Capsizing and Sinking of Commercial Fishing Vessel *Scandies Rose* Sutwik Island, Alaska December 31, 2019

Marine Accident Report

NTSB/MAR-21/02
PB2021-100924

National Transportation Safety Board

NTSB/MAR-21/02
PB2021-100924
Notation 67259
Adopted June 29, 2021

Marine Accident Report

Capsizing and Sinking of Commercial Fishing Vessel *Scandies Rose* Sutwik Island, Alaska December 31, 2019

National Transportation Safety Board

490 L'Enfant Plaza SW
Washington, DC 20594

National Transportation Safety Board. 2021. ***Capsizing and Sinking of Commercial Fishing Vessel*** **Scandies Rose,** ***Sutwik Island, Alaska, December 31, 2019*****. Marine Accident Report NTSB/MAR-21/02. Washington, DC: NTSB**.

Abstract: On December 31, 2019, about 2200 Alaska standard time, US Coast Guard Communications Detachment Kodiak received a distress call from the commercial fishing vessel *Scandies Rose*. The vessel was en route from Kodiak to fishing grounds in the Bering Sea when it capsized about 2.5 miles south of Sutwik Island, Alaska, and sank several minutes later. At the time of the accident, the *Scandies Rose* had seven crewmembers aboard, two of whom were rescued by the Coast Guard several hours later. The other missing crewmembers were not found and are presumed dead. The *Scandies Rose*, valued at $15 million, was declared a total loss. Safety issues identified in this report include the effect of extreme icing conditions, the vessel's inaccurate stability instructions, need to update regulatory guidelines on communicating and calculating icing for vessel stability instructions, and lack of accurate weather data for the accident area. As part of its accident investigation, the National Transportation Safety Board makes four recommendations to the Coast Guard, one recommendation to the National Oceanic and Atmospheric Administration, one recommendation to the National Weather Service, and one recommendation to the North Pacific Fishing Vessel Owners' Association. The NTSB also reiterates two recommendations to the Coast Guard.

For more detailed background information on this report, visit the NTSB Case Analysis and Reporting Online (CAROL) website and search for NTSB accident ID DCA20FM009. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting—

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, SW
Washington, DC 20594
(800) 877-6799 or (202) 314-6551

Copies of NTSB publications may be downloaded at no cost from the National Technical Information Service, at the National Technical Reports Library search page, using product number PB2021-100924. For additional assistance, contact—

National Technical Information Service
5301 Shawnee Rd.
Alexandria, VA 22312
(800) 553-6847 or (703) 605-6000
NTIS website

Contents

Figures

Tables

Acronyms and Abbreviations

AIS	automatic identification system
BSAI	Bering Sea/Aleutian Islands
CFR	*Code of Federal Regulations*
D17	Coast Guard district 17
EPIRB	emergency position indicating radio beacon
GT	gross tonnage
MBI	Marine Board of Investigation
MSC	Marine Safety Center
MSIB	Marine Safety Information Bulletin
NOAA	National Oceanic and Atmospheric Administration
NPFVOA	North Pacific Fishing Vessel Owners' Association
NWR	National Weather Radio
NWS	National Weather Service
OPC	Ocean Prediction Center
PLB	personal locator beacon
ROV	remotely operated vehicle
SAR	search and rescue
SCC	safety compliance check
SOLAS	*International Convention for the Safety of Life at Sea*
USCGC	United States Coast Guard Cutter
UTM	ultrasonic thickness measurements
VHF	very high frequency
WRF	Weather Research and Forecasting Model

Executive Summary

Accident

On December 31, 2019, about 2200 Alaska standard time, US Coast Guard Communications Detachment Kodiak received a distress call from the fishing vessel *Scandies Rose*. The vessel was en route from Kodiak to fishing grounds in the Bering Sea when it capsized about 2.5 miles south of Sutwik Island, Alaska, and sank several minutes later. [1] At the time of the accident, the *Scandies Rose* had seven crewmembers aboard, two of whom were rescued by the Coast Guard several hours later. The other missing crewmembers were not found and are presumed dead. The *Scandies Rose*, valued at $15 million, was declared a total loss.[2]

According to the surviving crewmembers, the vessel had begun to encounter freezing spray and accumulate ice from 0200 to 0800 on the day of the accident. By 2037, the captain of the *Scandies Rose* noted that his vessel was icing "really bad" and had developed a 20° starboard list. He was trying to seek shelter southeast of Sutwik Island, but when he changed course, the vessel's list worsened. At 2155, the captain of the *Scandies Rose* broadcasted a mayday call.

The NTSB's 2021–2022 Most Wanted List of Transportation Safety Improvements includes the issue area "Improve Passenger and Fishing Vessel Safety." Fishing consistently tops the list of most deadly occupations, due, in large part, to challenging work environments, such as poor weather and rough waters. Per the Coast Guard, there are 58,000 commercial fishing vessels in service in the United States, and between 2000 and 2020, there were 805 fatalities, 164 missing, and 2,122 injured in commercial fishing vessel accidents in the United States.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the capsizing and sinking of the commercial fishing vessel *Scandies Rose* was the inaccurate stability instructions for the vessel, which resulted in a low margin of stability to resist capsizing, combined with the heavy asymmetric ice accumulation on the vessel due to localized wind and sea conditions that were more extreme than forecasted during the accident voyage.

[1] Unless otherwise noted, all *miles* in this report are nautical miles (1.15 statute miles).

[2] Insured value of vessel taken from "F/V *Scandies Rose* Condition and Valuation Survey," completed by Fishermen's Maritime Services, Inc.

Safety Issues

The safety issues identified in this accident include the following:

- **The effect of extreme icing conditions.** Sea spray icing is a serious hazard to marine vessels because the ice accumulates over exposed decks and exterior surfaces of a vessel, adding weight that may ultimately capsize a vessel. Sea spray icing occurs in environmental conditions where cold, wave-generated spray contacts exposed surfaces and air temperatures are below freezing.

- **The vessel's inaccurate stability instructions.** Stability instructions for a vessel lay out different loading scenarios that a master can follow to ensure the vessel meets the stability criteria established by regulators. The intent of the regulatory requirements is to provide information to vessel operators that will enable them to readily ascertain the stability of their vessel under varying loading conditions and to operate them in compliance with applicable stability criteria. The *Scandies Rose*'s inaccurate stability instructions gave the vessel a smaller margin of safety than intended by the regulations.

- **Need to update regulatory guidelines on calculating and communicating icing for vessel stability instructions.** Stability regulations factor in a minimum set amount of added weight for accumulated ice from freezing sea spray on continuous horizontal and vertical surfaces. However, the regulations do not provide guidance on how to apply ice accumulation on crab pots, which consist of tubular frames and mesh, and have additional ice accumulation internally. Nor do they account for reported asymmetric ice accumulation on exposed vessel surfaces and pot stacks. Additionally, stability instructions are currently not required to present the accumulated ice thicknesses used to calculate vessel stability, which, if communicated to masters, would better prepare them in decision making.

- **Lack of accurate weather data for the accident area.** The area around Sutwik Island and west of Kodiak Island is subject to bad weather with northeast through northwest winds and cold air moving across the Alaska Peninsula. When observation sites are more spread out in remote areas like Alaska, the data do not accurately represent the entire area, which can lead to inaccurate and less precise forecasts and weather modeling.

Findings

- None of the following were safety issues for the accident voyage: (1) the captain's predeparture decision-making, (2) operational pressures, (3) fatigue, (4) drug and alcohol use, (5) the vessel's propulsion and steering systems, or (6) the vessel's hull integrity.

- Based on the voyage timeline and the estimated ice accumulation over that period, the *Scandies Rose* likely accumulated between 6 and 15 inches of ice on surfaces exposed to wind and icing during the accident voyage.

- Although the captain's decision to proceed to Sutwik Island was reasonable, by the time he was close enough to turn into the lee, the icing conditions had accelerated and reduced the vessel's stability.

- The added weight from ice accumulating asymmetrically on the vessel and the stacked crab pots on deck raised the *Scandies Rose*'s center of gravity, reducing its stability, and contributing to the capsizing.

- Although the crew loaded the *Scandies Rose* per the stability instructions on board, the stability instructions were inaccurate; therefore, the vessel did not meet regulatory stability criteria and was more susceptible to capsizing.

- Because the stability instructions were inaccurate, the captain was unaware that his vessel did not meet the margin of safety intended to be provided by the stability regulations.

- Current regulatory guidelines on calculating the effects of icing on a fishing vessel's stability do not take into account how ice actually accumulates on and in crab pots and crab pot stacks.

- If vessel captains were aware of the amount of icing that is factored into their stability instructions, they would be better prepared to make critical vessel safety decisions when operating in areas of potential icing.

- Formal stability training would provide fishing vessel crews with a better understanding of the principles and regulatory basis of stability, including the effect of icing.

- An oversight program to review and audit stability instructions produced for uninspected commercial fishing vessels, like the *Scandies Rose*, that are not required to carry a load line certificate, could identify and reduce potential errors in stability instructions, which in turn may reduce the chance that vessels are sailing without the intended margin of safety provided by applicable stability criteria.

- Due to the limited surface observation resources near Sutwik Island and the Chignik Bay region along the fishing vessel route from Kodiak to Dutch Harbor, the National Weather Service cannot accurately forecast the more extreme localized wind and sea conditions for the area, which can lead to vessels encountering conditions that are worse than expected.

- The National Weather Service Ocean Prediction Center website could provide mariners with more detailed, graphical icing information not currently available elsewhere, which would help them make decisions based on more accurate weather information.

- Personal locator beacons would aid in search and rescue operations by providing continuously updated and correct coordinates of crewmembers' locations.

Recommendations

New Recommendations

As a result of its investigation of this accident, the NTSB makes the following seven new safety recommendations:

To the US Coast Guard:

Conduct a study to evaluate the effects of icing, including asymmetrical accumulation, on crab pots and crab pot stacks and disseminate findings of the study to industry, by means such as a safety alert. (M-21-05)

Based on the findings of the study recommended in Safety Recommendation M-21-05, revise regulatory stability calculations for fishing vessels to account for the effects of icing, including asymmetrical accumulation, on a crab pot or pot stack. (M-21-06)

Revise Title 46 *Code of Federal Regulations* 28.530 to require that stability instructions include the icing amounts used to calculate stability criteria. (M-21-07)

Develop an oversight program to review the stability instructions of commercial fishing vessels that are not required to possess a load line certificate for accuracy and compliance with regulations. (M-21-08)

To the North Pacific Fishing Vessel Owners' Association:

Notify your members (Bering Sea/Aleutian Islands Crabbers/Fishing Vessel fleet) of the specifics of this accident, the amount of ice assumed when developing stability instructions, and the dangers of icing. (M-21-09)

To the National Oceanic and Atmospheric Administration:

Increase the surface observation resources necessary for improved local forecasts for the Sutwik Island and Chignik Bay region in Alaska. (M-21-10)

To the National Weather Service:

> Make your Ocean Prediction Center freezing spray website operational and promote its use in industry. (M-21-11)

Previously Issued Recommendations Reiterated in This Report

As a result of its investigation of this accident, the National Transportation Safety Board reiterates Safety Recommendations M-11-24 and M-17-45, which are currently classified "Open—Unacceptable Response":

To the US Coast Guard:

> Require all owners, masters, and chief engineers of commercial fishing industry vessels to receive training and demonstrate competency in vessel stability, watertight integrity, subdivision, and use of vessel stability information regardless of plans for implementing the other training provisions of the 2010 Coast Guard Authorization Act. (M-11-24)
>
> Require that all personnel employed on vessels in coastal, Great Lakes, and ocean service be provided with a personal locator beacon to enhance their chances of survival. (M-17-45)

1. Factual Information

1.1 The Accident

On December 31, 2019, about 2200 Alaska standard time, US Coast Guard Communications Detachment Kodiak received a distress call from the fishing vessel *Scandies Rose* (see figure 1).[1] The vessel was en route from Kodiak to fishing grounds in the Bering Sea when it capsized about 2.5 miles south of Sutwik Island, Alaska, and sank several minutes later.[2] At the time of the accident, the *Scandies Rose* had seven crewmembers aboard, two of whom were rescued by the Coast Guard several hours later. The remaining crewmembers were not found and are presumed dead. The *Scandies Rose*, valued at $15 million, was declared a total loss.[3]

Two days prior, on December 29, the captain and six crewmembers of the *Scandies Rose* prepared the vessel for departure from Cannery Row in Kodiak to participate in the Bering Sea pot cod fishery, which was scheduled to open on January 1, 2020. The crew, consisting of four deckhands, an engineer, and a deck boss, worked late into the night loading and securing 195 combination crab pots on the vessel (collectively, the pots were referred to as a "pot stack").[4]

The pots were on the main deck forward of the wheelhouse, predominately stacked in tiers five pots high. The majority owner and surviving crewmembers were not certain what the status of the three crab tanks were but agreed that the no. 1 tank was most likely empty, while the nos. 2 and 3 tanks were most likely filled with salt water, because that was how the vessel was typically loaded when operating with a full stack of pots on deck.

[1] All times reported are Alaska standard time.

[2] Unless otherwise noted, all *miles* in this report are nautical miles (1.15 statute miles).

[3] For more information, see the factual information and analysis sections of this report. Additional information can be found in the public docket for this National Transportation Safety Board (NTSB) accident investigation (case number DCA20FM009) by accessing the Accident Dockets link at www.ntsb.gov. For information about our safety recommendations, see the Safety Recommendation Database at the same website.

[4] *Combination crab pots* are submerged traps used for fishing. Commonly referred to as "crab pots," combination pots are used for fish as well.

Source: Gerry Cobban Knagin

Figure 1. *Scandies Rose* arriving in Kodiak, Alaska, before the accident (date unknown).

The next day, December 30, the crew prepared the vessel for sea and ensured "everything was tight." They chained the pot stack, secured hatches, and tested bilge level sensors. The vessel then shifted to a fueling dock where the crew loaded diesel fuel and potable water. The majority owner believed that 2,100 gallons of fuel taken prior to departure was intended to top off the no. 2 port and starboard wing tanks and that the no. 1 port and starboard wing tanks were likely empty. The no. 3 and aft port and starboard wing fuel tanks were also likely full at the time of departure. Company documents show that the crew purchased 15,016 pounds of bait, which was loaded in the forward storeroom. The crew also topped off the potable water tanks before departure.

The captain, who was the vessel's certified safety drill instructor, conducted drills with the crew, including discussions about the engine room fixed fire-extinguishing system, locations of liferafts, and the vessel's emergency position indicating radio beacon (EPIRB), and how to make a mayday call. [5] One crewmember demonstrated how to don an immersion suit. [6] In interviews following the accident, the surviving deckhands described the captain's safety drill as being "very thorough." The safety drill was documented on a company form, signed by all crew, and sent to the vessel manager.

In addition to the safety drill, the captain and crew discussed the weather forecast for the proposed route. Following the accident, Deckhand 2 told the NTSB that all the crewmembers, including the captain, knew the weather "was going to be bad" and that the

[5] Title 46 *Code of Federal Regulations (CFR)* 28.270, "Instruction, drills, and safety orientation," requires that "the master or individual in charge of each vessel must ensure that drills are conducted and instruction is given to each individual on board at least once each month."

[6] An *immersion suit* is a protective suit that reduces the body-heat loss of a person wearing it in cold water. See section, "1.5.5 Lifesaving and Safety Equipment."

captain had mentioned that the vessel would be going into icing conditions, where there would be a potential for sea spray to freeze to the vessel and the crab pots.[7] The vessel manager noted that the captain checked the weather frequently and had direct links on his computer (on the bridge) to both the National Weather Service's (NWS) Alaska information, which included marine forecasts, and to Windy.com, a weather forecasting website that is also available as an application (app) on mobile devices.[8] In addition, the NWS marine forecast was broadcasted continuously over very high frequency (VHF). Five hours before the *Scandies Rose* departed, the NWS issued a marine forecast that included a gale warning and a heavy freezing spray warning for the vessel's proposed route.

Table 1. NWS wind and freezing spray warnings.[9]

Winds	Freezing Spray
Gale Warning Sustained surface winds, or frequent gusts, in the range of 34 knots (39 mph) to 47 knots (54 mph)	**Freezing Spray Advisory** Accumulation of freezing water droplets on a vessel at a rate of less than 2 cm/hr caused by some appropriate combination of cold water, wind, cold air temperature, and vessel movement
Storm Warning Sustained surface winds, or frequent gusts, in the range of 48 knots (55 mph) to 63 knots (73 mph)	**Heavy Freezing Spray Warning** Accumulation of freezing water droplets on a vessel at a rate of 2 cm/hr or greater caused by some appropriate combination of cold water, wind, cold air temperature, and vessel movement
Hurricane Force Wind Warning Sustained winds, or frequent gusts, of 64 knots (74 mph) or greater	

At 2035 on December 30, the *Scandies Rose* got under way from the North Pacific Fuel dock and departed Kodiak, maintaining an average speed of about 9–10 knots. The vessel's planned route was through the Kupreanof Strait, then southwest for its voyage through the Shelikof Strait toward False Pass en route to the Bering Sea, as shown in figure 2.[10]

While the *Scandies Rose* was under way and not fishing, the captain and crew would take turns standing a navigation watch and steering the vessel. On the accident

[7] (a) The NTSB conducted postaccident interviews with the two surviving crewmembers, referred to as Deckhand 1 and Deckhand 2. See section 1.6, "Crew Information." (b) *Sea spray icing* occurs when cold, wave-generated spray contacts exposed surfaces and air temperatures are below freezing. Sea spray icing is a serious hazard to marine vessels because the ice accumulates over exposed decks and exterior surfaces of a vessel, adding weight.

