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Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

www.nsc.org

Occupational traumatic injuries among offshore seafood processors in Alaska, 2010–2015☆☆☆☆

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ARTICLE INFO

Article history:

Received 19 March 2018

Accepted 12 July 2018

Available online xxxx

Keywords:

Fish processing

Food manufacturing

Worker safety

ABSTRACT

Introduction: The US Coast Guard and Federal Occupational Safety and Health Administration have identified the Alaskan offshore seafood processing industry as high-risk. This study used Coast Guard injury reports to describe patterns of traumatic injury among offshore seafood processors, as well as identify modifiable hazards. *Methods:* From the reports, we manually reviewed and abstracted information on the incident circumstances, injury characteristics and circumstances, and vessel. Traumatic injury cases were coded using the Occupational Injury and Illness Classification System, and a Work Process Classification System. Descriptive statistics characterized worker demographics, injuries, and fleets. *Results:* One fatal and 304 nonfatal injuries among processors were reported to the Coast Guard during 2010–2015 across multiple fleets of catcher-processor and mothership vessels. The most frequently occurring injuries were: by nature of injury, sprains/strains/tears (75, 25%), contusions (50, 16%), and fractures (45, 15%); by body part affected, upper extremities (121, 40%), and trunk (75, 25%); by event/exposure resulting in injury, contact with objects and equipment (150, 49%), and overexertion and bodily reaction (76, 25%); and by source of injury, processing equipment and machinery (85, 28%). The work processes most frequently associated with injuries were: processing seafood on the production line (68, 22%); stacking blocks/bags of frozen product (50, 17%); and repairing/maintaining/cleaning factory equipment (28, 9%). *Conclusions:* Preventing musculoskeletal injuries, particularly to workers' upper extremities and trunks, is paramount. Some injuries, such as serious back injuries, intracranial injuries, and finger crushing or amputations, had the potential to lead to disability. *Practical applications:* Safety professionals and researchers can use the study findings to inform future intervention efforts in this industry. Hazard control measures should target: (a) overexertion from lifting and lowering objects and equipment; (b) equipment and boxes falling and striking workers; (c) workers being caught in running machinery during regular operations; and (d) slips, trips, and falls.

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1. Introduction

Offshore seafood processors work in a demanding environment that combines the occupational safety and health challenges faced in the commercial fishing and food manufacturing industries. The U.S. seafood

processing industry comprises onshore establishments and vessels operating at sea that engage in the following activities: eviscerating fresh fish by removing heads, fins, scales, bones, and entrails; shucking and packing fresh shellfish; processing marine fats and oils; smoking, salting, and drying seafood; canning seafood; and freezing seafood (NAICS, 2017). Two types of vessels engage in extensive seafood processing. Catcher-processors have the capacity both to harvest seafood using various types of gear on deck, and then to process, package, and freeze the catch in a factory below deck. Processor vessels – also known as floating factories or “motherships” – receive the catch that is harvested by other vessels and then process, package, and freeze it. Vessels' specific processing and packaging activities, seafood products (e.g., fillets, surimi, roe), and crew sizes vary by fleet. Fleets are groups of vessels that operate in the same geographic region, fish for and/or process the same species, and use the same type of gear (e.g., trawl, longline, pot). Only U.S.-flagged vessels are permitted to participate in fisheries within the U.S. Exclusive Economic Zone, which extends up to 200 nautical miles offshore (NOAA, 2017a). The American Fisheries

Q1 ☆ **Acknowledgments:** The authors express sincere gratitude to Daniel Hardin, Commercial Fishing Vessel Safety Coordinator for the 13th US Coast Guard District, and Garrison Bromwell, US Coast Guard Auxiliary, for their support in accessing reports and abstracting data for this study.

☆☆ **Funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

★ **Disclaimer:** The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of company names or products does not imply endorsement by the National Institute for Occupational Safety and Health.

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<https://doi.org/10.1016/j.jsr.2018.07.008>

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Please cite this article as: Syron, L.N., et al., Occupational traumatic injuries among offshore seafood processors in Alaska, 2010–2015, *Journal of Safety Research* (2018), <https://doi.org/10.1016/j.jsr.2018.07.008>

Act of 1998 (46 CFR Part 356) further limits foreign involvement in U.S. fisheries and stipulates that U.S. citizens must retain 75% ownership and control of these vessels (MARAD, n.d.).

In Alaska, processing seafood is a critical step in the supply chain that brings this valuable natural resource to market. During 2015, Alaskan fishermen harvested the majority of the nation's seafood, at 6 billion pounds, and generated the largest portion of the national revenue, at \$1.7 billion, with subsequent processing adding value to the product (NMFS, 2016). That year, Alaska's Division of Environmental Health approved seafood processing permits for 87 vessels that had the capability to process over 5000 lb of seafood per day (Alaska Division of Environmental Health, 2017). Approximately 3500 people worked onboard these catcher-processors and motherships, with only 6% being Alaska residents (Alaska Department of Labor, 2017). Working onboard these vessels in Alaska is difficult, requiring physical and mental endurance. When recruiting employees, companies describe how the vessels operate in remote locations, are wet, cold, and noisy environments, and the living conditions at sea are cramped. They explain that processors' work shifts are long, and tasks typically monotonous, with prolonged periods of standing, repetitive movements, and heavy lifting. Their photographs show processors wearing personal protective equipment such as: slip-resistant boots; waterproof pants, overalls, and jackets; gloves of various materials (depending on task); hearing protection; safety glasses; and hard hats (Glacier Fish Company, 2017; Premier Pacific Seafoods, 2017; Signature Seafoods, 2017; Trident Seafoods, 2017).

