axe)	Movement of sharp object	Axe	Injury to hand	1	3	2	**6**	Worker Training Covers over small hatches Guardrails around large hatches
11	General on-deck activities	Fall on same level	Slippery work surface	Contact trauma	1	2	2	**4**	Worker Training Footwear
		Wash or fall overboard	High waves Boat movement	Hypothermia Drowning	2	4	1	**8**	Worker Training PPE Rescue procedures
		Contact with structure and equipment	High waves Boat movement	Contact trauma	1	2	1	**2**	Worker Training PPE

PRACTICAL DECK SAFETY FOR CRAB FISHERS

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Purpose

Crab fishers face some of the highest occupational injury and death rates in the nation. In Alaska, the fatality rate for the shellfish fishery was higher than all other fisheries in the industry with 356 fatalities per 100,000 fishers per year between 1991 and 1996, or about 50 times the national average (Lincoln and Conway 1997). While most fatalities were caused by vessels sinking or person-overboard events, most of the nonfatal injuries were caused by deck machinery or falls on board the vessel. The goal of this study was to find practical, inexpensive solutions to deck safety problems and disseminate that information to fishers. We approached the problem of deck safety from the fishers' perspective, using extensive input from fishers during the course of the project.

This project was not intended to be a basis for any type of new regulation for deck safety installations. It was only intended to provide fishers with the information required to make improvements on their boats if the modification were appropriate for their particular arrangements and circumstances. The nonregulatory approach was critical to the success of the project. Without this approach, we would have had great difficulty in getting ideas from fishers. We would also have had far more limited fisher participation in the survey.

Methods

The initial analysis of the most common injuries on crab fishing boats was taken from the Alaska Trauma Registry (ATR), which records all traumatic injuries requiring hospitalization in Alaska (Lincoln, Husberg, and Conway 2002). By its nature, this database only includes the more severe injuries. The ATR includes a short narrative description of the circumstances surrounding the injury. A sample description from the ATR reads "left hand caught in a bait grinding machine on board vessel." These descriptions were used to categorize incidents into a particular fishery, as well as sort them by type of incident (slip/fall, machinery, etc.). This research helped determine where the hazards are on deck, allowing us to better focus our efforts during the rest of the project.

The next step was to spend time on board a crab boat during fishing operations, both to observe likely hazards and to document the process of setting, retrieving, and otherwise handling pots. The use of all deck equipment was observed and documented in photos and video recordings. Project staff spent 2 days on board the *Royal Viking* out of Akutan, Alaska, observing pot cod fishing, which uses the same equipment and procedures as crab fishing.

Armed with first-hand knowledge of fishing operations, project staff held a focus group meeting with a small group of crab boat skippers, each of whom had over 20 years of experience in the Alaska crab fisheries. We discussed modifications they had already made to their boats to reduce deck injuries, toured one of the boats to view the modifications, and discussed which safety issues were most likely to be addressed by physical changes to the vessels.

After the focus group meeting, we developed a list of proposed modifications to vessels, combining the ideas listed in the focus group meeting with some of our own ideas. These ideas were used in a survey to be given in port to the largest group of crab fishers possible immediately prior to a crab season. We asked the fishers if each idea or modification would help improve deck safety and whether it had been implemented on their boat. If the modification was not in place, we asked why it had not been incorporated. We also collected basic information such as number of years experience in the fishery, vessel name, and crew position. Where necessary, we inserted drawings or photos into the survey to help explain ideas to fishers.

The survey was administered during October 2001 in Dutch Harbor, Alaska, immediately before the start of the Bristol Bay red king crab season. A total of 89 fishers from 75 different boats were surveyed by project staff and US Coast Guard personnel. Forty-one of the fishers surveyed were skippers, while the others held other positions in the crew. Forty-four of those surveyed had more than 20 years of experience in the fisheries, while 11 had less than 5 years experience. We believe that the survey sample reflects a representative cross-section of crab fishers.

Results

Following are interventions discussed in the survey.

Group I: Visibility

1. Install adequate lighting on deck. This increases visibility in dark areas and during night and helps the crew work more safely (Figure 1).
2. Use a closed-circuit TV system on house-forward boats. This helps the skipper see what is happening on deck from the wheelhouse. He or she can then become more easily aware of dangerous conditions and activity on deck (Figure 1).

Figure 1: Closed-circuit TV camera (in the round white housing) and extra lighting at bait chopper

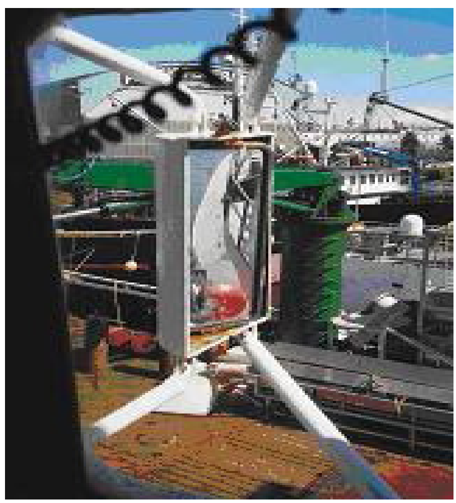

Figure 2: Truck mirror seen from inside wheelhouse

3. Install a truck mirror on the starboard side of the wheelhouse. This helps the skipper see work along the starboard rail and pot launcher (Figure 2).