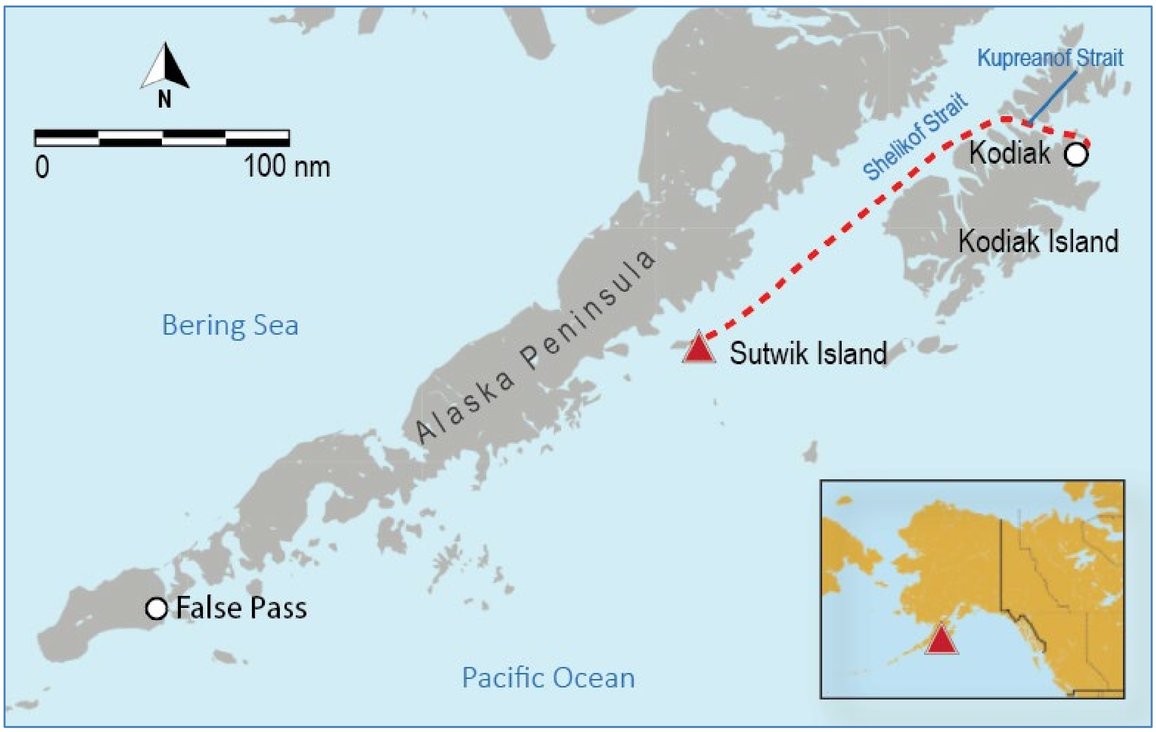
[8] Windy.com users can customize their experience by selecting from a multitude of layers such as wind, temperature, weather warnings, precipitation, etc. For more information, see section 1.7.5, "Meteorological Resources for Mariners."

[9] Source: Coastal Warning Display Program (weather.gov)

[10] *Scandies Rose* position, speed, and heading obtained through publicly available automatic identification system data.

voyage, the captain created a watch rotation that had him operating the vessel for 6 hours and each of the other six crewmembers operating the vessel for 1 hour. After 12 hours, the rotation would repeat. Both Deckhand 1 and Deckhand 2 told the NTSB that although they were tired after working long hours preparing the vessel for departure, they were able to sleep and felt rested once the vessel was under way.

About 0200 on December 31, the *Scandies Rose* exited Kupreanof Strait and entered Shelikof Strait, between the south side of the Alaska Peninsula and the west coast of Kodiak Island. The vessel steadied on a southwesterly course that followed the Kodiak coastline. The captain instructed the watch to maintain a heading of 240° and a speed of about 8 knots. The captain passed the watch to one of his crewmembers and departed the bridge.



Background source: Google Maps

Figure 2. *Scandies Rose*'s approximate route, as indicated by the red dotted line, and its eventual sinking location, indicated by the triangle.

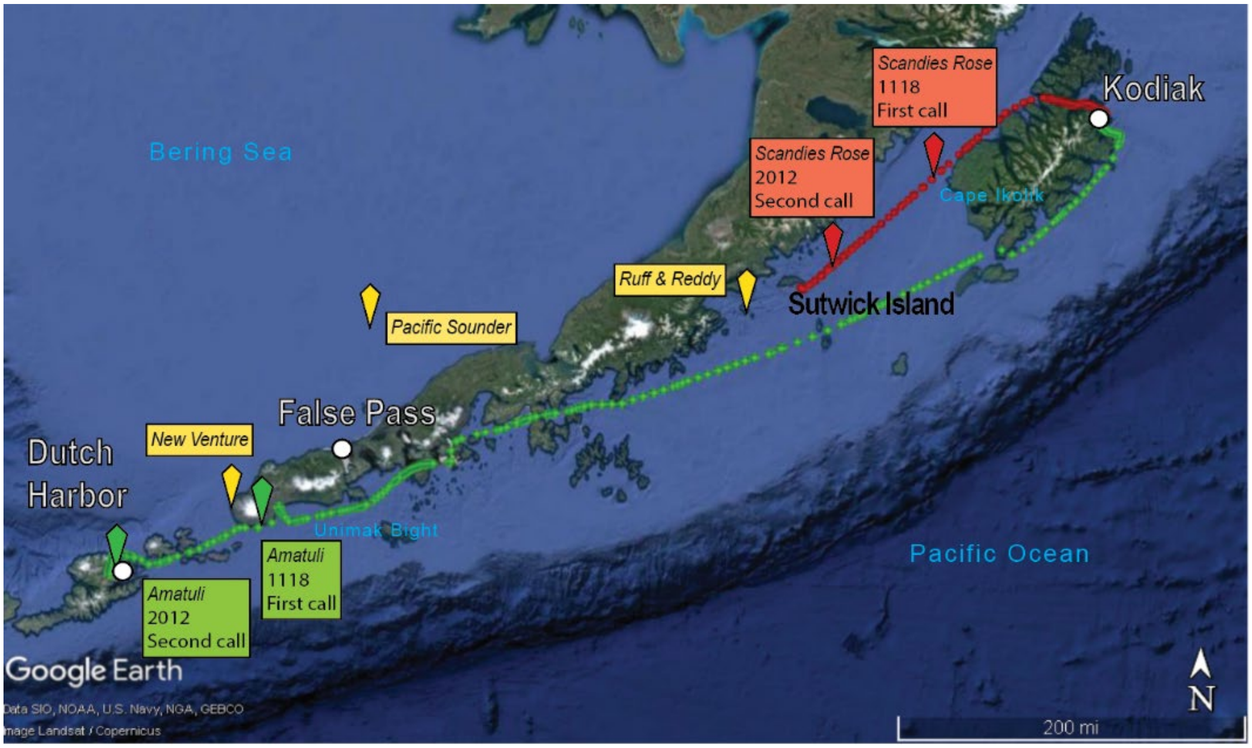
From 0200 to 0800, the crew of the *Scandies Rose* rotated through their hourlong bridge watches. At the end of each watch, the off-going crewmember would complete a round of the engine room to ensure the vessel's engines and auxiliary equipment were in good working order. The vessel had begun to encounter freezing spray and accumulate ice. The crew made estimates of ice accumulation on the vessel and crab pots from inside the vessel's bridge, although only two of the windows had heaters and did not ice over. Deckhand 1, who stood the 0600–0700 watch, told the NTSB that he had observed about 1 inch of ice "filling in the mesh" of the forward starboard pots and accumulating on the exterior railings of the vessel. Deckhand 2, on watch from 0700–0800, told the NTSB that the weather had picked up from the night before, with wind and waves acting on the starboard bow of the vessel. He noted that they had taken a "couple" waves over the bow of the vessel and that ice was accumulating on the starboard side of the vessel and "building" on the forward pots. Both crewmembers noted that the amount of accumulated ice on the vessel at that time was not enough to warrant manual removal.[11]

At 0800, when Deckhand 2 passed the watch to the captain, the vessel had an even keel, with no list or heel.[12] At 1118, with the vessel about 17 miles west of Kodiak Island's Cape Ikolik, the captain called the fishing vessel *Amatuli,* which had departed Kodiak ahead of the *Scandies Rose,* using the vessel's satellite "tag" phone.[13] The captain of the *Amatuli* was the majority owner of the *Scandies Rose*; the two captains spoke on the phone for about 12 minutes.

[11] Manual removal requires the vessel to slow or stop, to head into the wind, and the crew to use sledgehammers or other tools to knock off the accumulated ice. Slowing the vessel also reduces the amount of sea spray produced. (National Oceanic and Atmospheric Administration [NOAA] 2005)

[12] *List* and *heel* are terms used to describe the angle a vessel reaches off upright.

[13] The *Scandies Rose* was equipped with satellite communications, which allowed for internet access and voice calling. In addition, the vessel had a separate Mitsubishi Trac/Tag phone system that allowed for satellite voice calling.



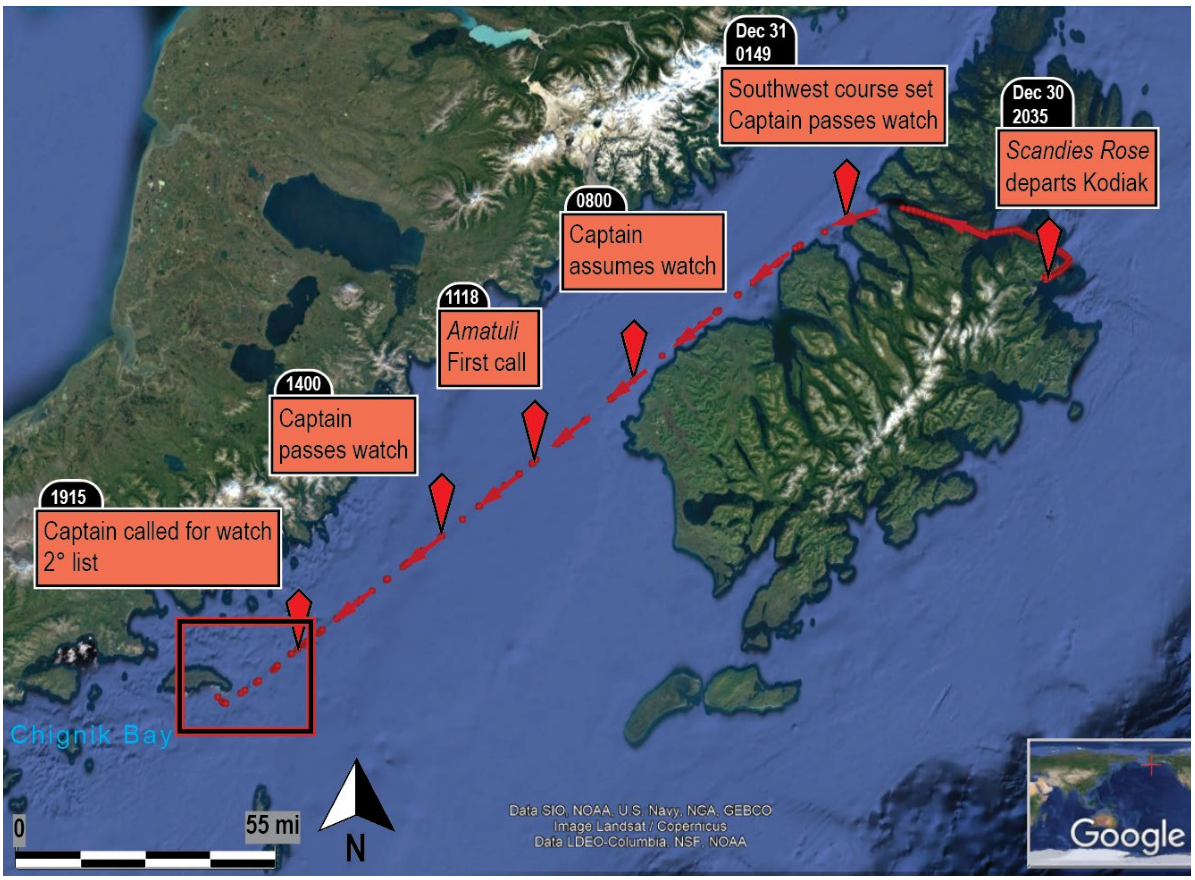
Background source: Google Earth

Figure 3. Tracklines of the *Scandies Rose* (red) and *Amatuli* (green). Positions of nearby fishing vessels that reported weather conditions are marked (yellow).

The *Amatuli*, which was en route to Dutch Harbor and then on to the Bering Sea to tender cod, had left Kodiak on December 28, taking a southerly route around Kodiak instead of the northwesterly route taken by the *Scandies Rose* (see figure 3). [14] The captain of the *Amatuli* told the NTSB that in order to fulfill his tender contract obligation, the vessel had to be in Dutch Harbor by January 1. At the time of the 1118 call with the *Scandies Rose*, the *Amatuli* was about 16 miles east of Unimak Pass. Before the two ended their 12-minute phone conversation, the captain of the *Scandies Rose* said that it was "very cold," his vessel was experiencing light icing, and the sea conditions were poor.

[14] A fish tendering vessel commercially supplies, stores, refrigerates, or transports fish to or from a fishing, fish processing, or fish tender vessel or a fish processing facility.

About 1400, after finishing his 6-hour watch, with the *Scandies Rose* still maintaining about the same course and speed, the captain passed the navigation watch to his crew. For the next 6 hours, the crew rotated through wheel watches. The vessel's heading remained steady on a southwesterly course, and the average speed decreased to 6.5 knots (see figure 4 for a closer map of the course). Deckhand 1 told the NTSB that the vessel's engine speed remained constant throughout the journey. The wind and weather "started coming up a lot more, and progressively got worse all day," Deckhand 2 recollected. He also told the NTSB that the vessel was "bucking" into the seas and was "making a lot of spray, and the spray was making ice."



Background source: Google Earth

Figure 4. Timeline of the *Scandies Rose* voyage. For detail of red inset box, see accident site map, figure 5.

About 1915, the crewmember on watch, Deckhand 2, called the captain to wake him for the 2000–0200 watch. Shortly after, the captain arrived on the bridge. The two discussed the worsening weather, the accumulating ice on the vessel's superstructure and crab pots, and the development of an approximately 2° starboard list. They considered reducing the vessel's speed and altering course to limit the freezing spray causing icing on the vessel, and the deckhand asked the captain if he should wake the crew to break the ice off the pots. Ultimately, the captain decided to maintain course and speed and not to wake the entire crew, although he did call the onboard engineer. Deckhand 2 assumed this was to have the engineer transfer fuel to correct the starboard list, which was a common practice. He told the NTSB that the captain said the weather was too rough to have the crew out on deck chopping ice and that they would wait until the vessel was in protected waters. At 1930, the vessel was about equidistant (11 miles) from locations to shelter at Ugaiushak Island and Sutwik Island, with Sutwik Island being along the vessel's planned route. The closest point on the Alaska Peninsula was Yantarni Bay about 19 miles to the north of the vessel.

After being relieved by the captain and before leaving the bridge, Deckhand 2 took note of the accumulated ice on the vessel's pot stack through the bridge window. He said that all pots were glazed over with ice. The starboard-side pots were more heavily coated with what he estimated to be about 2 inches of ice. The inside webbing on the starboard pots was also coated with ice.

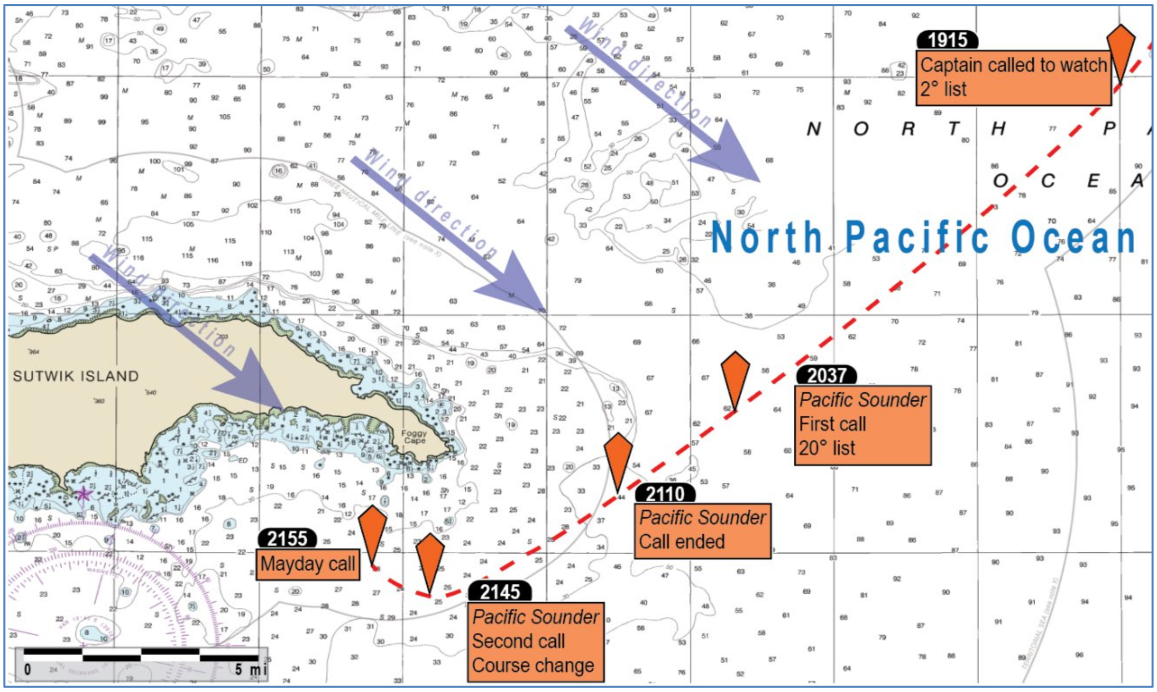
Starting about 2000, the captain of the *Scandies Rose* made a series of phone calls using both the vessel's satellite and tag phones. He first called a friend in North Carolina to wish her a happy new year. She said that he told her that his vessel was "icing and had a list." She added that he did not "sound alarmed" and that he stated that he needed to "tuck in someplace safe."