The U.S. Coast Guard and Federal Occupational Safety and Health Administration (OSHA) share jurisdiction over regulating worker safety and health onboard catcher-processors and motherships in Alaska, with OSHA's jurisdiction extending to 'uninspected vessels' under 5000 gross tons when operating within 3 nautical miles from the coastline (OSHA, 2010). Both agencies have identified offshore seafood processing as high-risk. Coast Guard regulations for processing vessels are more stringent than regulations for vessels that only harvest the catch, including classification and load line requirements (USCG, 2009). Factors that increase the safety and operational risks to fleets that engage in extensive processing activities within a factory include: having sizeable crews; utilizing processing and freezing machinery; using hazardous gases in refrigeration systems; and having the ability to freeze and store the catch, allowing crews to operate in remote areas that are far from search and rescue support (USCG, 2006). For all fleets, the Coast Guard's fatality prevention activities focus on emergency preparedness. OSHA determined that offshore seafood processing was a high-hazard industry in Alaska and therefore developed a Local Emphasis Program (LEP), which is an enforcement strategy to address hazards that pose a particular risk to workers (OSHA, 2017a). The LEP has been in effect for over a decade and established policies and procedures for regularly-programmed inspections (OSHA, 2016). OSHA's activities focus on preventing fatal and nonfatal injuries and illnesses among offshore processing workers.

Working offshore presents unique risks, including the potential for vessel disasters and falls overboard. Risks vary by vessel and fleet. In July 2016, the F/V Alaska Juris, an aging freezer-trawler built in the 1970s, sank in the Bering Sea more than 126 miles west of Adak, putting at risk the lives of 46 crewmembers, who successfully abandoned ship and were rescued (NTSB, 2017). Recently, a report assessed vessel disasters and fatalities due to traumatic injury during 2002–2014 in the Bering Sea/Aleutian Islands Pollock fleet (AFA fleet), which includes catcher vessels, catcher-processors, and motherships. Among the processor crewmembers, two fatal falls overboard in Alaskan waters occurred in 2003 and 2007. In terms of fatality and vessel disaster frequency, this fleet was found to be among the safest as compared with other Alaskan fleets. However, the report also found that future research was necessary to identify safety hazards related to nonfatal injuries (Case, Lucas, & Mason, 2017). Nonfatal injuries and illnesses constitute the vast majority of workplace incidents and can be severe, resulting

in lowered productivity, lost worktime and wages, lowered quality of life, and disability.

Working in a factory to manufacture food presents additional risks. Hazards in the onshore seafood processing industry include exposures to: bioaerosols containing allergens, microorganisms, and toxins; bacterial and parasitic infections; excessive noise levels; low temperatures; poor workplace organization; poor ergonomic practices; and contact with machinery and equipment (Jeebhay, Robins, & Lopata, 2004). Risk factors for musculoskeletal disorders in this industry include: highly repetitive and forceful upper extremity movements; localized mechanic stress; awkward and/or static postures at workstations; prolonged standing; and temperature extremes (Aasmoe, Bang, Egeness, & Løchen, 2008; Kim, Kim, Son, & Yun, 2004; Nag, Vyas, Shah, & Nag, 2012; Ólafsdóttir & Rafnsson, 2000; Quansah, 2005). Recent studies of onshore seafood processing in Washington State and Oregon have shown high rates of accepted workers' compensation claims in this industry compared to others (Anderson, Bonauto, & Adams, 2013; Syron, Kincl, Yang, Cain, & Smit, 2017).

Few occupational safety and health studies of the Alaskan commercial fishing industry have discussed nonfatal injuries and illnesses among processors (Beaudet et al., 2002; Lucas, Kincl, Bovbjerg, Lincoln, & Branscum, 2014; Neitzel, Berna, & Seixas, 2006; NIOSH, 2016a; Syron, Lucas, Bovbjerg, Bethel, & Kincl, 2016). To date, no epidemiologic study has focused solely on offshore processors across the multiple catcher-processor and mothership fleets in Alaska. This study's objectives were to determine patterns of traumatic injury characteristics and circumstances among offshore seafood processors working in Alaskan waters during 2010–2015, as well as identify modifiable hazards. The long-term goal of this research is to inform injury prevention strategies.

2. Methods

2.1. Case definition

Companies that operate commercial fishing industry vessels are legally required to report to the Coast Guard any "injury that requires professional medical treatment (treatment beyond first aid) and, if the person is engaged or employed on board a vessel in commercial service, that renders the individual unfit to perform his or her routine duties" (Code of Federal Regulations, Title 46, Section 4.05-1). Companies use the "CG-2692 Report of Marine Casualty" form to document the details of incidents, including writing a narrative description of what occurred (USCG, 2016). This study included all cases of fatal and nonfatal traumatic injuries among seafood processors working in Alaskan waters during 2010–2015 that were reported to the U.S. Coast Guard. A traumatic injury was defined as: "any wound or damage to the body resulting from acute exposure to energy... caused by a specific event or incident within a single workday or shift" (BLS, 2016). Not included in this study were disorders resulting from cumulative trauma (e.g., carpal tunnel syndrome, repetitive motion strains, and noise-induced hearing loss) or illnesses (e.g., infections, heart attacks, and diabetes-related complications). Offshore seafood processors were considered at work and exposed to potential hazards any time while at sea, even if they were off duty. Processors complete tasks in the factory and freezer, as well as offloading the frozen product from the vessel once it returns to shore. Workers onboard catcher-processor vessels sometimes perform a combination of tasks related to both harvesting and processing the catch. For this study, if "combination" workers were injured while performing deckhand duties related to harvesting the catch, then they were not included as cases.

2.2. Data sources

The National Institute for Occupational Safety and Health (NIOSH) Western States Division manages the Commercial Fishing Safety Research and Design Program. This program's ongoing surveillance

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