Group II: Machinery

4. Install lock valves on cranes, haulers, or winches on older machinery. These valves make the machinery hold the load when the hydraulic valve is in the neutral position. On most hydraulic machinery, this is not a problem, since most machinery already has these valves installed.
5. "Footprint" the pot launcher. A small half-round or half-oval strip around the deck where the pot launcher meets the deck will outline hazardous areas. This will help the crew feel when their feet are starting to get into a dangerous working zone (potentially leading to crushed feet, toes, or lower extremities).
6. Install pressure relief valves on the pot launcher. This would keep the launcher from crushing a person underneath the launcher when it is being lowered from the upright position.
7. Install an emergency shut-off for the launcher near the launcher. This allows the crew to shut down the launcher quickly if a person is caught while it is moving.
8. Paint the hazardous zone around the launcher, and/or the launcher itself, a contrasting color. This helps the crew see the danger area around the pot launcher and makes the moving part of the launcher more visible.
9. Install "pot guides" on the outside of the bulwark (Figure 3). Pot guides are triangular stops that run vertically on the outside of the

Figure 3: Pot guides

bulwarks. In heavy seas, pot guides help the crew control the crab pot after it is out of the water, but before it is pulled over the rail on to the launcher.

10. Install a guard over the bait chopper. This helps prevent the crew from reaching into the chopper box and risking injury (Figure 4).
11. Install an emergency shut-off on the bait chopper. This allows another person to turn off the bait chopper if a fisher either has been injured by the chopper or is about to be injured.

Figure 4: Bait chopper guard made from old conveyor belt material.

Figure 5: Boat with raised bulwark on port side and raised pipe rail on starboard side

12. Mark the crane to help align it with the pot launcher. This allows the crew to position the crane head rapidly and accurately over the pot launcher, reducing the chance of injury from a swinging pot as it is being lifted or lowered at the launcher.

Group III: Crew protection

13. Install a raised bulwark on the port side or around the entire working deck. This provides a sheltered area that helps protect the crew from large waves coming over the side (Figure 5).
14. Install gratings over hold manholes. This prevents a fall into the hold manhole if the watertight cover must be removed. If the watertight cover is removed, some of the water circulating in the hold flows out on deck, helping reduce ice buildup on the deck.
15. Increase the rail height along the perimeter of the working deck. This helps prevent a wave from washing a crew member overboard (Figure 5).

16. Install nonskid grating in low-wear areas. Most crab boats are fitted with a steel or wood grating above the actual deck to prevent the crab pots from wearing away the watertight deck. Nonskid grating provides better footing in low-wear areas. However, it cannot be installed everywhere, since it will not stand up to the wear from the crab pots.
17. Install man-overboard recovery devices (life rings, life slings, flares, etc.) at the stern of the boat or at the hauling station. This helps the crew respond quickly to a person-overboard event.

After the data from the survey had been analyzed, we created a booklet describing each of the ideas we discussed in the survey. Since no idea received less than a 25% overall "approval rating," the project team decided to include all the suggested interventions in the booklet. However, some items were consolidated into general sections.

The project team also added some ideas to the booklet based on the surveys and discussions with fishers. The most significant of these was a section on emergency preparedness. Several fishers told us about the importance of planning ahead for emergencies, creating procedures for responding, and drilling the crew on those procedures. The emergency most commonly mentioned was person overboard. In this case, fishers said it was important to practice both returning the vessel to the person in the water and retrieving the person from the water.

The booklet gives the fishers all the information required to make an informed decision about whether each safety idea will work in given situations. For each idea, the booklet has a description of the idea with drawings and photos as necessary, what problem it is intended to solve, and how to go about making the change to the vessel. Approximate costs for implementing each idea were also included. The booklet was published and has been distributed widely throughout the West Coast, with particular emphasis on Alaska.

To further illustrate the improvement ideas, a model of a typical crab boat showing most of the safety ideas was made to display at conventions and trade shows. The model has attracted quite a bit of discussion and interest wherever it has been displayed.

Conclusions

This project has been an effective tool in finding low-cost, effective solutions to deck safety problems on commercial crab vessels and in distributing the information to the fleet. Fishers have been very willing to participate in the project and have appreciated the information presented in the booklet and deck model. Much of the success of this project has been due to the non-regulatory approach and assistance from fishermen's associations and the US Coast Guard. The success and acceptance of this project has led to a similar project working with smaller vessels engaged in longline, troll, seine, dive, and small-pot crab fisheries.

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AN EXPERIMENTAL COMPARISON OF MARINE VESSEL DECK MATERIALS AND FOOTWEAR SLIP RESISTANCE UNDER VARYING ENVIRONMENTAL CONDITIONS

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Introduction

Commercial fishing continues to rank at or near the top of the most hazardous occupations in the United States (US Coast Guard 1999). Commercial fishing is a complex industrial process that that can vary greatly among fisheries (NIOSH 1994). This type of work is often performed in extreme weather conditions and on unstable platforms. Work may be performed at extremes of temperature, daylight, and work hours. According to 1995 statistics, commercial fishing ranked as the most hazardous occupation in America. Second that year were sailors and deckhands on other classes of vessels (US Coast Guard 1999).