At 2012, the captain again called the *Amatuli* captain. At the time of the call, the *Scandies Rose* was about 8 miles northeast of Sutwik Island, and the *Amatuli* was 6 miles northeast of Ulakta Head, about 360 miles southwest of the *Scandies Rose* position, preparing to enter Dutch Harbor. The two captains discussed the weather and the current condition of the *Scandies Rose*.

At 2037, the *Scandies Rose* was about 5.5 miles due east of Sutwik Island, still maintaining a southwesterly course (see figure 5). The captain called a fellow captain on the commercial fishing vessel *Pacific Sounder*. The two had known each other for 9 years and fished within the same cooperative.[15] The *Pacific Sounder* was preparing to fish for cod in the Bering Sea at the time of the call; the captain had just set his pots and was trying to hold steady into the weather while the crew was breaking ice that had accumulated on the vessel. According to the *Pacific Sounder* captain, the captain of the *Scandies Rose* said that his vessel was icing "really bad" and he was concerned about a 20° starboard list the vessel had developed. The *Scandies Rose* captain also noted that the winds were blowing 60–70 knots from the west, the temperature was 12°F, and it was too rough to send the crew out to break ice. He was trying to seek shelter southeast of Sutwik Island but was nervous about the "uncharted rock[s]."

[15] A *fishing cooperative* is a group in the fishing industry that pools resources such as vessels, docks, and processing and distributing facilities.

The two captains also talked about the recent holiday season and about the *Scandies Rose* captain having just purchased more shares of the vessel. After the accident, the captain of the *Pacific Sounder* told the NTSB that "it didn't seem like it was that bad," when referring to the demeanor of the *Scandies Rose* captain. At 2110, the captain of the *Pacific Sounder* ended their conversation in order to change over a generator in the engine room.



Background source: National Oceanic and Atmospheric Administration (NOAA)

Figure 5. *Scandies Rose*'s positions over last 3 hours before mayday call.

About 2145, automatic identification system (AIS) data show that the *Scandies Rose* was about 2.5 miles south of Sutwik Island (see figure 5). The vessel had turned about 50° to starboard and held a northwesterly course in the direction of Sutwik Island's southern bay. After completing his work in the engine room, the captain of the *Pacific Sounder* called the captain of the *Scandies Rose* back. He said that the captain's "tone had changed" from their previous conversation. He said that the captain of the *Scandies Rose* said, I don't know how this is going to go," and that his vessel's "list had gotten a lot worse." The captain of the *Pacific Sounder* said that he had never heard that level of stress in the voice of the *Scandies Rose* captain before.

About the same time as the call, the two surviving *Scandies Rose* crewmembers were resting in their stateroom, one deck below the bridge, when they were jolted by a sudden sustained vessel list to starboard. "I jumped out of my bunk in a panic and ran upstairs. I knew something was wrong right away," Deckhand 1 recalled after the accident. Upon reaching the bridge, he yelled to the captain, "What is going on!" and the captain responded, "I don't know, I don't know…I think we are sinking." No alarms, including the general alarm, were sounding on the bridge at that time. Deckhand 1 yelled down to his roommate, Deckhand 2, that the boat was sinking. Deckhand 1 later told the NTSB that he could hear the captain talking to the *Pacific Sounder* captain at this time.

Deckhand 1 was quickly joined on the bridge (shown in figure 6) by Deckhand 2, who located the immersion suits in their designated cabinet and began getting them out. The remaining four crewmembers arrived on the bridge shortly after. The crew attempted to don their immersion suits while the vessel was listed hard to starboard; Deckhand 1 described the scene as "pure mania." Once he was able to get his immersion suit halfway on, he exited the bridge via the portside door. Deckhand 2 attempted to don his immersion suit but also had difficulties because the vessel was "leaning over so hard." The chair he was using to prop himself up "broke away," and he slid down the floor. He managed to climb his way up to the portside door and join Deckhand 1 outside. He completed donning his immersion suit while leaning against the superstructure of the vessel and then assisted Deckhand 1 with his. The two crewmembers remained close to each other as the vessel continued to heel to starboard. After the accident, Deckhand 2 told the NTSB that "it kept going more and more," and then the lights went out.

Source: 2019 condition and valuation survey

Figure 6. Photo of the bridge of the *Scandies Rose* taken from the starboard helm station.

At 2155, the captain of the *Scandies Rose* broadcasted a mayday call on high frequency 4125 kHz, the designated calling and distress frequency. "Mayday, mayday, mayday…*Scandies Rose*, *Scandies Rose*, *Scandies Rose*…We are rolling over." The captain also included the vessel's position in the call. Coast Guard Communications

Detachment Kodiak received the transmission and attempted to establish communications with the vessel but was unable to.

Deckhands 1 and 2 attempted to locate a line to assist others who were still inside the bridge and could not climb to the port door with the vessel on its starboard side, but Deckhand 2 noted that the "lines were all just too iced up." They remained on board, yelling into the bridge for their fellow crewmembers to exit. One other crewmember was able to make it to the portside door and don his immersion suit but did not join the others outside. Deckhand 1 described that the vessel "laid over" further and began to sink. Deckhands 1 and 2 planned to stay on board the vessel as long as they could and then stay together if possible after entering the water. Ultimately, a wave swept them off the side of the vessel and into the water. It is unknown if a third crewmember, who was just inside the port bridge door, or any other crewmembers made it off the vessel.

Deckhands 1 and 2 found themselves separated and floating for about 20 minutes in what they estimated to be 30-foot seas with winds gusting to 50–60 mph (43–52 knots) and in icy conditions, before Deckhand 1 saw the light from an inflatable liferaft that had automatically deployed from the *Scandies Rose* as it sank. He was able to swim a "couple hundred yards" to the covered raft and climb aboard. Once inside, he began yelling for his fellow crewmember. After several minutes, Deckhand 2 heard him and was able to swim to the raft and climb aboard as well.

The two could see the light of the vessel's second liferaft, which had also auto-deployed, and considered swimming to it because the light on their raft had gone out shortly after boarding, but they ultimately decided not to risk abandoning their raft. After about an hour, the two located their liferaft's equipment pack. They managed to fire off several flares but did not see any rescue craft.

About 4 hours after boarding the liferaft, the two crewmembers saw what they thought was a vessel's mast light by the other liferaft. With no flares left to fire, they used a flashlight from the raft's equipment pack to signal. The light was from a Coast Guard rescue helicopter. After completing a search and finding no survivors in the first liferaft, the helicopter crew spotted the flashlight shining and the liferaft containing the two crewmembers.

1.2 Emergency Response and Search and Rescue

Coast Guard Communications Detachment Kodiak received the *Scandies Rose* mayday transmission at 2155 on high frequency 4125 kHz. The unit notified Coast Guard district 17 (D17) command center (in Juneau, Alaska) of the vessel in distress and relayed the vessel's name and position. D17 in turn informed the Coast Guard Sector Anchorage command center.

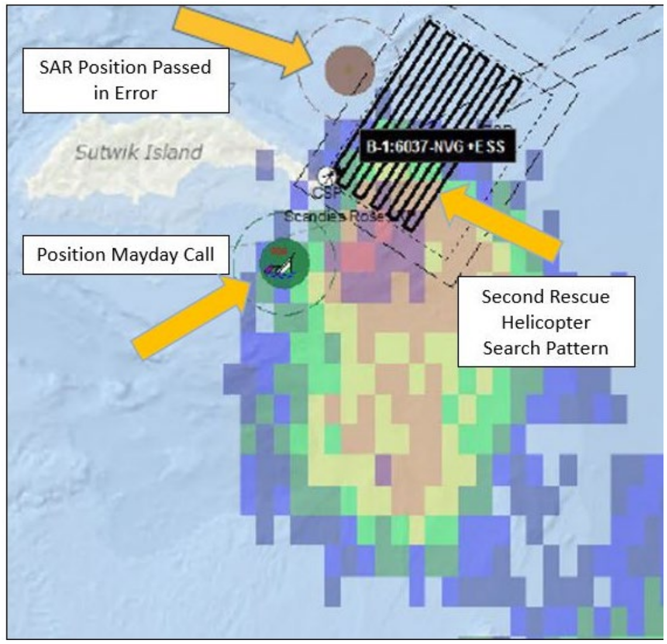
After repeated unsuccessful attempts to establish communications with the vessel, the Coast Guard issued an urgent marine information broadcast on both high frequency and VHF, requesting all vessels in the area of the *Scandies Rose*'s last known position to maintain a sharp lookout and report all sightings to the Coast Guard. The Coast Guard also used a satellite phone number on record to call the fishing vessel *Ruff N Reddy,* anchored approximately 25 miles west of the last known position of the *Scandies Rose*. The *Ruff N Reddy* was unable to assist due to the weather conditions.

About 2330 on December 31, an MH-60 Jayhawk rescue helicopter departed Air Station Kodiak to conduct search and rescue (SAR) operations at the last known position of the *Scandies Rose*. The remoteness of the location and the severe weather forecasted along the route added complexities for the flight crew: additional flight planning was required, and extra fuel had to be loaded onto the helicopter. Several minutes after the rescue helicopter departed, the D17 command center diverted Coast Guard Cutter (USCGC) *Mellon* from its patrol near Dutch Harbor to the last known position of the *Scandies Rose*. The *Mellon* gave an estimated time of arrival to the position of 20 hours. While the MH-60 and cutter were en route, the Coast Guard also deployed a C-130 aircraft from Joint Base Elmendorf–Richardson in Anchorage to assist in the search for the *Scandies Rose* and act as a communications platform.

Upon arrival at the captain's mayday coordinates around 0200, the MH-60 Jayhawk crew began to search for the vessel and any survivors. Upon locating a liferaft, they sent a rescue swimmer down to investigate and discovered that it was empty. They located the liferaft with the two crewmembers aboard shortly after. At 0208 on January 1, 2020, hoisting operations of the two crewmembers began. Assisted by the rescue swimmer, both crewmembers individually exited from the liferaft and were hoisted to the helicopter. On board the helicopter, the two survivors informed the Coast Guard that they had not seen any other crewmembers get off the vessel before it sank. After successfully recovering the two crewmembers and rescue swimmer from the water, the rescue helicopter, now low on fuel, returned to base. While en route, the crew shut off the helicopter's auxiliary power unit to conserve fuel, which prevented the crew from operating the interior space heaters.

The MH-60 carrying the two survivors landed at Air Station Kodiak at 0340—about 6 hours after the captain's mayday call. The two surviving crewmembers were transported to a waiting ambulance and driven to the local hospital for hypothermia treatment. Once treated, the two crewmembers were released later the same day. The C-130 remained on scene and continued to broadcast the urgent marine information broadcast. At 0324, about 20 minutes before the first MH-60 landed, a second MH-60 took off from Air Station Kodiak to continue the search for any additional survivors.

The coordinates where the two survivors were found had been reported back to the Coast Guard command center from the MH-60 via the on-scene C-130. These coordinates were used to generate a search pattern that was provided to the second helicopter. However, the location information relayed to the command center was incorrect and was north of Sutwik Island (7.8 miles north of the location of the captain's mayday transmission). The second helicopter arrived on scene at 0534 and followed the search pattern created from the northern coordinates, until it departed the scene at 0640 (see figure 7). It wasn't until after the second helicopter departed the scene to return to base that SAR command determined that the survivor recovery location coordinates were passed through the C-130 to the command center with an error, and that the second helicopter's search pattern was too far north. All subsequent searches were based off the coordinates from the captain's mayday call and the updated coordinates of the liferaft.



Source: Coast Guard

Figure 7. Second rescue helicopter search area, based off position passed in error. Purple and red indicates the highest-probability areas for locating survivors.

Throughout the morning and afternoon of January 1, multiple Coast Guard MH-60 helicopters, departing from Air Station Kodiak, participated in the search. The C-130 from Anchorage that was initially on scene was relieved by another C-130 from Anchorage. The *Mellon* arrived on scene at 1615 and assisted in the search efforts. In total, the Coast Guard used three MH-60 helicopters, two C-130 airplanes, and a cutter to search a 1,400-square-mile area near Sutwik Island. At 1808, 20 hours after receiving the mayday call and after 16 hours of searching for any additional survivors from the *Scandies Rose*, the Coast Guard suspended SAR operations.

After the accident, the flight commander of the first MH-60 on scene recounted to the Marine Board of Investigation (MBI) during a public hearing that he was "anticipating bad weather" when his crew was planning the mission, "but what we got was a lot worse."[16] It took the crew of the rescue helicopter roughly 2.5 hours to complete the approximately

[16] The Coast Guard was the lead federal agency in this investigation. The MBI conducted interviews as well as a formal hearing as part of its accident investigation, from February 22 to March 5, 2021. During the hearing, Coast Guard and NTSB investigators questioned 43 individuals, including the surviving crewmembers, company management, commercial fishing vessel workers, industry safety educators and advocates, naval architects, Coast Guard personnel, and commercial fishing industry stakeholders.

170-mile journey and arrive on scene, in what the commander testified to be the “most challenging flight of his career.” Strong headwinds and winds “with the terrain” caused severe turbulence with multiple downdrafts. The turbulence was so severe, it took both pilots to keep the helicopter flying as level as possible, and they had to slow the flight. They reported 30-foot seas and freezing spray so bad that, during hoisting operations, they had to de-ice the rescue swimmer’s goggles and drysuit.

The captain of the *Mellon* reported that they arrived on scene around 1615 on January 1, but they had to stop the search pattern to break ice before sunset (1701) because 2 to 3 inches of solid ice had accumulated on the deck during the voyage, as shown in figure 8. The icing had built on the ship asymmetrically, and they had to steer 40° off their intended course due to the wind and waves to maintain search lines.

Source: Coast Guard

Figure 8. USCGC *Mellon* crew breaking ice during search efforts late afternoon on January 1.

1.3 Injuries and Fatalities

The two surviving crewmembers were admitted to Providence Kodiak Island Medical Center. They were treated for hypothermia and exposure and then released. The captain and remaining four crewmembers were not found. On May 11, 2020, the Coast Guard sent a “Letter of Presumed Death” to an attorney associated with the crew’s families, to document "the loss and presumptive death" of the missing crew, in lieu of a death certificate.[17] Table 2 summarizes the total injuries from the accident.

Table 2. Injuries sustained in the *Scandies Rose* accident. [18]

Type of Injury	Crew	Passengers	Total
Fatal	5	0	5
Serious	0	0	0
Minor	2	0	2
None	0	0	0

1.4 Remotely Operated Vehicle Wreckage Survey

Following the sinking of the *Scandies Rose,* the owners of the vessel hired a marine salvor and a hydrographic survey company to find the vessel and document the wreck. On February 9, 2020, the motor vessel *Endurance*, which was owned and operated by Paradigm Marine, departed Kodiak harbor. The *Endurance* acted as an operations platform for the survey equipment and a remotely operated vehicle (ROV). Using position data provided by the Alaska Maritime Prevention and Response Network, the Coast Guard, and the *Scandies Rose* owners, the *Endurance* was able to identify a search area.

Early on the morning of February 10, the crew aboard the *Endurance* arrived at the last known position of the *Scandies Rose*. A diesel fuel sheen stretching about one-quarter mile was observed on the water's surface. Using sonar, the *Scandies Rose* was located in about 160 feet of water about 1,100 feet from the mayday position. The vessel lay on its starboard side in an east-west direction with the bow pointing east. Off the deck side of the vessel (to starboard if upright) was a debris field roughly 94 feet by 42 feet, with a height of about 20 feet off the seafloor. Fishing buoys still attached to the vessel extended upward to within 40 feet of the water's surface. ROV video surveys were conducted on February 11 and 13, 2020. Working around the winter weather and tidal conditions, the ROV documented on video the *Scandies Rose* and the debris field (see figure 9). An empty EPIRB bracket was located on the port rail aft of the bridge door. Attempts to locate the vessel's EPIRB trapped within the debris field or the superstructure of the vessel were unsuccessful. Several of the vessel's external doors appeared to have been damaged by the impact with the seafloor. The ROV survey was unable to video the starboard side of the vessel because of the vessel's position on the seafloor. Footage of the vessel's bottom, port side, and stern did not show any hull breaches. The survey report indicated that two orange survival suits appearing to contain the remains of individuals were observed on the bridge but were not recovered. No additional survival suits were seen. Following the final ROV

[17] The Coast Guard, when required, will issue a letter of presumed death. The Coast Guard will not issue a death certificate, as that is the role of the medical examiner or coroner.

[18] The NTSB uses the International Civil Aviation Organization injury criteria in all of its accident reports, regardless of transportation mode. A *serious injury* is a non-fatal injury that requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; results in a fracture of any bone; causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.

dive on February 13 and due to deteriorating weather, the *Endurance* returned to Kodiak and demobilized.

Source: Global

Figure 9. The *Scandies Rose* wreck, located on February 11.

On September 23, 2020, the National Oceanic and Atmospheric Administration (NOAA) vessel *Oscar Dyson*, acting on the request of the Coast Guard MBI to verify the size of the pots on board, attempted to recover several crab pots from the *Scandies Rose*'s debris field. Faced with challenging weather conditions, the *Oscar Dyson* was unsuccessful and departed the scene later that afternoon.

1.5 Vessel Information

The *Scandies Rose* was a 130-foot-long, 195-gross-ton steel fishing vessel registered in Dutch Harbor, Alaska. Table 2 shows additional vessel information. It was built in 1978 by Bender Shipbuilding in Mobile, Alabama. The vessel fished in the Bering Sea for king crab, opilio crab (Alaska snow crab), and Pacific cod using rectangular-shaped, ridged-steel mesh cages known as pots. In the summer months the vessel would act as a tending vessel for the salmon fisheries in the Bering Sea and Gulf of Alaska.

Table 3. Vessel information.