Historically, fishing vessel safety has been an on-going struggle between the rights of fiercely independent individuals willing or resigned to accept the hazards of their profession, and those from within and outside the industry who attempt to mitigate the extreme dangers of the business (US Coast Guard 1999). Numerous initiatives have been proposed and rejected or dampened. Most legislation enacted focuses on preparation and survival of catastrophic accidents and the availability of safety equipment during and after a disaster at sea. Prevention measures have been recommended by numerous organizations, but few have been developed into enforceable standards for the commercial fishing industry. Governmental agencies that have made occupational safety recommendations directed at the commercial fishing industry include the National Institute for Occupational Safety and Health (NIOSH), the Occupational Health and Safety Administration, the Coast Guard, the National Transportation Safety Board, the National

Marine Fisheries Service, and the National Research Council, to name a few. The almost unanimous conclusion from these organizations was to direct occupational safety initiatives that focus on accident prevention rather than incident mitigation.

Over 21% of the fatalities occurring in Alaskan waters involve falls on deck or falls overboard (Lincoln and Conway 1997). In 1994, these two types of falls were identified as major hazards aboard commercial fishing vessels and recommended the use of safety lines, guard rails, and nonskid decking materials. In 1997, this suggestion was reemphasized when NIOSH recommended that all fishermen wear personal flotation devices (PFDs) while on deck surfaces (Linoln and Conway 1997). The same report listed prevention efforts as critical factors that must be addressed; however, the use of PFDs was emphasized rather than the prevention of falls in the first place. The Coast Guard's landmark report from the Fishing Vessel Casualty Task Force, *Living to Fish, Dying to Fish* (1999), also identified falls as a common hazard on fishing vessels and recommended several items to be addressed relating to falls. These items include better research and development in the area of human factors engineering, occupational safety awareness, industrial safety standards, wearing of PFDs, and the development of "good marine practices."

In preventing slips and falls, the concept is simple: Use a flooring (deck) surface that has a coefficient of friction high enough not to be "slippery" (English 1996). This is can be accomplished in a number of ways; however, in the marine industry, it is frequently addressed by the application of "nonskid" deck coatings, particularly on steel-decked vessels. In a commercial fishing environment, decks can become more slippery because of water, ice, snow, oils, fish/shellfish body tissues and fluids, and other potential deck contaminates. Friction cohesion can also be altered by deck angles and motions caused by sea conditions.

The performance and effectiveness of deck materials and coatings in combination with personnel footwear remain relatively unevaluated as they relate to personnel falls in the commercial fishing industry. The problem to be dealt with in this study was to analyze and compare the effectiveness of various available deck materials and coatings and footwear under laboratory conditions that would simulate the actual environmental conditions that might be encountered during commercial fishing activities. There was also a need to validate the marketing claims of those producing an increasing variety of deck surfaces and footwear available to vessel owners, builders, and operators.

In land-based industrial settings, slip resistance of floor surfaces may be generally measured through the use of tribometers or horizontal pull dynamometers to calculate a coefficient of friction and apply it toward a standard. Based on consensus standards, proposed regulations, and case law (English 2000), the standard for a safe level of friction is generally recognized to be a coefficient of friction of 0.50 or higher. It should be noted that this is for level surfaces. The Americans with Disabilities Act recommends wheelchair access ramps have a minimal static coefficient of friction of 0.80 or higher (English 2000).

Slip resistance is a complicated science. It is generally recognized among researchers that slip resistance is affected by a number of factors, including shoe bottom material and texture, floor (deck) material and finish, environmental contaminants, and pedestrian gait or ambulation dynamics (English 1996). It is also generally recognized that surface slope, cross slope, and surface movement can affect slip resistance; however, the majority of published research appears to address level and stable pedestrian walking surfaces.

In this study, 36 different combinations of boot/surface/contaminant experiments were examined using a novel testing device—a dynamic shoe tester designed to simulate parameters of human ambulation on normal walking surfaces. The device is named the English XST Traction Tester (US patent 5 259 236). An analysis of variance (ANOVA) was performed on the raw sample data to detect interactions and significance levels. The test slip index readings were compared by surface contaminant, deck coating, and footwear, and any interactions were noted.

A common theme among more modern slip-resistance studies is the attempt to correlate surface roughness measurements to dynamic friction properties. While it is commonly known that floor and shoe texture properties affect slip resistance, more modern research seems to be directed at better measuring the specifics of surface roughness. Current researchers, such as Chang, Grönquvist, and Bunterngchit, seem to generally agree that a strong relationship exists between surface roughness measurements and slip resistance results. The methods for measuring surface roughness and surface characteristics can also vary widely. The hardness characteristics of walking surfaces and footwear bottoms are generally not taken into account in slip resistance research. Facility owners, such as a grocery store chain for example, may have little control over pedestrian footwear. Therefore, much US research tends to be litigation-driven and geared toward floor surfaces rather than ideal combinations of floor and footwear. With the exception of Grönqvist (Gronqvist, Roine et al. 1990), little published research has been directed toward mariner ambulation and slip resistance aboard work vessels. Because the crews on board a fishing vessel are "captive" in the sense they can't leave the work space, this situation presents an ideal environment where slip resistance research concerning deck surface-footwear combinations could be of benefit.

Materials and methods

This study was designed to explore the relationship and causal factors between several variables affecting slip resistance. It concentrated on a limited number of deck surfaces and work boots under varying environmental conditions simulated in a laboratory setting. Pedestrian gait dynamics for personnel aboard marine vessels was not a consideration in this study as no reliable reference concerning the gait dynamics of marine personnel could be found, and a test device that mimics such pedestrian gait dynamics (specific to marine deck locomotion) could not be located.