Length	130 ft (39.6 m)
Beam	34 ft (10.4 m)
Draft	11.3 ft (3.4 m)
Tonnage	195 GT ITC[19]
Engine	(2) Detroit Diesel 12V2000-R1227K22, 805 hp (600 kW)

The *Scandies Rose* was subject to the regulations set forth in Title 46 *Code of Federal Regulations* (*CFR*) Subchapter C, Part 28, "Requirements for Commercial Fishing Industry Vessels," which included equipment, stability, and other safety requirements. Monthly drills and instruction were required of the crew while aboard the vessel and, at a minimum, had to cover procedures for abandon ship, firefighting, flooding, man overboard, donning an immersion suit, launching a survival craft, making a voice radio distress call, and activation of the general alarm. Per 46 *CFR* Subpart E, "Stability," as an uninspected commercial fishing vessel 79 feet or more in length that had gone through conversions and alterations after construction, the *Scandies Rose* was required to have stability instructions. However, there were no requirements for the completed stability instructions to be reviewed for accuracy by the Coast Guard or other authorized authority.[20]

The vessel was also required to participate in the Coast Guard's commercial fishing vessel dockside safety examination program, which primarily focuses on lifesaving equipment on board the vessel and confirms the presence of lifesaving equipment and correct documentation, including stability instructions. It does not review the hull or machinery as required for Coast Guard-inspected vessels. These exams are valid for 2 years. The *Scandies Rose* last underwent a dockside safety exam in October 2018, where no deficiencies or comments were noted.

1.5.1 Construction and General Layout

The *Scandies Rose* bow plating was 5/8-inch steel, and the hull and deck plating were 1/2-inch steel. Figure 10 shows the vessel's layout. The hull had a nearly flat bottom and vertical sides. The bow was raked and there was a transom stern, a single hard chine, and a centerline skeg.[21] A former crewmember referred to the *Scandies Rose* as a "tank"

[19] *GT ITC*, or *gross tonnage-international tonnage convention*, is the international standard for the measurement of the volume of all enclosed spaces on a vessel, as defined in the *International Convention on Tonnage Measurement of Ships, 1969*.

[20] Newer United States fishing vessels (built on/after July 1, 2013) that are 79 feet or longer, and that operate outside the Boundary Line, are required to have a *load line*. A *load line certificate* is documentation confirming that a vessel meets specific structural design, construction, and maintenance criteria. Classification societies such as the American Bureau of Shipping review vessel stability instructions and issue load line certificates on behalf of the Coast Guard, and the Coast Guard periodically audits the classification society's load line and stability oversight program to ensure compliance with regulations.

[21] (a) A *transom stern* is a stern shape characterized by a generally flat shape extending to the waterline. The transom stern offers a greater deck area aft and is a simpler construction. (b) A *chine* is the seam in a boat's hull where the bottom and side pieces of sheet material meet. (c) A *skeg* is a keel projection designed to protect the propeller and support the rudder.

because of his experience with it in adverse weather conditions. Another former crewmember said the fishing vessel was a “big boat” and could “push through” bad weather when other vessels could not. Above the main deck at the bow was a fully enclosed focsle that housed the bait freezer on the port side and a workshop on the starboard side.[22] Midships was the fishing deck, which had an elevated hardwood wear deck. Further aft was the deckhouse, consisting of three levels.

The main deck housed a galley, electrical equipment room, and accommodations for the crew. The second deck was a partial-width deckhouse with accommodations and utility spaces. Open decks were aft, with exterior ladderways port and starboard leading up to the back of the bridge. Underneath these ladders were engine room vents. The bridge deck was also partial width and housed the bridge forward and an open weather deck aft. The bridge had three maneuvering stations (port, starboard, and center). The starboard station was the primary operating station. It faced forward, and the forward-adjacent windows were equipped with heaters to melt away accumulated ice. The starboard station also was equipped with two radars, navigation and positioning equipment, maneuvering controls, communication equipment, and machinery monitoring gauges and alarm panels. The bridge was also outfitted with weather-monitoring equipment, including a barometer to measure atmospheric pressure and an anemometer to measure wind speed.

Below the main deck, starting at the bow, was a ballast tank, followed by the anchor chain locker and a dry stores room, also called the forepeak. Next aft were three crab tanks: floodable holds used to store the catch. Aft of these tanks were the vessel’s engine room and machinery space, housing the vessel’s propulsion equipment and other machinery associated with the operation of the vessel. The aft-most space was a steering gear room. Four sets of port and starboard outboard fuel tanks ran the length of the vessel. Double-bottom fuel tanks were positioned underneath the holds but were not typically used and were empty during the accident voyage. Two pipe alley voids ran down the port and starboard side of the vessel, from just aft of the chain locker to the engine room. They were accessed from bolted hatches located in the forepeak and engine room. It could not be determined whether these hatches were open or closed at the time of the accident. The engine room and forepeak space were equipped with float-type bilge alarms that would alarm locally and on the bridge when activated. The floodable holds were not equipped with bilge or slack tank alarms, or level indicators.

[22] A *focsle*, or *forecastle*, is a raised portion of the forward part of a vessel (bow) normally used for storage.

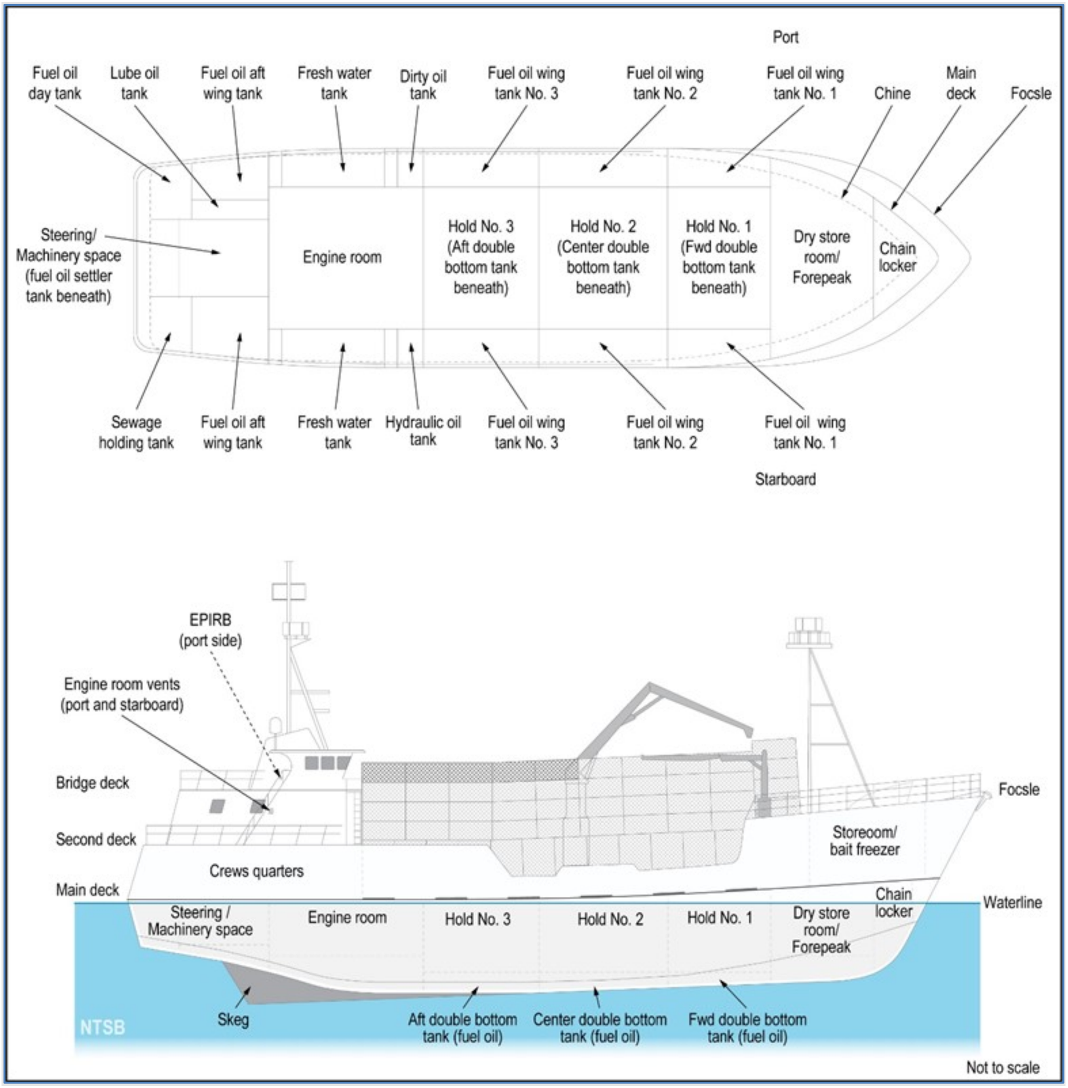


Figure 10. *Scandies Rose* simple plan and profile views similar/approximated to accident voyage.

At the time of its sinking, the *Scandies Rose* had two rectangular watertight steel waste chutes, one each on the port and starboard sides, slightly forward of midships. The chutes were used to discharge bycatch, or other unwanted material brought on board while fishing, from the main deck overboard, slightly above the waterline (see figure 11). When the vessel was under way or fishing, the vessel's waste chutes would be exposed to constant wave action.

The *Scandies Rose* had two 12-cylinder Detroit Diesel 805-horsepower turbocharged main engines. They were coupled to reduction gears and 6-inch stainless steel shafts. The shafts ran out through stern tubes and were connected to two four-bladed, fixed-pitch propellers. Vessel steering was accomplished by twin rudders powered by hydraulic rams. Two Detroit Diesel-driven electrical generators supplied the vessel with alternating current power. The generator's engines were also coupled to hydraulic pumps, which supplied the vessel's hydraulic systems. The two deck cranes had self-contained hydraulic power packs.

1.5.2 Maintenance

The *Scandies Rose* underwent planned maintenance every year between fishing seasons. As an uninspected vessel, the vessel was not required by regulation to adhere to a drydocking inspection schedule. The owners of the vessel set their own schedule and would haul the vessel out of the water every 2 years, which was last done in 2019. During this biennial event, the vessel's sacrificial zincs would be replaced, and the hull would be stripped, visually inspected, and repainted.[23] The vessel's propulsion shafting, propellers, rudders, and steering systems would also be inspected and repaired as needed. In 2003, in order to determine the hull's thickness, ultrasonic thickness measurements (UTMs) were taken. UTMs to detect hull wasting or thinning are not required by regulation for uninspected vessels like the *Scandies Rose.* The marine surveyor, who was hired by the owners of the vessel, indicated in the vessel's condition and valuation survey that the hull was in "very good condition." In 2012, UTMs were taken of the vessel's hull plating, where the three double-bottom fuel tanks were located. Some pitting was found and repaired by filling the pits with weld. About the same time, the hull plating that made up a portion of the sewage-holding tank was cropped out and renewed. The tank design was changed and converted to an independent internal tank that did not share any plating with the hull.

The managing owner told the NTSB that other than a recent repair to the vessel's starboard waste chute, the sewage tank repair was the only hull plating replaced during his ownership. The most recent UTM examination on the vessel's hull was performed in 2017. The surveyor did not find anything of concern and verbally informed the majority owner of his findings, but there was no formal report or documentation detailing the results.

In the summer of 2019, the starboard chute was repaired while the vessel was at the dock (see figure 11). An outside welding contractor was hired to weld plate steel, also known as "doublers," over the sections of deteriorated steel to complete the work. The welding contractor also closed off a third waste chute, farther aft on the starboard side, that the vessel had at the time. Shortly after the repairs were completed and while the vessel was fishing, the crew discovered that the welds from the forward starboard waste chute repair were allowing water to leak into the starboard void. The crew effected a temporary repair by applying underwater epoxy to the leaking welds. There was no indication of the welds failing where the third waste chute was closed off. Upon returning to the dock after the king crab season, the owners hired another welding contractor to assess the issue of the leaking starboard waste chute and make repairs. The new welding contractor cut out the existing starboard waste chute and rebuilt it using 3/8-inch steel. The American Bureau of Shipping-certified welder completing the work used a dye penetrant to inspect his welds

[23] A *sacrificial zinc* is a type of galvanic anode designed to be attached to the submerged surface of a vessel's hull and to corrode instead of the steel hull of the vessel.

after completion. All welds passed inspection, and the work was completed before the vessel departed.

Source: Colton Zacher, Jordan Young

Figure 11. *Scandies Rose* on the blocks in May 2019. The starboard waste chute is highlighted, with inset photo showing waste chute undergoing repairs, as viewed from on board the vessel, looking outboard.

In 2019, a condition and valuation survey was completed. It included a list of maintenance completed during annual and biennial drydocking periods, dating back about 16 years. Items such as main engine overhauls, communication equipment renewal, and refrigeration equipment maintenance were all captured. The 2019 attending surveyor inspected the vessel while it was both afloat and hauled out of the water. He commented that the construction of the *Scandies Rose* was "extraordinary" for a vessel of its era. He concluded that the vessel was "well kept and maintained" and that it was "suitable for operation in its intended service."

1.5.3 Ownership and Management

The vessel was owned by the Scandies Rose Fishing Company, based in Bremerton, Washington. At the time of the accident, the *Scandies Rose* ownership was made up of three individuals. A majority owner had 50.2% of the shares; the captain of the vessel had

30% of the shares; and a minority owner had 19.8% of the shares. The three, with several other investors, had bought the vessel in 2008 from the previous owner. Several years after the original purchase, the trio bought out the other investors.

A management company consisted of the majority (managing) owner and a vessel manager, both of whom managed the vessel. The majority owner handled the vessel's finances and made "sure the bills got paid." He would also give input on fishing strategy and had the final say on major purchases for the vessel. He was listed by name on both the vessel's 2019 stability instructions and its 2019 condition and valuation survey.

The vessel manager was located in Bremerton. Prior to the accident, she had worked aboard the *Scandies Rose* as a cook during several summer tendering seasons. Shortly after working on board as a cook, she began the vessel management position. Her duties included hiring the crew after the captain had vetted them; ensuring that their criminal background checks and drug screens were acceptable; purchasing equipment, parts, and stores for the vessel; creating and maintaining a "shipyard list" that tracked work to be completed and parts to be ordered for the vessel's planned shipyard maintenance; and, when safety equipment on board needed servicing, coordinating with third-party companies to facilitate. She had registered the vessel's EPIRB with NOAA.

The minority owner was not involved in the management or operational decisions of the *Scandies Rose*. He had bought into the vessel strictly as an investment and had not seen the vessel in over 2 years. As an insurance broker, his company had negotiated the insurance policies for the *Scandies Rose*, as well as for many other fishing vessels in the industry.

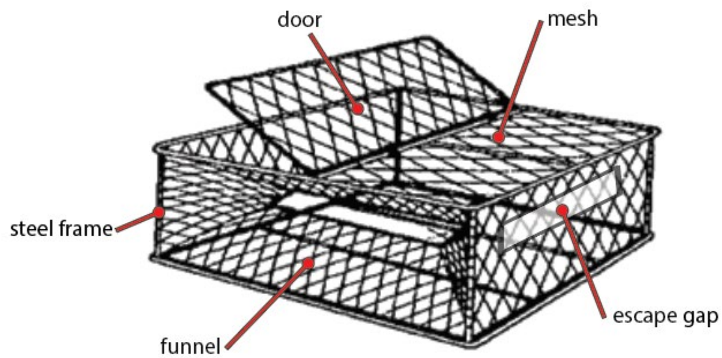
1.5.4 Combination Pot Stack

Prior to the accident voyage, the *Scandies Rose* and crew had participated in the king crab fishery that had opened on October 15, 2019. They completed fishing and returned to Kodiak on November 2, 2019, for the remainder of the year. The managing owner of the vessel told the NTSB that the decision to bring the vessel and a full load of pots to Kodiak instead of Dutch Harbor was made because the captain wanted to make repairs on some of the pots while in port and because of air transportation issues at the airport in Dutch Harbor, which made it difficult to get crew in and out of the harbor.

The *Scandies Rose* departed Kodiak on the casualty voyage with a pot stack consisting of 195 combination crab pots (see figure 12). Each pot was 7 feet by 8 feet by 34 inches. Combination pots vary in weight; while the 2019 stability instructions assumed a pot weight of 835 pounds, when the *Scandies Rose* underwent a Coast Guard safety compliance check (SCC) in October 2019, a sample of the combination pots on board weighed 863, 799, and 800 pounds.[24]

[24] For more information, see section 1.10, "Coast Guard Fishing Industry Safety Compliance Checks."

The combination crab pots were stacked about nine rows fore and aft and four across, which took up the exterior main deck space of the vessel and reached up to 20 feet high above the deck. The majority of pots were stacked five high, except in front of the starboard bridge conning station where the pots were only stacked four high so that the crew's vision would not be completely obstructed. The first level (tier) of pots was positioned on their sides to facilitate easier access by the crew when fishing. The pots were secured to the vessel with chains but were not covered by a tarpaulin. There was no access tunnel for the crew underneath the pots, so the crew would have to climb over the stack to reach the storeroom and focsle at the bow of the vessel.



Source: Food and Agriculture Organization of the United Nations, annotated by NTSB

Figure 12. An example of a king crab pot similar to the ones used on the *Scandies Rose*. Escape gaps are often fitted into pots and traps to make sure that undersize fish or crustaceans, especially lobster and rock lobster, are not taken.

1.5.5 Lifesaving and Safety Equipment

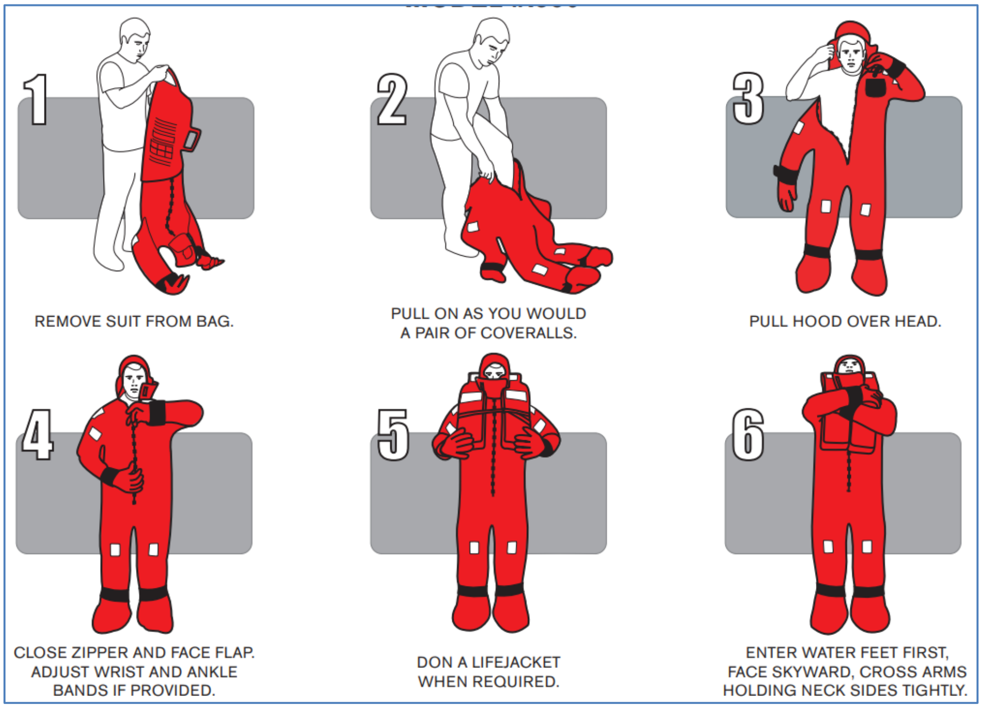
The vessel had 12 survival suits, 1 EPIRB, and 2 liferafts. On October 11, 2019, before the vessel departed Dutch Harbor for king crab season, the Coast Guard had completed a voluntary SCC that verified the safety equipment was present and not expired, with correct registration and installation. In addition, before the December 2019 departure, the captain of the vessel completed the internal company "Monthly Emergency Test and Check Log" form, which indicated that the vessel's safety equipment was checked and tested.

Immersion Suits. Immersion suits, also called survival suits, are neoprene suits designed to protect the wearer from hypothermia after abandoning a vessel, especially in colder waters. Coast Guard-approved immersion suits must provide the wearer with sufficient thermal insulation to ensure that his or her body core temperature does not fall more than 3.6°F after 6 hours of immersion in calm, circulating water measuring between 32°F and 35.6°F. Immersion suits are required to prevent "undue ingress of water… following a period of flotation in calm water of one hour" but are not required to be watertight.[25] Expected survival time in cold water is affected by several factors, including proper use of survival equipment, weather conditions, time in water, body type, health, and knowledge of survival techniques. Without immersion suits, the expected survival time for

[25] 46 *CFR* 160.171–11.

a person in calm, 32.5°F water is between 30 and 90 minutes. With immersion suits, the expected survival time under the same conditions ranges from 2 1/2 to 5 1/2 hours, depending on whether the suit leaks or stays dry (Transport Canada, 2003).

The immersion suits on the *Scandies Rose* were equipped with a lifting ring, whistle, strobe light, reflective material, and an inflatable pillow. The majority of these suits were located in a cabinet on the bridge of the vessel. The night of the accident, the immersion suits were accessible and sufficient in number for each one of the crew to have one. Figure 13 shows the process for donning a suit, similar to what the surviving crewmembers would have had to do in the vessel's bridge, as the vessel heeled over.



Source: Stearns, Inc

Figure 13. Donning instructions for an *International Convention for the Safety of Life at Sea* (SOLAS)-approved immersion suit.

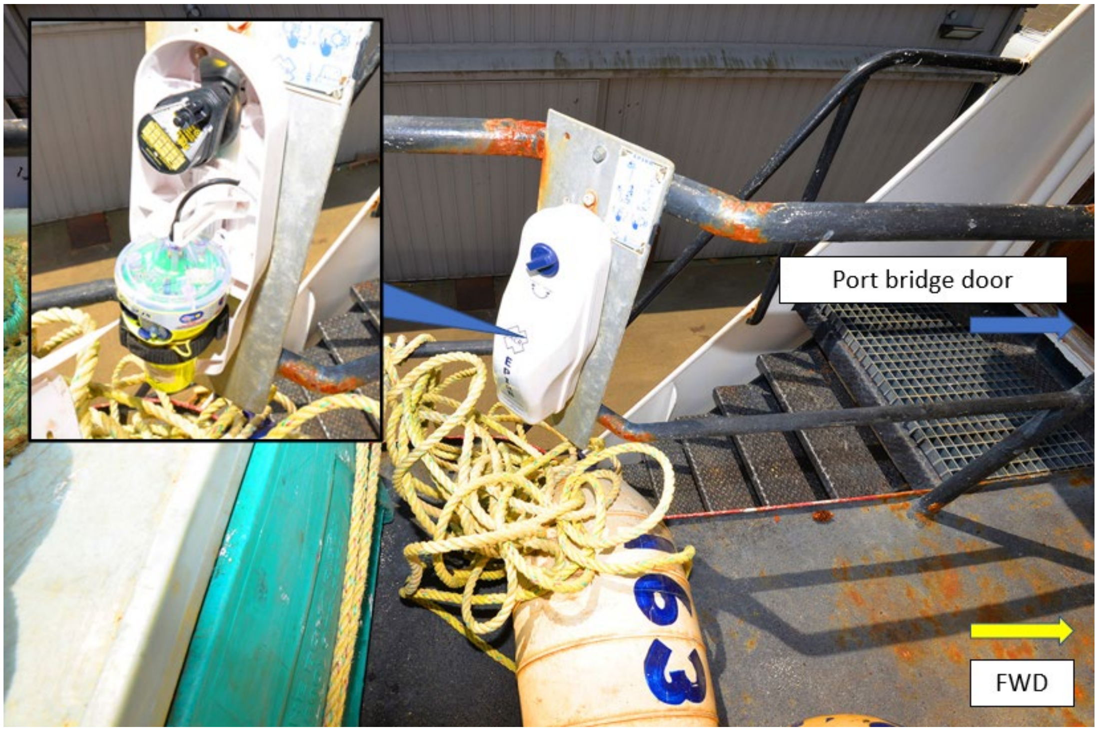
Inflatable Liferafts. The vessel was equipped with two eight-person SOLAS inflatable liferafts. They were mounted in cradles on top of the bridge on the port and starboard sides. These rafts were held in place with straps that were designed to be released either manually or automatically when the raft submerged to a depth of about 13 feet (hydrostatic release). In the event of the vessel sinking, the hydrostatic pressure acting on the raft's release mechanism would cause the mechanism to activate and release the strap holding the liferaft in place. Once released, the liferaft could float free. When the approximately 100-foot painter (securing line) that attached the liferaft to the vessel was stretched to its full length, the liferaft's compressed CO_2 cylinder would be activated, and the raft would auto inflate. The rafts were each equipped with a strobe light that automatically activated upon raft inflation.

The October 2019 Coast Guard SCC documented that one of the vessel's liferafts was due for annual service by the end of that same month.[26] Company records obtained after the accident indicated that this liferaft was removed and sent to a third-party company for servicing in November, after the vessel had finished fishing for king crab. The raft was returned to the vessel and reinstalled with a new servicing certification valid until December 2020. The vessel's second liferaft was not due to be serviced until June 2020. The hydrostatic release mechanisms for the liferafts did not expire until October 2020 and December 2020.

EPIRB. The vessel was equipped with an ACR "Global Fix" model V4 406 EPIRB, which emits a 406-MHz distress signal containing a unique identification code that can be used to reference information about the carrying vessel, including its name, type of survival gear, and emergency points of contact ashore. The vessel's EPIRB was also equipped with an internal GPS device that, when the beacon was activated, would relay the vessel's position using the satellite signal beacon message to facilitate a more rapid response. The vessel's EPIRB was purchased new and registered to the vessel in October 2017. The vessel manager updated the beacon's registration with NOAA on August 17, 2019, and the internal battery was valid until 2027.

The *Scandies Rose*'s EPIRB, shown in figure 14, was mounted on the exterior portside handrail behind the bridge to allow for its float-free design to activate automatically if the vessel sank. It was housed inside a special bracket and protected from the elements. The cover of the bracket was equipped with a hydrostatic release mechanism similar to those used on the vessel's liferafts. Once about 13 feet underwater, the release would activate, allowing the bracket's cover to open and the EPIRB to float free. The hydrostatic release was required to be renewed every 2 years. During the vessel's 2019 SCC, the Coast Guard noted that the EPIRB hydrostatic releasing mechanism was due to expire that same month. The company purchased and installed a new EPIRB hydrostatic release 4 days later in Dutch Harbor. The expiration date for the EPIRB's hydrostatic release mechanism listed on the monthly emergency test and check log form, which was completed before departure, was October 2022.

[26] See section 1.10, "Coast Guard Fishing Industry Safety Compliance Checks."

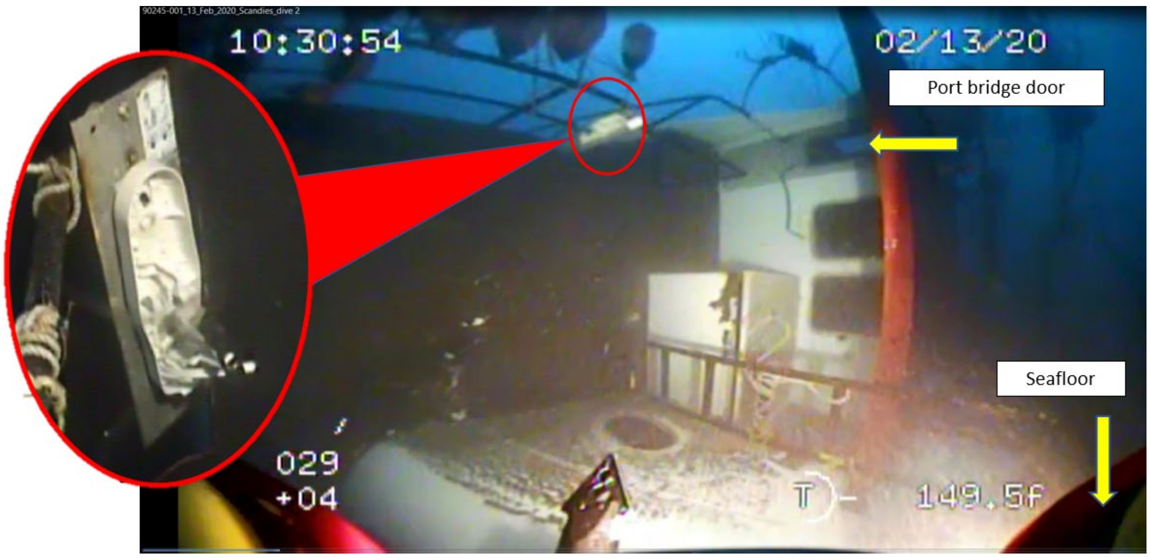


Source: 2019 condition and valuation survey

Figure 14. The *Scandies Rose* EPIRB mounted on the handrail aft of the bridge. Inset shows the float-free EPIRB with protective cover removed.

The EPIRB had a button for monthly testing. During a test, the beacon would transmit a 406-MHz self-test message and 121.5-MHz signal. The self-test also checked battery capacity, beacon memory, GPS functionality, and the circuit board. Both surviving crewmembers said that, during the safety drill before the vessel departed Kodiak on December 30, 2019, the captain showed the crew the EPIRB, but they did not witness a self-test of the beacon. Regulations require that the EPIRB be tested once a month but do not require this test to be logged. There is no company record of EPIRB tests being conducted.

At no point after the sinking of the *Scandies Rose* was a signal received from the vessel's EPIRB. Neither of the surviving crewmembers saw the EPIRB while abandoning the vessel. The manufacturer of the EPIRB lists the unit as having an operating life of 48 hours and states that the unit is "waterproof" at 33 feet for 5 minutes. The manufacturer also states that for proper beacon operation, the antenna of the unit must have a "clear view to the sky."[27] The ROV survey video footage showed the empty EPIRB bracket mounted to the handrail aft of the port bridge door (see figure 15), but the EPIRB was not found.



Source: Global

Figure 15. Screen capture from ROV video taken of the *Scandies Rose* showing the portside third deck, aft of the bridge. Exploded view shows an empty EPIRB bracket, mounted to the port handrail.

Personal Locator Beacons. A personal locator beacon (PLB) is a portable unit that operates like an EPIRB. PLBs are designed to be carried by a person. They are certified through the Federal Communications Commission and are registered with NOAA to a person, not a vessel or an aircraft. Neither of the surviving crewmembers had a PLB, nor were they aware of any of the other crewmembers possessing one.

A PLB is activated manually and operates on 406 MHz to achieve an accuracy of within 3 miles using the 406-MHz satellite system. It also has a low-power homing beacon that transmits on 121.5 MHz. Newer models allow GPS input to the distress signal to achieve an accuracy of about 100 meters (328 feet). There are no regulations that require PLBs for vessel crews at sea. Several manufacturers offer models for marine use that sell for between $300 and $400.

[27] ARC GlobalFix V4 406-MHz EPIRB Product Support Manual

1.5.6 Communication Equipment

As a commercial fishing industry vessel, the *Scandies Rose* was subject to commercial fishing vessel regulations in 46 *CFR* Part 28, which included communications equipment requirements (46 *CFR* 28.245). The *Scandies Rose* had onboard communications equipment, including VHF-FM radiotelephone, single side-band radio, and AIS equipment. In addition, the vessel was equipped with satellite internet and Mitsubishi satellite Trac/Tag phones on the bridge as well as in the captain's stateroom.

1.6 Crew Information

The crew of the *Scandies Rose* on the accident voyage was made up of a captain and six deckhands with varied experience.

The captain had 45 years of fishing experience, with about 40 years as captain on various fishing vessels in the Gulf of Alaska and the Bering Sea. In 2009, the captain began skippering the *Scandies Rose* full time. He was also part owner of the vessel. As captain of the vessel, he made the determinations on when and where to fish. His business partner and fellow captain described him as a "very, very good fisherman," and "probably the most experienced captain" he had ever been around. During testimony at the MBI public hearing, former crewmembers described the captain's safety drills as very thorough and better than other boats they had been on. Another said he was a "great captain" and "surprised at how safety conscious he was." Following the sinking of the *Scandies Rose* and the subsequent SAR operation conducted by the Coast Guard, the captain of the vessel was not found and was presumed dead.

The deckhands' experiences ranged from as little as 1 year working on similar vessels to as much as 20 years. One deckhand was the captain's son. The deckhands' duties on board included preparing gear for fishing, operating fishing gear and equipment, mending and repairing pots and gear, safety vigilance, participating in safety drills, and standing navigational watches. One of the deckhands also acted as the vessel's engineer and, under the direction of the captain, was responsible for the operation and maintenance of mechanical equipment on board the vessel. Another deckhand acted as the "deck boss" who, under the direction of the captain, made sure the fishing gear was ready for use and mustered the crew when it was time to work on deck. Another deckhand also functioned as the vessel's cook. Only two deckhands were rescued and survived.

The vessel had an alcohol and substance use and abuse policy that prohibited the use of drugs and alcohol while on board the vessel. Each crewmember was required to sign this policy and submit to a drug screen before employment on board. The captain also had the right to randomly test for drugs or alcohol at any time. After any major marine casualty, the vessel owner is required by regulation to conduct an alcohol test and drug screen of all persons involved.[28] The two survivors were not tested for alcohol because the regulatory time window had expired by the time they were rescued. At the request of the company,

[28] 46 *CFR* 4.06–3, "Requirements for alcohol and drug testing following a serious marine incident."

both survivors used a take-home drug testing kit, the only option the company was able to find, following their release from the hospital. Although one drug test returned positive results for THC, the testing procedures and results were not independently verified by an approved facility.

1.7 Waterway and Meteorological Information

1.7.1 Waterway Information

The area south of the Alaska Peninsula is frequently traveled. Fishing vessels en route to the Bering Sea or Dutch Harbor from Kodiak or other parts of southern Alaska will traditionally take the most direct route along the southern side of the Alaska Peninsula. Commercial ferries operated by the state of Alaska run along the peninsula, transporting people, equipment, and supplies to various ports along the route. In addition to vessels frequently traversing the waterway, the area is host to fishing vessels that harvest marine species that are found in the waters.

Five vessel captains familiar with the accident area were interviewed at the MBI public hearing. Most noted that the area west of Kodiak Island and around Sutwik Island and Chignik Bay is subject to bad weather with northeast through northwest winds and cold air moving across the Alaska Peninsula. The commanding officer of the *Mellon* noted that the area had the "worst icing he has ever seen in his life." He added that the captain of the *Scandies Rose* was extremely familiar with the area around Sutwik Island and had taught him how to fish in the area. Many of the captains stated that, despite the weather forecast, they would have agreed with the *Scandies Rose* captain's decision to leave Kodiak at that time. The captain of the *Amatuli,* when asked about suitable locations in the area for a vessel such as the *Scandies Rose* to drop anchor and shelter from the weather, told the NTSB that "there are literally hundreds of places."