Numerous slipmeters have been designed or developed to assess floor slipperiness. These slipmeters can produce quite differing results, and some may not provide reliable data when used on contaminated surfaces (Chang 1999). Most slipmeters are designed for testing floor surfaces only and do not allow for the incorporation of footwear. A small number of machines reported in the literature allow for the use of footwear during testing. The demand for a traction testing device to rate the performance of footwear on contaminated surfaces is present but is complicated by fundamental problems that include the lack of a recognized device and standards for its use. The slipperiness of deck coatings and footwear combinations was assessed with the English XST Traction Tester (Figure 1).

The principle of operation for slip resistance measurement by the device is calculated by measuring the tangent of the angle of incidence at which the test boot will slip when brought into contact with the test surface. The slip resistance measurement is referred to as the "slip resistance index" rather than a static or dynamic coefficient of friction. The device gives test indications in degrees of angle-of-incidence or as a slip resistance index (Figure 2).

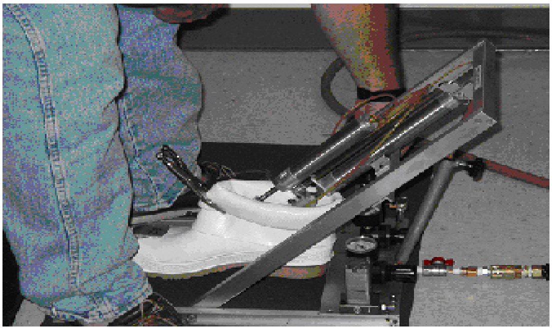

Figure 1: English XST Footwear Traction Tester and boot

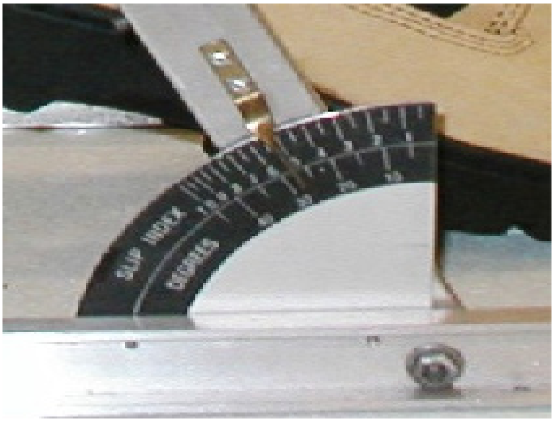

Figure 2: Slip index scale

Marine deck coating samples were applied to identical sheets of mild carbon deck steel cut to 36 by 18 inches to facilitate test standardization. The four deck coatings used in the study are commercially available and are formulated and marketed for the marine industry. Three are marketed as slip-resistant coatings or additives to coatings, while one was simply marine deck paint. The coatings were chosen to represent different types of materials used to increase the roughness of marine deck surfaces. All coatings were applied according to the manufacturer's specifications.

The following summarizes the four types of deck coating selected.

1. Painted steel with no aggregate or textured material incorporated.
2. Painted steel with aluminum oxide grit mixed with paint.
3. Painted steel with rubber-crumb grit mixed with paint.
4. Steel coated with a spray-foam application of polyurethane (also commercially marketed as a pickup truck bed spray liner under the name Rhinoliner).

Work boots selected for the study are all commercially available work boots designed for industrial or marine use. Three boot styles were selected for evaluation and are generally classified as follows:

1. All-purpose steel-toed industrial work boot with oil-resistant lug sole.
2. Soft-soled PVC work boot (known locally as a white "shrimpers" boot).
3. Soft-soled, industrial polyblend work boot impregnated with strips of "renewable" aluminum oxide grit (marketed as slip-resistant boots).

Three levels of contaminants with increasing levels of viscosity were chosen for the study to test the boot/coating combinations under varying environmental conditions.

1. Dry (no contaminant applied).
2. Wet (distilled water).
3. Oil (SAE 20).

All contaminants were applied manually with spray bottles until an even film of contaminant covered the test surface. Test boot sole and heel surfaces were also evenly contaminated prior to each test run.

Test procedure

All test procedures were performed at the University of Southern California in the Department of Biokinesiology and Physical Therapy's Musculoskeletal Biomechanics Research Laboratory. The procedure required 36 different combinations to be tested. Each test combination (coating-boot-contaminant) was repeated four times with the direction of boot travel parallel to the longest side of the test surface. The tests were then repeated four times with the direction of boot travel parallel to the shortest side of the test surface. This provided a total of eight test results for each test combination for a total of 288 tests. The test results were then averaged for each test combination.

The test device incorporates a cycle timer so that the same forces and force duration are applied to each shoe tested. To initiate the testing sequence, a plunger on the test device is manually depressed. The device will then proceed through an automatic test cycle. The test cycle causes the test boot to contact the test surface in a heel-first manner. The test boot rotates about a simulated "ankle" joint until it rests flat on the test surface. A horizontal force, along with the vertical force, is then applied, causing (or not) the footwear to slide forward along the test surface. The testing cycle for each test combination was repeated until a slip occurred four times. The test device was then rotated 90°, and the test sequence was repeated until a slip condition occurred four more times in the perpendicular direction.

The test device has an adjustable frame that allows the test boot angle of incidence to be manipulated with a set screw. The frame was adjusted during the test sequence until the angle of incidence was high enough to cause a slip. This slip was quite evident as shown by the continued forward motion of the test boot in the testing device. Because of the relative crudeness of the frame mechanics, all slip index readings were rounded to the nearest 0.05. The test device measurement gauge indicated an angle of incidence or slip index. Calculating the tangent of the angle of incidence derives the slip index figure.