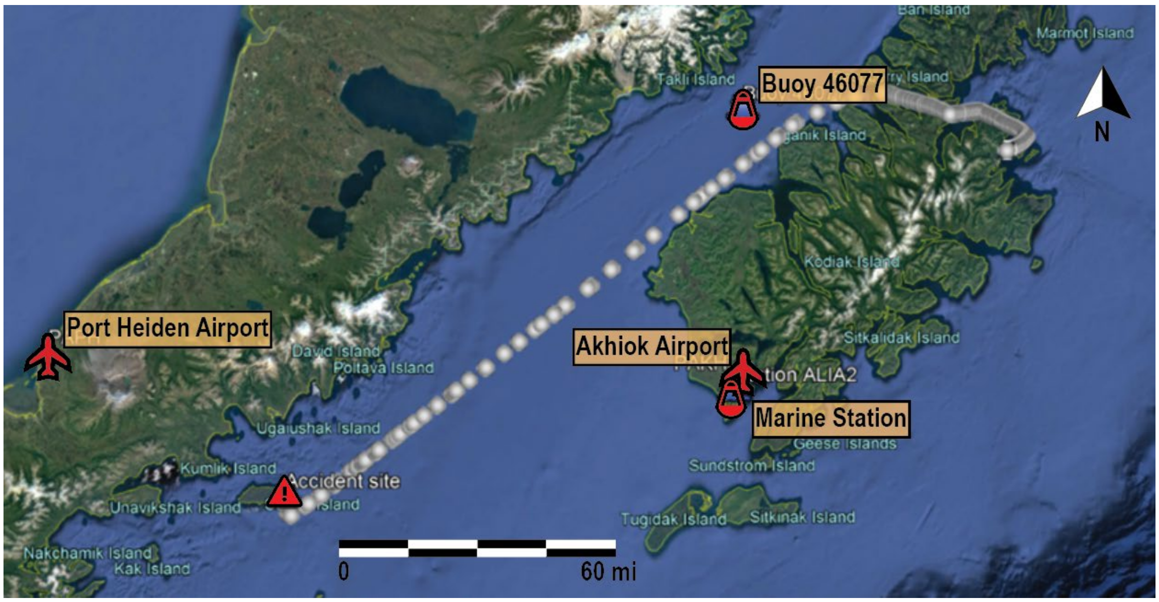
NOAA's *United States Coast Pilot 9 Alaska: Cape Spencer to Beaufort Sea*, a resource for navigators, notes that the area is subject to "williwaws," which are described as

> …dangerous winds [that] occur mainly along the Aleutian chain and Gulf of Alaska shores, and are influenced by local topography. They are most frequent in winter and are usually the result of air damming up on the windward slopes of mountains. This air spills over in strong gusts on the lee side; that lasts as long as the dammed-up cold air lasts, which frequently is only a matter of minutes. However, such winds are violent, often reaching hurricane force, and their onset is sudden, often interrupting periods of near-calm conditions (NOAA, 2020).

The *Coast Pilot* notes that in Shelikof Strait, along the *Scandies Rose* route, "during windy conditions, wind force is sharply higher in the vicinity of, and even in the lee of the capes and point that extend into Shelikof Strait. During these conditions, entry well into the bays is necessary for refuge."

1.7.2 Weather Observation Stations

Four weather observation stations are in the area around the Alaska Peninsula and Sutwik Island, as shown in figure 16. At the MBI public hearing, several captains testified that they would like for there to be more weather observation sites or buoys in the area; one captain stated that the current weather observation sites “are not representative of the weather conditions near Sutwik Island.” Table 4 shows the weather conditions recorded for each of the four stations around the time of the accident.



Background source: Google Earth

Figure 16. Map of accident area with the location of the accident site, closest surface weather observation sites, and accident voyage track.

Table 4. Weather conditions in the area around the accident time, as recorded by weather observation stations.

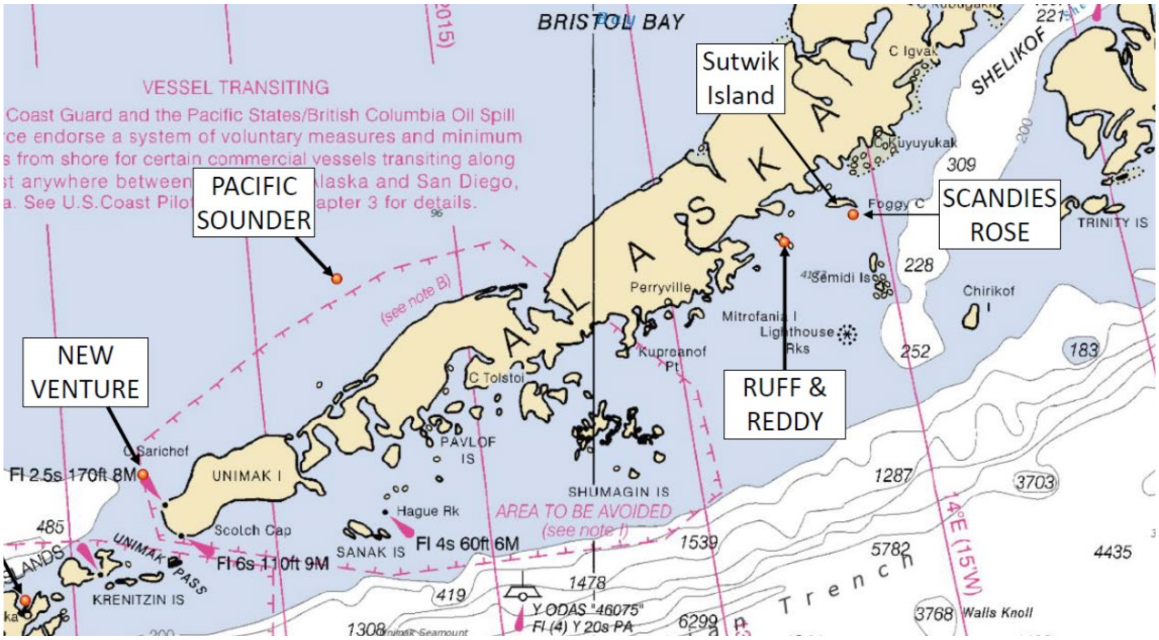
Note: A double asterisk (**) indicates that the weather station could not or did not record the weather condition.

	Port Heiden Airport 2156 Dec 31	Akhiok Airport 2156 Dec 31	Marine Station 2200 Dec 31	Weather Buoy 46077 2150 Dec 31
Distance from accident site	59 miles northwest of the accident site on the northwestern side of the Alaska Peninsula	97 miles east-northeast of the accident site east of the Aleutian Range	95 miles east-northeast of the accident site	125 miles northeast of the accident site
Winds	from 310° at 31 knots with gusts to 39 knots	from 310° at 19 knots with gusts to 37 knots	from 296° at 32 knots with gusts to 42 knots	from 258° at 26 knots with gusts to 33 knots
Seas[29]	**	**	**	significant wave heights of 8.4 feet, a mean wave direction of 233°, and a dominant wave period of 9 seconds
Weather	heavy snow and freezing fog, overcast skies	overcast skies	**	**
Temperature	-13°C	-12°C	air temperature 10.5°C water temperature 4°C	air temperature -9.4C water temperature 6.1C

1.7.3 Weather Conditions for Nearby Vessels

To better understand the unique icing and weather conditions of the area, and to obtain more accurate data of the accident area than the weather stations could provide, the captains of fishing vessels that had left Kodiak and were operating in the area around the same time as the *Scandies Rose* were interviewed at the MBI public hearing; the positions of the vessels are shown in figure 17.

[29] *Seas*, measured in feet, describes the interaction of wind, waves, and swell; the foot measurement of *seas* is the same as the significant wave height. *Significant wave height*, the value given in weather forecasts, is the average of the highest third of waves measured or forecasted.



Source: Coast Guard

Figure 17. Vessel positions relative to the *Scandies Rose* at approximately the accident time.

Pacific Sounder. The captain of the *Pacific Sounder* stated that, during the accident timeframe, his crew was experiencing a 45-knot northwest wind and 15- to 20-foot seas at their location north of the Alaska Peninsula. Up to one-half foot of ice had accumulated on various parts of the vessel, and it took them 2 hours to clear all the ice off the vessel. He had heard the weather report around 0600 on December 31 for worsening weather conditions and started setting pots around 0900 to avoid ice accumulation. By 2100, they had set all their pots and were in heavy freezing spray conditions.

Ruff N Reddy. The captain of the *Ruff N Reddy*, whose vessel had departed Kodiak on December 29, stated that they started to accumulate ice in 25- to 30-knot northwest winds while between Sutwik and Nakchamik Islands from 0100 and 0500 on December 31. They sheltered behind Nakchamik Island—about 25 miles southwest of the *Scandies Rose* accident site—and dropped anchor around 0500 on December 31 (15 hours before the time of the accident). When the *Ruff N Reddy* dropped anchor in the lee of Nakchamik Island, it had a maximum of one-half inch of ice on the rails in snow conditions with heavy northwest winds and gusts. Around the time of the accident, while the boat was still sheltering behind Nakchamik Island, the captain stated that they were experiencing northwest wind of 40 knots with heavier gusts, with seas 1 foot or less and no building seas.

New Venture. The captain of the *New Venture* recalled 25-knot winds with no icing conditions at their location at the time of the accident.

1.7.4 NTSB Weather Simulations

Weather Simulation. To validate the weather forecasts and further investigate the potential for williwaws, the NTSB ran a Weather Research and Forecasting (WRF) model.[30] The model used observational and model weather information to simulate the weather conditions along the Alaska Peninsula surrounding the time of the accident. The simulation indicated wind increasing with time, with sustained winds between 40 and 55 knots near the accident site at the accident time. (Wind gusts were not calculated.) Higher windspeeds were coming from the bays and passes in the lee of the Alaska Peninsula (red and orange on figure 18).

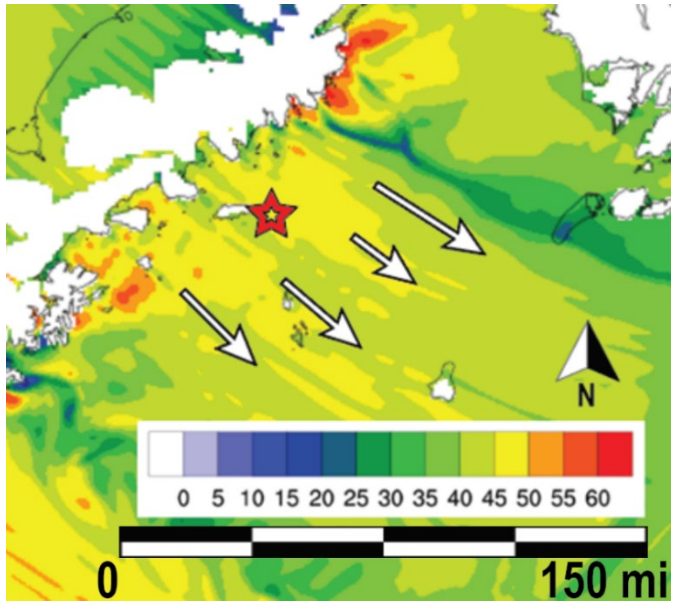


Figure 18. NTSB weather model showing near-surface wind in knots at 2100. The *Scandies Rose*'s approximate location is marked by a star. White arrows show estimated wind direction.

Sea Spray Icing. Sea spray icing has long been a serious hazard to marine vessels because the ice accumulates over exposed decks and exterior surfaces of a vessel, adding weight that may ultimately capsize a vessel (NOAA 2005). As defined by NOAA, sea spray icing occurs in environmental conditions where cold, wave-generated spray contacts exposed surfaces and air temperatures are below freezing. Factors affecting sea spray icing include wind speed, air temperature, water temperature, freezing temperature of water, relative wind direction, and sea and swell wave characteristics (height, period, and propagation direction). Contributing factors based on the characteristics of the vessel include speed, heading (with

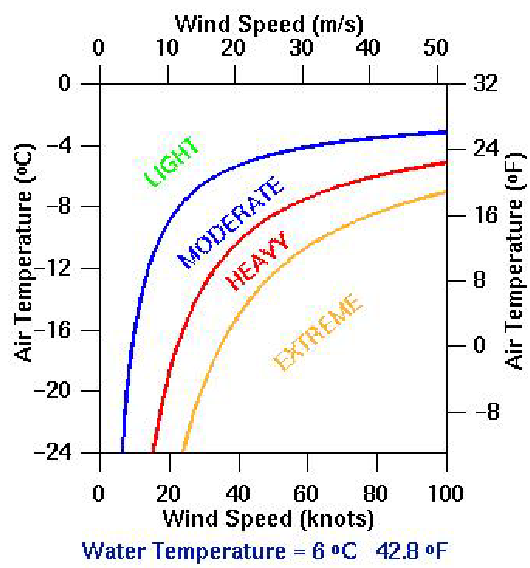
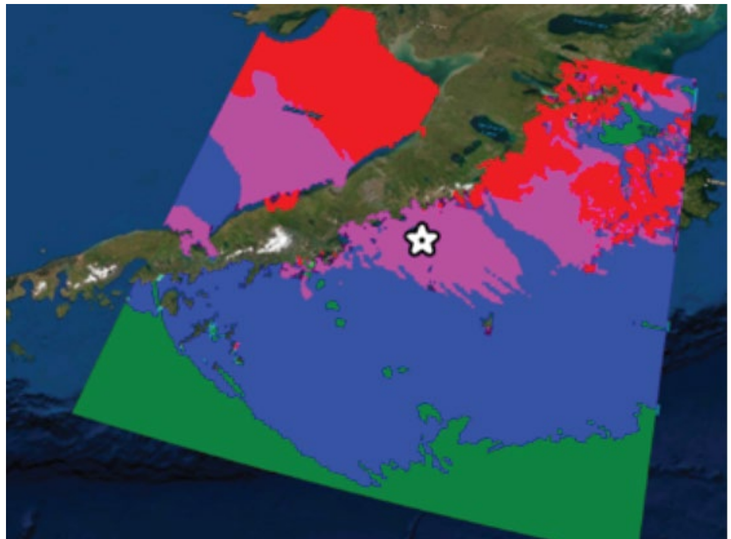


Figure 19. Overland (1990) sea spray ice accretion potential for water temperature of 6.0°C.

[30] The WRF model is maintained by the National Center for Atmospheric Research's Mesoscale and Microscale Meteorology Laboratory.

respect to wind, waves, and swell), length, and amount of freeboard (distance between the waterline and uppermost watertight deck).

In general, more sea spray reaches the deck and superstructure when the vessel travels faster into the wind and waves, particularly for smaller vessels and vessels with less freeboard. The NWS Alaska currently uses an algorithm to estimate the amount of sea spray ice accretion and forecast situations of freezing spray and heavy freezing spray (Overland 1990). The rate of icing increases as the temperature drops and the wind speed and sea height increases. At the time of the accident, the sea spray ice accretion potential for vessels between 20 and 70 meters in length (which included the accident vessel, at 39.6 meters) is shown in figure 19.[31]



PPR	<0	0-22.4	22.4-53.3	53.3-83.0	>83.0
Icing Class	None	Light	Moderate	Heavy	Extreme
Icing Rates (cm/hour) (inches/hour)	0	<0.7 <0.3	0.7-2.0 0.3-0.8	2.0-4.0 0.8-1.6	>4.0 >1.6

Table source: Vessel Icing: Prediction, nps.edu

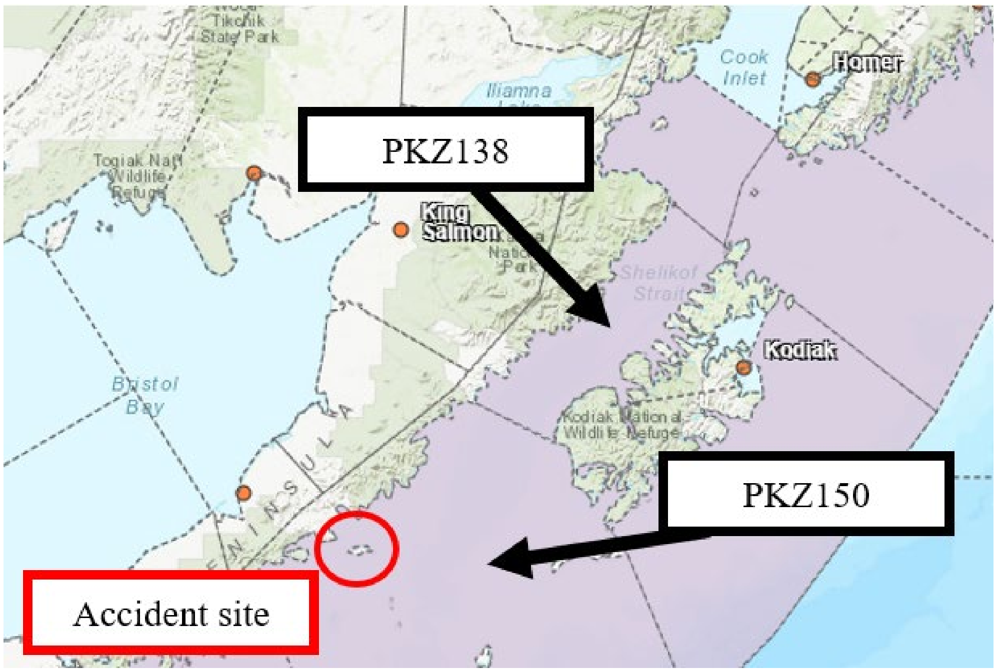
Figure 20. Modeled sea spray ice accretion values for the accident area on December 31, 2020, at 2200. The approximate accident location is marked by a star.

Using data from the NTSB weather model, the NTSB estimated the amount of sea spray ice accretion (measured in inches per hour) at times and locations along the *Scandies Rose*'s trackline. At the time of the sinking, about 2200 on December 31, the vessel was in an area that the NTSB weather model calculated as experiencing heavy sea spray ice accretion of up to 1.6 inches per hour (see figure 20).

[31] Sea surface temperature of 6.0°C from the NWS Sea Surface Temperature Analysis, December 31, 2019.