Statistical analyses

ANOVA was performed on the raw sample data to detect interactions and significance levels. The test slip index readings were compared by surface contaminant, deck coating, and footwear, and any interactions were noted.

Results and discussion

The test results for the surface-boot combinations under dry conditions show that all test combinations failed to produce a slip. Since most slip accidents are related to contaminating conditions, it is not surprising that the dry surfaces would not be considered "slippery." The test data do not suggest that the combinations will not cause a slip, only that the test device limits were reached prior to reaching a slip condition.

All surface-boot combinations but two failed to slip up to the limits of the test device. Not surprisingly, both slips occured on plain painted steel. Data for the wet tests also show that when a deck surface was treated with one of the slip-resistant coatings, results rose significantly.

While surface roughness measurements were not a part of this experiment, it was assumed that plain painted steel would have the lowest surface roughness figure. Crude measurements of surface aggregate peak-to-valley distances were taken using a dial micrometer and indicated that surface 2 peaks averaged 127 μ, surface 3 averaged 254 μ, and surface 4 averaged about 152 μ. Surface 1 was relatively smooth and glassy, averaging a peak-to-valley distance of 25.4 μ. Although surface 3 appears to have the highest peak-to-valley surface characteristics (approximately 254 μ), it did not perform as well as the two test surfaces (2 and 4) and had less pronounced peaks. This could be attributed to other surface roughness characteristics not measured or to some compressability factor of the rubber crumb aggregate in the surface coating. While the rubber crumb aggregate gave improved results over plain painted surfaces, the crumb material did not appear to be hard enough to sufficiently engage the soles of the test boots to prevent a slip. This type of surface aggregate is commonly used in water slide and other amusement parks where patrons spend a good deal of time barefoot. The ability for soft rubber crumb to "engage" a bare human foot may be quite different than for engaging a hard boot sole.

Most combinations of surface and boot produced a slip condition during oil contamination down to the lower detection limits of the test device. Three test combinations failed to produce a slip at the device's upper detection limit. Oily contaminant performance on surface 4 appeared to be excellent with boots 2 and 3. Two combinations produced mid-range values when subjected to oil contamination. During testing, boot 3 grit strips absorbed the oil contaminant and grit particles were easily abraided from the boot surface, so that they acted as a type of ball bearing to actually increase slips. These two factors likely contributed to poorer performance on most surfaces during the oil tests.

In these series of tests, three test combinations failed to produce a slip under all three contaminating conditions. These three superior combinations were traditional footwear and nonskid paint, grit-impregnated boots, and foamed polyurethane deck coating. Specialized boot surfaces or deck coatings appeared to offer practical alternatives to traditional deck surfaces to help provide better traction while performing work at sea. Two of the polyurethane coatings tested also offered a high degree of corrosion and chemical resistance. Nontraditional deck surfaces, both above and below the weather deck, can offer a high degree of slip resistance and greater comfort while walking or standing or when a fall does occur.

This study illustrates that the traction characteristics of marine deck walking surfaces can be evaluated and improved with footwear and surface combinations in a laboratory setting. Some of these evaluation techniques and test equipment have only become available in the last few years. Likewise, the market has seen a flood of new products claiming to improve slip resistance.

For a vessel owner or builder, more choices are now available regarding decking surfaces and crew footwear.

Footwear and surface combinations can only be compared to one another within the scope of this study, since the test device used is different than those used in other studies in the published literature. This method may prove useful to the marine industry, particularly if used in conjunction with subjective human evaluations of footwear and deck coatings. Factors that may be pertinent to material selection for marine businesses, such as cost and durability, were not evaluated or considered in this particular study; however, all the materials used are commercially marketed for use in marine industries, are relatively cost-effective, and are durable in industrial marine settings.

While general knowledge in the marine industry holds that grit coatings, such as surface 2, can provide a more slip-resistant deck surface, these coatings can abraid equipment, such as fishing nets, and catch if sorted from the deck. These surfaces can also be hard and abrasive to personnel if someoe does fall. Specialized surface coatings, such as 4, appear to offer a practical alternative for marine decks when used with appropriate footwear and would likely be less abrasive to equipment or personnel.

The test conditions in this study were designed to simulate actual environmental conditions that may be found in a marine environment. Several useful test devices are available that could be used under actual field conditions in future studies. The results of this study offer information useful in slip resistance research, but cannot explain all possible interactions. A number of questions remain that offer many possibilities for expanded research. Recommendations for further study include refinements to the line of investigation presented in this study and development of new analysis techniques for footwear and surface combinations on marine work surfaces. Research should also include ambulation studies of work aboard marine vessels, development of improved slip-resistance testing devices, expansion of the types of surfaces and footwear tested, and further exploration of roughness and compressability factors on nontraditional deck surfaces. A comprehensive investigation into the incidence and causes of slips and falls aboard marine vessels can also help guide future maritime tribometric investigations.

Acknowledgments

The laboratory tests for this study were conducted at the University of Southern California, Musculoskeletal Biomechanics Research Laboratory. Special thanks are given for use of the laboratory and equipment during the course of this research. The East Carolina University School of Allied Health, Department of Biostatistics, assisted with the statistical analysis. Although the study itself was self-funded, the Coast Guard provided and funded numerous opportunities for research networking as well as the presentation of study results.

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A VESSEL SAFETY AND SEAFOOD PROCESSOR ORIENTATION PROGRAM FOR WESTERN ALASKANS

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Abstract

Federal legislation established the Community Development Quota (CDQ) program to allow Bering Sea communities to share in the commercial harvest of many species. The Norton Sound Economic Development Corp., representing 15 villages, formed a partnership with the Alaska Vocational Technical Center to train area residents for processing jobs on factory trawlers that harvest pollock and other species of fish. This paper describes the CDQ program, the marine safety and seafood processing training program, and the benefits it has provided to Norton Sound residents.

Introduction

The Bering Sea is one of the most productive parts of the world's oceans. It is estimated that 20% of the fish directly consumed by people on the planet comes from its bounty. This amounts to some 1.5 million tons of fish per year (Witherell 2000). Unfortunately, even after the transitions from foreign harvest, to joint ventures, to the largely American harvest of the resource late in the 20th century, people in the communities of western Alaska adjoining the Bering Sea did not see much economic benefit. With many of the corporate interests and larger vessels based outside Alaska, there was little incentive to include economically depressed regions of western Alaska in the decisions concerning resource management of the Bering Sea.

Community Development Quota program

After hard work by Alaska political leaders and strong support by the Alaska Congressional delegation, a plan to share some of the bounty of the Bering Sea with the region's residents evolved. The Community Development Quota (CDQ) program was begun in December 1992 (State of Alaska 2003) and formalized by the US Congress under the Magnuson-Stevens Fishery Conservation Act (1992). In the initial CDQ program 7.5% (approximately 100,000 metric tons) of the annual harvest of pollock in the Bering Sea was allowed to be harvested by entities representing the people living in communities bordering on the Bering Sea. The program stipulated that the communities that lay within 50 nautical miles of the Bering Sea form associations to arrange for the harvest of the pollock resource. They were to use the proceeds of the fishery for the economic benefit of the people in the region.

The original 56 communities formed six associations. Based on the number of persons represented by the association and analysis of business plans submitted to the State of Alaska Department of Community and Regional Affairs, a share of the CDQ allocation was granted to each association. Careful oversight by the State of Alaska and the U.S. Department of Commerce mandates accountability.

The initial program demonstrated success, and it has evolved over the years. There are now 65 villages participating. The CDQ share of the annual pollock harvest has increased to 10%. There is now also a CDQ allocation of other Bering Sea species, including king crab, tanner crab, Pacific cod, halibut, and sablefish. While the program is not without its critics, there is no doubt that appreciable economic benefits have come to the region. In 2002, 1,900 CDQ jobs brought $12 million in wages to western Alaska (State of Alaska 2002).

The 15 villages in the Norton Sound region of Alaska formed the Norton Sound Economic Development Corporation (NSEDC) to pursue economic development based on their allocation of fishery quota. It established a partnership with the Glacier Fish Company of Seattle to catch much of the resource quota. The relationship has proven successful to the point that NSEDC now owns 50% of the Glacier Fish Company.

Since a significant objective of the CDQ program is to provide gainful employment to western Alaska residents, NSEDC looked for job opportunities aboard factory trawlers. While many residents of the region rely heavily on subsistence resources and some are engaged in near-shore commercial fisheries on small vessels, few individuals had experience or training for the distant-water fisheries practiced by the large factory trawlers, which generally had their home port in Seattle.

Vessel safety and seafood processor orientation program

Working with the management of Glacier Fish Company, the NSEDC Board of Directors determined careful screening and training of candidates would be a precondition for employment aboard the factory trawlers. Three times each year the training coordinator of NSEDC recruits potential workers. Each village has a local representative who can talk to people and provide information. Applications are forwarded to the training coordinator who makes the selection of who will participate in training.

The chosen individuals are brought to Nome, Alaska, as a central city in the region. To reinforce NSEDC and Glacier Fish Company's zero tolerance of illicit drug use, everyone is given a pre-employment drug screening. The Coast Guard mandates zero tolerance for illegal drug use aboard all US commercial vessels, and so the rules are set for workers from the start. Since the nature of the work is strenuous, individuals are also given fitness-for-duty physical examinations.

Many candidates have little experience outside the region and the whole process is meant to prepare them for what lies ahead. Accordingly they travel by airplane and then bus from Nome, to Anchorage, to Seward to begin the training process.

The Alaska Vocational Technical Center (AVTEC) is located in Seward and is part of the State of Alaska Department of Labor and Work Force Development. NSEDC has formed a training partnership with AVTEC because of a number of factors. The Maritime Department has more than 10 years of experience orienting CDQ and specifically NSEDC trainees for work on factory processors. Trainees must adapt to dormitory life and cafeteria food in a new town away from friends and family. This is similar to changes they will experience with shipboard life. Strict rules about drug and alcohol use are enforced as they would be on board the Glacier ships. Students must adhere to a regular class schedule. The training is varied but focuses on four general subject areas: Safety and Survival at Sea, First Aid and CPR, Commercial

Fishing Methods, and Fish Processing Technology. Competencies are clearly defined at the start of classes, and employment is preconditioned on successful completion of the 2-week class. Hands-on skills are emphasized as much as possible.