1.7.5 Meteorological Resources for Mariners

National Weather Service. The NWS provides weather forecasts and warnings to help mariners "make decisions that save lives and protect property."[32] The NWS forecast office in Anchorage issued official marine forecasts along the route the accident vessel took after departure from Kodiak, including the accident site. The *Scandies Rose* passed through two different marine forecast zones, as shown in figure 21: PKZ138 (Shelikof Strait) and PKZ150 (Sitkinak to Castle Cape). Forecasts for both marine zones included gale warnings for the entire period of the accident voyage.



Source: NWS, annotated by NTSB

Figure 21. Exemplar image of NWS Anchorage office Alaska Peninsula forecast areas.

Table 5. NWS forecasts for the area.

Note: All forecasts were valid for 1800 December 31 to 0600 January 1.

Issue time	1529 December 30 (before departure)	1525 December 30 (before departure)	1452 December 31 (after departure)
Zone	PKZ138	PKZ150	PKZ150
Winds	W35 knots	NW45 gusts to 55 knots out of bays and passes	NW45 knots
Seas	9 ft	21 ft	21 ft
Icing	Freezing spray	Heavy freezing spray	Heavy freezing spray

Weather Radio Range. The NWS uses NOAA Weather Radio (NWR) as another avenue to provide weather forecast and weather observation information to mariners using VHF transmitters. The NWS forecast information (available within 10 minutes or less of

[32] For more information, see NWS's website at https://www.weather.gov/about/forecastsandservice.

forecast issuance time) would have been available to the accident captain from the time of departure through the Middle Cape area (WZ2556), which the vessel transited then departed about 1200 on December 31 (see figure 22). The majority owner of the vessel and a family member stated that the accident captain had both access to and used a VHF radio to receive NWR information.

Source: NWS, annotated by NTSB

Figure 22. NWR VHF coverage areas.

Third-Party Weather Applications. Because the captain of the *Scandies Rose* used the Windy.com app and had discussed its forecasts and information with his crew before the accident voyage, the NTSB gathered additional information about Windy.com, which provides users with weather information from weather model data sources using different interfaces and layers.[33]

The surviving crewmembers, as well as all the captains of fishing vessels operating in the area who were interviewed at the MBI public hearing, testified that they used the Windy.com app, noting that they preferred the graphics and the finer scale details available. (While some captains also received information via Fleet One, Windy.com was used by all captains interviewed.) Most of the captains noted that they checked the Windy.com app while in port and under way. The captains interviewed also all used the NWS forecasts, via VHF radio or online, and many mentioned that they also discussed weather conditions with other captains in their area.

---

[33] Other alternative sources of weather information such as the Windy.com app, include Buoy Weather, Windfinder, and Ventusky.

Ocean Prediction Center Icing Website. In 2014, the NWS Ocean Prediction Center (OPC) developed and made available an Experimental Freezing Spray Guidance website.[34] While NWS categorizes freezing spray into two levels (heavy freezing spray warning and freezing spray advisory), the OPC website provides a higher level of detail, with graphical information displaying 12 distinct icing rates ranging from 0 centimeters per hour (cm/hr) up to 25 cm/hr for the 12-, 24-, and 36-hour icing rate forecasts for the Bering Sea and Gulf of Alaska.[35] This experimental website was available at the time of the accident, but the NTSB was unable to retrieve the imagery valid around the accident time.

Although none of the captains of fishing vessels operating in the area who were interviewed at the MBI public hearing were aware of the website, many of them stated that it would be a "helpful tool" to use since they would "use any weather information they can get their hands on."

NWS Freezing Spray Information Request. The NWS and Environment Canada (Canada's weather service) work together to improve freezing spray forecasts by using "analysis of freezing spray cases, forecaster feedback, and ship observations" to evaluate current freezing spray forecast models and tools (NOAA 2015). The effort has resulted in modifications to current forecast models; however, meteorological observations are needed to verify the models. In 2018, NWS and Environment Canada developed and distributed a flyer to request more freezing spray and icing observations from the mariner community to help with weather forecast. The flyer was distributed via the web and local NWS office points of contact.

To date, the NWS has not received any feedback from the mariner community related to the 2018 request. Several captains interviewed at the MBI public hearing were not aware that the NWS was seeking feedback.

1.8 Stability

A vessel that is floating upright in still water will list, or heel over to an angle, when an off-center force, such as one created by wind or waves, is applied. Stability is the vessel's tendency to return to its original upright position when the force is removed. See appendix C, "Principles of Stability," for more information.

Stability criteria, established by regulators, set numeric bounds for a vessel's stability as determined through a set of calculations that account for the vessel's physical characteristics. The criteria are generally recognized as providing an adequate level of safety for vessels that are operated prudently, which means not overloaded and not

[34] Ocean Prediction Center - Overview (weather.gov)

[35] (a) Per the NWS, an "Experimental" Product/Service is "a proposed new/enhanced product/service issued on an experimental basis for a specified, limited time period to solicit public feedback." national Weather Service Instruction 10-102. (b) The website uses both a modified Overland algorithm and the Stallabrass sea spray icing rate algorithm.

operating in dangerous conditions such as violent storms. A margin of safety is built into the stability criteria and is intended to accommodate forces that can act on a vessel, such as rolling in waves, heeling due to wind, or listing from accumulated ice or as people or cargo move from side to side. Because of the margin of safety in regulatory stability criteria, a vessel may be functionally stable even if it does not meet the criteria. In addition, the only way to determine if a vessel meets the stability criteria is through calculations. If something changes about the vessel, such as a structural modification that might affect its stability, new stability calculations should be computed.

1.8.1 Coast Guard Stability Regulations

Vessel Stability Instructions. The stability criteria that applied to the *Scandies Rose* are found in 46 *CFR* Part 28, Subpart E, which required that the *Scandies Rose* be provided with stability instructions, also referred to as a stability booklet, developed by a "qualified individual," defined in the regulations as "an individual or an organization with formal training in and experience in matters dealing with naval architecture calculations," most often a practicing naval architect. Stability instructions for a vessel lay out different loading scenarios (sample loading conditions) that a master can follow to ensure the vessel meets the stability criteria established by regulators. The intent of the regulatory requirements is to provide information to the operator of a vessel that will enable them to readily ascertain the stability of the vessel under varying loading conditions and to operate the vessel in compliance with applicable stability criteria.

The Coast Guard does not review stability instructions for uninspected vessels such as the *Scandies Rose.* Although Coast Guard representatives review the stability instructions' operational conditions with the captain during dockside safety exams and SCCs, they do not verify the accuracy of the stability instructions aboard the vessel nor can they, as it requires a technical expert review of the calculations used to produce the instructions.

Although stability instructions for vessels such as the *Scandies Rose* are valid for the life of the vessel as long as no major modification has been made, the majority owner of the *Scandies Rose* had contracted a licensed naval architect to complete a new set of stability instructions in April 2019. (The same naval architect also completed the vessel's previous stability assessment in 1988.) The majority owner of the *Scandies Rose* stated that because of the age of the previous report, he thought it would be prudent to have the instructions renewed. He also stated that the recent casualty of a similar vessel, the *Destination*, factored into his decision.[36]

The instructions must be developed based on each vessel's individual characteristics and must be in a format that is easily understood by the individual in charge of the vessel. The regulations note that because few operating personnel in the commercial fishing industry have had specialized training in stability, stability instructions should consider the conditions a vessel may reasonably be expected to encounter and provide

[36] See section 1.11, "Fishing Vessel *Destination*."

simple guidance. The regulations permit "maximum flexibility" when developing this guidance and do not require anything specific to be included. To convey this guidance, the *Scandies Rose*'s stability instructions included an introductory list of requirements and recommendations titled "Instructions to Master." These instructions listed 12 items, including the number of pots the vessel could carry (208), minimum freeboard to maintain, the importance of keeping freeing ports clear, and the significance of preventing a slack tank.[37]

Icing. Because ice accumulation raises a vessel's center of gravity and can therefore decrease stability, the regulations require that the stability instructions for vessels that operate in areas where icing conditions are present, such as the *Scandies Rose,* factor in the added weight of ice accumulation on the vessel.[38] The text of the regulation, which mirrors guidance from the International Maritime Organization, requires that icing calculations account for a minimum of 1.3-inch-thick ice to be applied to continuous horizontal surfaces and 0.65-inch-thick ice to be applied to continuous vertical surfaces.

The naval architects and qualified individuals from private industry and within the Coast Guard interviewed by the MBI stated that when conducting stability calculations for the icing effects on a stack of crab pots, they use guidance from regulations and treat the top and vertical sides of the stack as continuous surfaces, similar to a "shoe box" covering the top of the stack. The regulations also assume that ice accumulation around a stack of crab pots is distributed evenly (symmetrically). During the MBI hearing, Bering Sea/Aleutian Islands (BSAI) fishermen and industry naval architects interviewed indicated that, in reality, ice accumulates asymmetrically on pot stacks; the side of the stack that is exposed to the wind and freezing spray accumulates the majority of the ice, while the opposite side accumulates very little. They also stated that ice rarely accumulates only on the exterior tubes and webbing of a crab pot but most often also accumulates on the interior webbing of the pots positioned both on the outside and inside of the pot stack. The fishermen also noted that ice would accumulate asymmetrically on their vessels' structures. The naval architect who completed the stability instructions for the *Scandies Rose* calculated that ice would accumulate symmetrically on the external surfaces of the pot stack, meeting the distribution and minimum thickness guidance in the regulations.

The *Scandies Rose* stability instructions did not mention the ice accumulation thicknesses used to compute the required stability of the vessel, nor were the instructions required to do so. Of the BSAI fishing vessel captains who testified at the MBI hearing, several stated that they would frequently use their vessels' stability instructions to ensure their vessels were operating safely, but many of the captains did not know how much ice accumulation the stability regulations prescribed to be used in the development of their

---

[37] (a) A *freeing port* is an opening in the bulwark or rail, often covered by a hinged plate, to allow large quantities of deck water to run overboard. (b) A *slack tank* refers to a condition when a tank is only partially filled, which can cause a free surface effect within the tank and reduce the vessel's stability. When any tank or a compartment is partially filled, the motion of the liquid due to the ship's rolling and pitching motions reduces the stability of the ship.

[38] Each vessel that operates north of 42° latitude between November 15 and April 15 or south of 42° latitude between April 15 and November 15 must meet the requirements of 46 *CFR* 28.550.

stability instructions. At the MBI hearing, when told the icing amounts used in the stability instructions development, most captains stated that if and when they accumulated ice, they would typically allow more than that amount to accumulate. One captain indicated that he would not attempt to remove the ice until a "few inches" accumulated, adding that anything less would be too difficult and time consuming to remove.

Following the sinking of the *Scandies Rose,* USCGC *Polar Star* simulated sea spray ice accumulation to observe how ice can potentially accumulate inside a crab pot. The crew used a garden hose with a mist applicator to spray fresh water over a 1,040-pound crab pot on the vessel's deck while on patrol in the Bering Sea (see figure 23). After 72 hours, with temperatures ranging from 5°F to 15°F and variable winds, the pot weight more than tripled due to the accumulated ice, and the exact weight of the pot could not be determined because it maxed out the load cell used, which was rated for 3,000 pounds. The crew observed significant ice accumulation inside the pot, but the thickness of the ice, outside and inside the pot, was not determined.

Source: Coast Guard, modified by NTSB

Figure 23. Crewmembers aboard USCGC *Polar Star* weigh a crab pot following a 3-day freezing spray experiment.

Stability Training. Captains and crew of uninspected commercial fishing vessels such as the *Scandies Rose* are not required to participate in formal stability training or to demonstrate proficiency in vessel stability. The North Pacific Fishing Vessels Owners' Association (NPFVOA), based in Seattle, Washington, and the Alaska Marine Safety Education Association, based in Sitka, Alaska, both offer Coast Guard-approved stability courses that cater to fishing industry workers. Both schools' executive directors told the MBI that, because these classes are not required, participation is traditionally low. One fisherman, who was required to take a stability class to obtain a merchant mariner credential, told the MBI that while learning about icing in class, he was surprised how even a small amount of ice accumulation could negatively affect vessel stability and that he suspected that other fishing industry workers and vessel captains would come to the same realization and would benefit from the training.

Following the sinking of the *Scandies Rose*, a maritime vocational school in Seattle partnered with the minority owner of the *Scandies Rose* and developed a stability class specific to BSAI crab vessels. As of March 2021, the 8-hour class had been offered twice and was well attended according to the instructor. Two participating crab vessel captains told the MBI that they would highly recommend the class, and one mentioned that he believed the class should be mandatory for all crab vessel captains.

Marine Safety Information Bulletin. On January 19, 2021, in response to the *Scandies Rose* sinking, the Coast Guard published a Marine Safety Information Bulletin (MSIB) titled *MSIB 01-21: Improving Fishing Vessel Stability*. The MSIB included links to online vessel stability training resources and emphasized the dangers associated with icing and its negative effects on vessel stability. The MSIB also reminded vessel operators to be aware of the amount of accumulated ice that stability instructions are required to account for and included mitigation methods if icing conditions are encountered.

1.8.2 *Scandies Rose* Postaccident Stability Analysis

For the MBI, the Coast Guard's Marine Safety Center (MSC) conducted a forensic technical stability analysis of the *Scandies Rose* following the sinking (Coast Guard 2021).[39] To evaluate the vessel's onboard stability instructions at the time of the accident, the analysis used hydrostatic model and lightship characteristics from the vessel's stability assessment used to develop the 2019 stability instructions and a new MSC hydrostatic model and lightship calculation.[40] The analyses relied on new hull modeling and a lightship determination based on existing drawings and photos, investigators' approximation of the accident voyage loading, and estimates of crab pot weights. The report evaluated all 11 loading conditions in the 2019 stability instructions and two estimated loading conditions for the accident voyage. For all conditions, the MSC calculated icing using the requirements in 46 *CFR* 28.550 (1.3 inches of surface ice on horizontal surfaces and 0.65 inches of surface ice on vertical surfaces).

When modeled by the MSC, the majority of the loading conditions in the 2019 stability instructions failed the required stability criteria. The MSC's analysis of the two loading conditions that approximated the accident voyage found that "the estimated casualty voyage loading condition may have met the restrictions of the owner's naval architect's 2019 stability instructions but failed regulatory stability criteria, including water on deck, intact stability, and severe wind and roll criteria." The MSC also noted that the *Scandies Rose* "may have physically felt stable to crewmembers in these conditions despite having dangerously low righting energy," which is the amount of energy that a vessel can absorb from external heeling forces (winds, waves, weight shifts, etc.) before it capsizes.

The report concluded that the 2019 stability assessment did not accurately model the vessel's poop and forecastle enclosed volumes and "apparently neglected

[39] See appendix E for more information on the MSC study.

[40] *Lightship*, or *lightweight*, is generally defined as the weight of a ship ready for sea with no cargo, fuel, water ballast, stores, provisions, or passengers on board.

downflooding."[41] It also did not accurately model the bulwarks' height, and the 2019 instructions significantly underpredicted the superstructure windage area. The MSC report also noted significant "differences when comparing tank capacities," "mathematical errors," and "errors and omissions" in the 2019 stability instructions. Additionally, the report concluded that the "magnitude and asymmetry of the icing during the casualty voyage was likely different than the symmetric" icing criteria referenced in the regulations, and that "this could have made the stability worse than calculated during the casualty voyage."

The naval architect who completed the *Scandies Rose* stability instructions, who had been independently completing vessel stability instructions for about 30 years, stated that while on board the vessel he had never visually inspected for engine room vents located on the second level behind the bridge stairwell, which the Coast Guard analysis represented as the vessel's first downflooding points when heeled over. Instead, he relied on his prior experience with other vessels and conversations he had with the vessel owner and assumed that the only downflooding points were vents on the uppermost section of the vessel on the funnel casing of the stack, centerline of the vessel.

1.9 Cod and Crab Fishery

The *Scandies Rose* was planning to participate in the BSAI Pacific cod fishery and the BSAI opilio crab fishery directly following the cod delivery. During the MBI public hearing, the majority owner of the *Scandies Rose* said that the vessel didn't fish for cod consistently from year to year because of the "meager paycheck" associated with the catch. He added that the reason the vessel intended to participate in the 2020 season was because of recent discussions regarding the pot cod fishery changing to a rationalized system. The change would allocate portions of the total allowable catch to specific vessels and organizations. His desire was to get a single cod delivery on record in order establish a catch history, a variable that traditionally factored into the allocation. The majority owner stressed that the plan was to only make a single cod delivery while simultaneously scouting for opilio crab and that the vessel would complete this before the season closed (historically the season was open 2–3 weeks).

1.10 Coast Guard Fishing Industry Safety Compliance Checks

Developed in 1999, the Coast Guard initiated voluntary SCCs to assist in reducing fatalities and vessel loss within the BSAI crab fleet. In particular, the goal of the SCC was to deter vessels from overloading with crab pots. SCCs are traditionally completed each year in early October, before the king crab season, when most of the fleet has congregated

[41] (a) The *poop deck* on the *Scandies Rose* was also referred to as the second deck, as indicated in figure 10 of this report. The *poop volume* referenced in the MSC report was the total enclosed space between the main deck and second deck. (b) *Downflooding* occurs when seawater enters an undamaged vessel through an opening, such as an engine room vent or non-weathertight hatch, in the hull or superstructure. The *downflooding angle* is the minimum angle of a vessel's heel at which a vessel opening is submerged, thus allowing downflooding to occur.

in Dutch Harbor. During the compliance checks, Coast Guard representatives verify and document that each vessel has the required safety equipment and stability instructions.[42] A sample of the crab pots on board each vessel is measured and weighed. The Coast Guard representative cross references this information and the current loaded condition of the vessel with the vessel's stability instructions and discusses the results with the vessel's captain.

The *Scandies Rose* underwent an SCC in Dutch Harbor on October 11, 2019, (about 2 months before the accident voyage) before participating in the king crab season. The Coast Guard representative examined the vessel and the vessel's safety equipment. The representative also documented that the stability instructions were present and recorded the loaded conditions. No deficiencies were noted.