It is hoped that those who successfully complete the training process have the self-discipline to adapt to new circumstances and not be distracted by alcohol. They should have a solid knowledge of personal survival equipment, first aid, industrial safety, commercial fishing methods, and processing methods. Individuals should also have a sense of how well they are suited to the rigors of shipboard life and the duties of a seafood processor. While people are strongly encouraged to complete the training program, they are under no obligation to go to sea. NSEDC feels many of the skills taught in the orientation program, such as cold water survival and first aid, will have application to the lives of people whether at home in the village or on a factory trawler.

At the end of the 2-week orientation program, a human resources manager from Glacier Fish Company interviews those persons interested in at-sea employment. They fill out applications and federally required paperwork. Individuals are given an approximate schedule of when there might be job openings for new employees, as well as company policies on travel, pay, and advancement. At this point, motivated individuals should be prepared for the ship-board workplace and will bring a realistic but enthusiastic attitude to the job.

The class schedule followed while the trainees are in Seward is shown on the next two pages. A typical school day runs from 0830 to 1700. The various components of the class are taught in blocks with the intent that immersion is the best way to enhance learning.

The first day begins with an orientation to the facilities and schedule. School rules and competencies required for successful course completion are presented. Since many individuals are unfamiliar with nautical vocabulary and parts of a ship, lectures and exercises deliver this material early in the course. Relevant videos are often used throughout the course to emphasize key points.

The module of the course dealing with Safety Equipment and Survival illustrates the relationship between lectures and hands-on skills. As shown in the schedule, a variety of topics is covered. Reference material is provided by is-

ALASKA VOCATIONAL TECHNICAL CENTER
CLASS SCHEDULE

Seafood Processing and Marine Safety Orientation Class
WEEK ONE

Time	Monday	Tuesday	Wednesday	Thursday	Friday
SESSION 1	Introductions, orientation to facilities + staff, schedule, competencies, expectations	Preparation for an Emergency Seven Steps to Survival	Life Raft Equipment and Launch	Fire Fighting	Personal equipment and supplies for a two month voyage
SESSION 2	Overview of the history and intent of the CDQ program and NSEDC opportunities	Hypothermia Coldwater Near Drowning	Signals EPIRB	Fire Fighting	Ergonomics and proper lifting techniques
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
SESSION 3	Bering Sea Nautical vocabulary	Personal Floatation Devices Immersion Suits	Radio communications MAYDAY	Fire Fighting with hand held extinguisher and flare exercise	Industrial Safety
SESSION 4	Layout of Factory Trawlers Parts of a ship On board life	Immersion suit Practice Life Raft	Helicopter Rescue	Station Bill and On Board Drills Safety Exam	Industrial Safety
HOME WORK	Reading	Pool Session	Reading Review for Exam	Prepare list of personal equipment for a two month voyage	First Aid Reading

ALASKA VOCATIONAL TECHNICAL CENTER CLASS SCHEDULE

Seafood Processing and Marine Safety Orientation Class
WEEK TWO

Time	Monday	Tuesday	Wednesday	Thursday	Friday
SESSION 1	First Aid	First Aid	First Aid Exam Commercial Fish Species	Processing Operations	Product Quality Control
SESSION 2	First Aid	First Aid	Long lining	Processing Operations	Surimi and Meal Production
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
SESSION 3	First Aid Skills	First Aid CPR	Demersal Trawling	Product Quality Control	Processing Exam Course Evaluations
SESSION 4	First Aid	First Aid	Mid-Water Trawling	Field Trip	Presentation of Certificates Job Interviews with Glacier Fish Company
HOME WORK	Reading	Review for First Aid Exam	Reading	Reading and Review for Exam	Finished

suing each student a copy of the book *Beating the Odds in Northern Waters* (Clark-Jensen and Dzugan 2002). Nightly reading is assigned. In one section of this module, lectures and discussion cover preparation for an emergency, hypothermia, cold water near-drowning, and person overboard. Emphasis is placed on the use of immersion suits as a key method of enhanced survival in cold Alaska waters. After discussion and demonstrations, each individual is issued an appropriately sized immersion suit. They are required to inspect the suit for material damage, lubricate the zipper, and practice donning it. For nearly all trainees, this is their first exposure to this critical piece of gear, and some need more practice and guidance than others. As illustrated by the competency checklist, the students must be able to don the suit in the classroom in less than 2 minutes, although with practice, nearly everyone is able to do it in less than a minute in competitive time trials. While not timed, everyone also needs to don a suit in the dark to demonstrate familiarity with the gear.

In the controlled environment of the local high school swimming pool, the trainees are able to gain confidence in the buoyancy of immersion suits and various personal flotation devices (PFDs). In-water skills minimally include swimming a distance with an immersion suit, properly entering the water from a height of 1 meter while wearing a suit, climbing into an inflatable life raft from the water, righting a capsized life raft, and comparing the comfort and effectiveness of various PFDs in the water.

While some individuals are excellent swimmers, others have had negative in-water experiences or are nonswimmers. The goal is to have all trainees gain confidence in the equipment that could save their lives in an emergency. It is extremely gratifying for the AVTEC maritime instructors to see a nonswimmer overcome his or her fear and trepidation of being in the water and use the equipment properly. Because most ships conduct drills monthly (US Code of Federal Regulations 2002), there is regular practice in donning immersion suits, but this pool exercise is one of the few times individuals get to use suits and rafts in the water. Students must dry and maintain all the equipment they use in the pool. This time-consuming task emphasizes the importance of proper care for safety equipment.

First aid and cardio-pulmonary resuscitation (CPR) are skills that may be useful to people in all phases of their lives. It is an aspect of the safety training that individuals can make use of on the vessels and at home in the village. This module is based on a Coast Guard-approved first-aid and CPR course.

Students who successfully pass a written test and demonstrate the skills listed below are issued a card valid for 2 years. The intent is to help individuals render immediate assistance until a person of greater medical training and ability arrives on the scene. The students can then be of assistance to that person. Students are more enthusiastic about training when they are actively engaged in performing skills on manikins or each other.

The material presented in the Safety and Survival and First Aid modules of the course is similar to those modules in the International Maritime Organization's (IMO) Basic Safety Training course (International Maritime

NORTON SOUND ECONOMIC DEVELOPMENT CORPORATION

SEAFOOD PROCESSING AND SAFETY ORIENTATION CLASS

REQUIRED COMPETENCIES

XX PUT ON A SURVIVAL SUIT IN LESS THAN TWO MINUTES

XX PUT ON A SURVIVAL SUIT IN THE DARK

XX SWIM 50 YARDS IN A SURVIVAL SUIT

XX RIGHT A LIFERAFT WITH A SURVIVAL SUIT

XX ENTER A LIFERAFT WITH A SURVIVAL SUIT

XX CLEAN, DRY, AND MAINTAIN A SURVIVAL SUIT

XX DEPLOY AT LEAST ONE FLARE

XX MAYDAY (WRITE OUT OR STATE FROM MEMORY)

XX EXTINGUISH A DIESEL FIRE WITH A HAND-HELD EXTINGUISHER

XX SHOW LIST OF PERSONAL EQUIPMENT & SUPPLIES FOR A 2-MONTH VOYAGE

XX WATCH VIDEOS IN FISHERIES SURVIVAL SERIES

XX WATCH VIDEOS IN NPFVOA SAFETY AND SURVIVAL SERIES

XX WATCH VIDEOS IN AFTA INDUSTRIAL SAFETY SERIES

XX ATTEND U.S.C.G. APPROVED FIRST AID COURSE (CARD ISSUED: YES / NO)

XX ATTEND C.P.R. COURSE (CARD ISSUED: YES / NO)

XX PASS A WRITTEN TEST ON SEAFOOD PROCESSING AND TRAWLER ORIENTATION WITH A MINIMUM SCORE OF 70%

XX PASS A WRITTEN TEST ON MARINE SAFETY WITH A MINIMUM SCORE OF 70%

XX HAVE NO MORE THAN FOUR SESSIONS OF UNEXCUSED CLASS TIME

XX OBSERVE ALL SAFETY RULES

STUDENT INSTRUCTOR DATE

Organization 1997). This program provides more time in lectures and skills practice than the minimums suggested by the IMO. Because many individuals have had little or no marine safety training, it is felt this provides a solid foundation for course objectives and cultivates a positive attitude toward safety.

Students are given an overview of relevant commercial fishing methods for species they are likely to encounter. Basic fish anatomy and identification are presented as well. As seafood processors, the main focus of their work

Elementary First Aid Course

Required Competencies

AVTEC - Seward Alaska

Student's Name: ____________________

Practical Exercises

____ Adult One-Person CPR

____ Adult Rescue Breathing

____ Adult Concious Choking

____ Adult Unconcious Choking

____ External Bleeding Control

____ Shock Position

____ Recovery Position

____ Clothes Drag

____ Lifting Technique

____ Log-Roll

Written Examination

____ Score a minimum of 70% on a written exam.

Classroom

____ Have no more than one (1) hour of unexcused class time.

____ Observe all safety rules.

Date completed: ________________ Assessor ___________________ Initials _______ will be on producing quality food products at sea. Treating all fish caught as the food someone will be eating sets the stage for the importance of quality. Basic bacteriology and the theory of autolysis are described, as is the critical nature of temperature in the spoilage process.

Trainees are lectured on the various fish processing machines with which they will be working and the different jobs on the processing line. The season of the year and market forces will dictate the product being emphasized. For example, pollock roe production is the focus in January with varying percentages of fillets and surimi throughout the rest of the year. Meal production is also described.

NSEDC has been committed to this safety training and processor orientation program for more than 10 years. Six-hundred individuals have participated in this program over the years. With successful course completion, the trainees have the option for at-sea employment on Glacier Seafood ships. Some chose not to go to sea, while others are enthusiastic about the opportunity. Some make a few trips and lose interest, but some Norton Sound residents mesh well with the work and integrate regular trips into their lifestyle. The cash flow to the region from seafood processor wages has been significant. The most recent figures indicate more than $8 million in direct worker wages have flowed into the region since NSEDC began preparing people through this training program. Because of the low availability of jobs in most area villages, seafood processing jobs on Glacier ships represent an important economic option to motivated and trained individuals.

Conclusions

The NSEDC Seafood Processing and Safety Orientation program provides an opportunity to screen individuals interested in employment opportunities aboard the Glacier Fish Company factory trawlers. Often individuals have had little experience outside their village and no marine safety training. The skills-based course and overview of what they can expect in terms of daily life at sea readies individuals for jobs at sea. Many of the skills learned and demonstrated in the program, such as first aid and water safety, prove useful in their day-to-day lives when individuals return to their communities. This program has qualified individuals for employment that has yielded important economic benefits to the Norton Sound region. With careful management of the fishery resource in the Bering Sea and continued dedication to the training and employment goals of the Community Development Quota program, Norton Sound Economic Development Corporation will provide economic benefits to the people of the region.

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