1.11 Fishing Vessel *Destination*

On February 11, 2017, the *Destination*, which was a fishing vessel similar in type to the *Scandies Rose* with the same regulatory requirements, capsized and sank while transiting from Dutch Harbor to St. Paul Island, Alaska, with 200 crab pots on board (NTSB 2018). None of the six crewmembers survived. Following the accident, both the NTSB and the Coast Guard conducted parallel investigations into the sinking and concluded that the vessel likely capsized due to added weight on the vessel from ice accumulating on the vessel and its pot stack from freezing spray. The Coast Guard found that the vessel left port overloaded and did not meet minimum stability criteria.

The Coast Guard's MBI tasked with investigating the *Destination* accident requested that the MSC conduct a stability assessment of the vessel. Similar to the *Scandies Rose*, the *Destination* was required to have stability instructions completed by a "qualified individual." MSC staff disagreed with the qualified individual's assessment that the recent addition of a bulbous bow had a negligible effect on vessel stability. In addition, MSC staff determined that with the addition of a new bulwark, the vessel lacked sufficient freeing port area as defined in regulations. The *Destination* MBI's Report of Investigation stated that the MSC's analysis showed "the vessel did not comply with intact stability criteria for the majority of prescribed loading conditions found within the stability instructions" (Coast Guard 2017).

[42] See section 1.8, "Stability," for additional information on stability instructions.

As a result of the *Destination* investigation, the Coast Guard published *Safety Alert 11-17: Remain Upright by Fully Understanding Vessel Stability*, which was intended to assist mariners in identifying ways to improve their stability awareness and understand their vessel's stability instructions. The safety alert mentioned that "operators and crews should seek out opportunities to further their knowledge of stability via courses, training, workshops, and visits from Naval Architects" (Coast Guard 2011).

Figure 24. Ice accumulation on the fishing vessel *Sandra Five* in King Cove, Alaska, February 12, 2017. The vessel was operating the previous day in the Bering Sea in the vicinity of the *Destination* (NTSB 2018).

The NTSB also issued a safety alert in 2018 following the sinking of the *Destination* (NTSB 2018). The alert showed icing on vessels exposed to freezing spray operating near the capsized vessel (see figure 24) and provided operators with different precautions to take if icing conditions were encountered. The alert stressed that operators should understand their vessels' stability information and ensure that their vessels are operating within the limits set in the stability instructions.

Several fishing vessel captains were asked by the MBI if they had seen the MSIB or safety alert highlighting the dangers of icing, or if they had read the Coast Guard report of investigation following the *Destination* sinking. None of the individuals could recall seeing the documents.

1.12 NTSB 2021–2022 Most Wanted List

The NTSB's 2021–2022 Most Wanted List of Transportation Safety Improvements includes the issue area "Improve Passenger and Fishing Vessel Safety." The commercial fishing industry, which remains largely uninspected, is a marine sector of concern. Per the Coast Guard, there are 58,000 commercial fishing vessels in service in the United States, and between 2000 and 2020, there were 805 fatalities, 164 missing people, and 2,122 injured people in commercial fishing vessel accidents in the United States.

Fishing consistently tops the list of most deadly occupations due, in large part, to challenging work environments, such as poor weather and rough waters. These conditions threaten vessel stability and integrity. More than 800 fatalities have occurred on fishing vessels in the past two decades. Many fishing crews aren't trained in stability management techniques or emergency response, and the NTSB has found that many vessels do not have proper life-saving equipment, such as flotation devices and SAR locator devices.

1.13 Postaccident Actions by the Coast Guard

After the accident, the Coast Guard Sector Juneau conducted a SAR case review to evaluate the effectiveness of the Coast Guard at providing early and sustained response to the sinking of the *Scandies Rose*. The report acknowledged the remote location of the accident and the severe weather encountered by the flight crews but cited deficiencies in the response time of air assets and gaps in time when there was no on-scene coverage from assets. The case review provided four recommendations to the Coast Guard, including that the MBI conduct further review with appropriate follow-on actions to address any recommendations and lessons learned, that D17 command centers conduct mission-focused discussions to address the deficiencies identified in the review, and that additional rescue helicopters and crewmembers be made available to enhance response times and increase the on-scene coverage during SAR operations.

2. Analysis

2.1 Introduction

On December 31, 2019, about 2200 Alaska standard time, US Coast Guard Communications Detachment Kodiak received a distress call from the fishing vessel *Scandies Rose*. The vessel was en route from Kodiak to fishing grounds in the Bering Sea when it capsized about 2.5 miles south of Sutwik Island, Alaska, and sank several minutes later. At the time of the accident, the *Scandies Rose* had seven crewmembers aboard, two of whom were rescued by the Coast Guard several hours later. The remaining crewmembers were not found and are presumed dead. This accident occurred while the *Scandies Rose* was transiting through high wind and seas while exposed to extreme icing conditions caused by freezing spray.

As a result of this accident investigation, the NTSB identified the following safety issues:

- The effect of extreme icing conditions (section 2.2.1),
- The vessel's inaccurate stability instructions (section 2.2.2),
- Need to update regulatory guidelines on communicating and calculating icing for vessel stability instructions (section 2.2.3), and
- Lack of accurate weather data for the accident area (section 2.3).

Having completed a comprehensive review of the circumstances that led to the accident, the investigation established that the following factors did not contribute to its cause:

- *Predeparture decision-making*. The captain of the *Scandies Rose* had nearly 40 years of experience as captain on numerous fishing vessels operating in the Bering Sea and Gulf of Alaska. Colleagues called him the most experienced fisherman they had ever met. He had traveled the accident voyage route many times before and was aware of the prevailing weather conditions in the area during the winter months. While the exact weather information the accident captain viewed before departure from Kodiak or along the route is not known, the surviving crewmembers told the NTSB that the captain discussed the weather conditions with the crew before departing Kodiak and that the captain stated the weather was going to be bad. The NWS forecast covering the accident voyage's route and timeframe called for heavy freezing spray and was initially issued over 5 hours before the vessel's departure; forecasts with gale warnings and heavy freezing spray were common occurrences in that area.

The *Scandies Rose* was loaded with 195 pots on deck, and the captain had been using similar pot stacks aboard the *Scandies Rose* for 12 years. Although the captain had not taken any formal stability training, he was familiar with the vessel's stability instructions, which included sample loaded conditions, having reviewed them with the Coast Guard several times during SCCs and dockside safety examinations. After the accident, several captains testified that they would have followed the same course of action as the captain regarding the vessel's load and timing of the departure from Kodiak. In fact, several other vessels left Kodiak around the same time as the *Scandies Rose*. The captain was familiar with the area and the weather forecast along the route, had loaded his vessel in accordance with the vessel's stability instructions, and had considerable experience with the vessel; thus, his decision to depart on the voyage on the *Scandies Rose* was reasonable.

- *Operational pressures*. As the captain and part owner of a Bering Sea fishing vessel, the captain was responsible for the safety of his crew and to harvest ample catch to make each trip profitable. BSAI fishing vessels operate in remote waters, often in harsh weather, and the fishery areas, seasons, and quotas often change. These pressures are common in the industry and were not unique to the accident voyage. The majority owner told the NTSB that the *Scandies Rose* would have ample time to complete the planned single cod run before the closure of the fishery and that the vessel did not rely on cod as a main source of income. Rather, the vessel's participation in the fishery was to establish a catch history if the fishery were to rationalize in the future.

- *Fatigue*. The accident voyage was the *Scandies Rose*'s first voyage of the season, so the captain and crew had just returned to the vessel from time off over the holidays. The survivors' work/rest logs and testimony indicated that the crew worked long days getting the vessel ready for departure. However, once the vessel departed, the crewmembers rotated through a watch schedule of 1 hour on and 11 hours off, which gave them time to rest during the day and a half before the accident. The surviving crewmembers both indicated that, although they were tired after working long hours at the dock, they were able to sleep following departure and did not feel fatigued during the accident voyage. The captain stood longer 6-hour watches while under way but did not participate in the more strenuous vessel load-out activities.

- *Drugs and alcohol.* Due to the remoteness of the accident location and the severity of the weather, almost 6 hours elapsed between the captain's mayday call at 2155 and when the survivors arrived at Air Station Kodiak about 0340. Regulations require alcohol testing to be conducted within 2 hours following an accident, so alcohol testing was not conducted. A take-home drug test, the only option the company was able to find, was given to the survivors. Although one deckhand tested positive for THC, the test was not administered or verified in a controlled manner. Moreover, the surviving crewmembers stated that, in accordance with company policy, they had not consumed any alcohol or drugs during the accident voyage, nor had they seen any other crewmember doing so.

- *Propulsion and steering systems*. The captain of the *Scandies Rose* had successfully navigated the vessel out of Kodiak harbor and through Whale Pass without incident. In the hours leading up to the accident, the two surviving crewmembers stood navigational watches and conducted engine room rounds as the vessel sailed southwest. They told the NTSB that they did not discover any mechanical issues with the propulsion and steering systems. In addition, the captain did not mention any mechanical issues or concerns when he made phone calls to the *Scandies Rose* managing owner and the *Pacific Sounder* captain.

- *Hull integrity*. Hull maintenance on the *Scandies Rose* was well documented in the vessel's 2019 condition and valuation survey. The vessel had non-destructive ultrasonic thickness measurements taken of the steel hull plating in 2017; although the results were not recorded, per witness testimony, the gauging indicated the hull was in good condition. A steel repair made to the starboard waste chute during the 2019 summer shipyard period was promptly identified as insufficient/faulty by the captain. Following the season, another welder repaired the chute and verified the quality of the new welds with a dye-penetrant check and they passed inspection. After the accident, ROV footage of the vessel's bottom, port side, and stern did not indicate any hull breaches that could have contributed to the sinking.

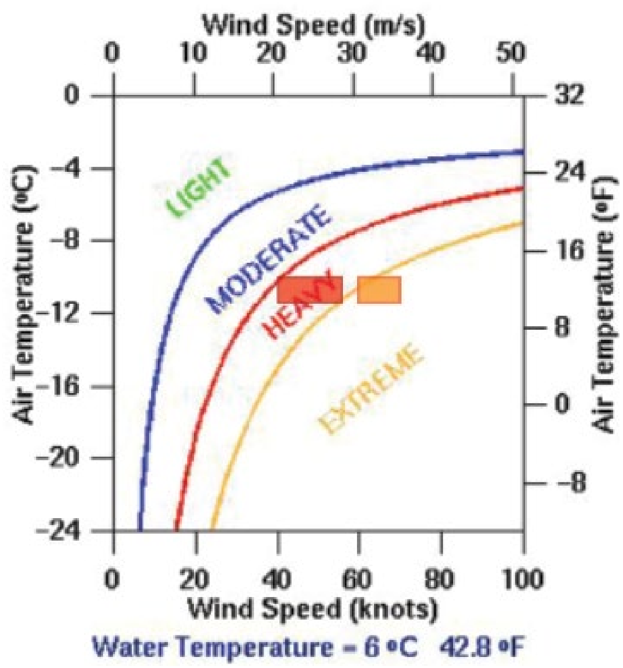
  During the accident voyage, crewmembers, including the two survivors, routinely conducted rounds of the engine room. None of them reported any water accumulating in the engine room bilges or indications of water ingress. In addition, the vessel's bilge alarms, located in the engine room and forepeak, were tested before departure and were reported to be in working condition. The survivors also stated that all watertight hatches and doors were secured and double-checked before departure. During the initial accident sequence, before the vessel laid over, the two surviving crewmembers said that there were no alarms sounding, indicating that bilge alarms had not activated.

Thus, the NTSB concludes that none of the following were safety issues for the accident voyage: (1) the captain's predeparture decision-making, (2) operational pressures, (3) fatigue, (4) drug and alcohol use, (5) the vessel's propulsion and steering systems, or (6) the vessel's hull integrity.

2.2 Stability

2.2.1 Voyage Stability and Icing

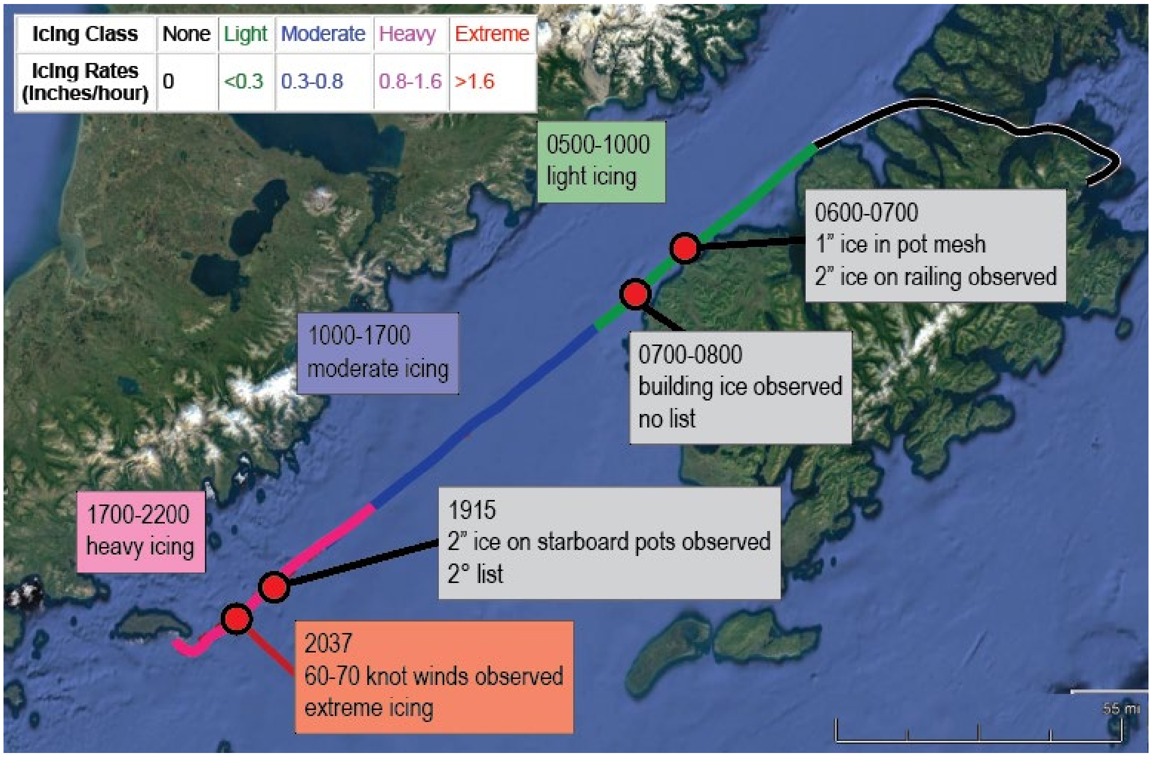
Based on the ice accretion rate obtained from the NTSB's weather model (which relied on weather conditions reported from the larger area's four weather stations) the *Scandies Rose* experienced progressively worse icing during the voyage.[43] Plotting the vessel's track, it is likely that the vessel first started accumulating ice around 0500 on December 31 (crew first observed icing at 0600). The vessel was then likely in light icing between 0500 and 1000, in moderate icing between 1000 and 1700, and in heavy icing between 1700 and 2200 (see figures 25 and 26). However, based on the localized weather conditions reported by the captain and crew, the *Scandies Rose* was likely experiencing ice accumulation greater than 1.6 inches per hour, which is categorized as extreme icing, over the final 2 hours of the voyage. The NTSB concludes that, based on the voyage timeline and the estimated ice accumulation over that period, the *Scandies Rose* likely accumulated between 6 and 15 inches of ice on surfaces exposed to wind and icing during the accident voyage.



Annotated by NTSB

Figure 25. Overland (1990) sea spray ice accretion potential for water temperature of 6.0°C. The weather conditions from 1700 to 2200 obtained from the weather model are noted in red and are primarily in the "heavy" portion of the graph. The weather conditions observed by the captain during the last 2 hours, about 2000 to 2200, are noted in orange and are primarily in the "extreme" portion of the graph.

[43] The nearest source of weather data was 59 miles away. See section 1.7.2, "Weather Observation Stations."



Background source: Google Earth

Figure 26. NTSB-calculated icing conditions the *Scandies Rose* would have encountered along voyage route and observed conditions.

Witness testimony and AIS data show that for about 20 hours—from 0149 on December 31, when the *Scandies Rose* exited the Kupreanof Strait, until 2145, when the captain steered the vessel toward the lee of Sutwik Island—the *Scandies Rose* held a relatively constant southwest heading. Weather reports and firsthand accounts indicate that the prevailing wind was northwesterly throughout this 20-hour period, meaning that the effects of the wind acted predominantly on the starboard side of the vessel as it sailed on this heading. Survivors first noted icing, formed from freezing spray, at 0600, and testified that the icing accumulated asymmetrically on the vessel, concentrated on the starboard side, and became progressively worse as the vessel continued the voyage.

When the captain of the *Scandies Rose* first called the *Amatuli* captain at 1118, his vessel was about 17 miles west of Kodiak Island. The crew observed ice building, and the vessel was likely experiencing moderate icing. However, the vessel was not yet experiencing a list, and it was reasonable for the captain to continue on his course. However, by the time the *Scandies Rose* captain woke and reported to the bridge to assume the watch shortly before 2000, the nearest location to shelter was Sutwik Island, an area the captain was familiar with that was also along the vessel's intended route, but the *Scandies Rose* was now likely experiencing heavy icing conditions and beginning to list to starboard.

During the captain's watch, the *Scandies Rose* experienced increased winds from the peninsula (williwaws). At 2037, the captain of the *Scandies Rose* called the *Pacific Sounder* captain and reported that the list was 20° and that winds were at 60–70 knots out of the west. The captain also noted that the outside temperature was 12°F and that his vessel was experiencing "really bad" icing. Per icing calculations, temperatures and winds at this speed would have resulted in extreme icing conditions. The *Scandies Rose* captain told his fellow captain on the *Pacific Sounder* that it was too rough to send his crew out to remove the accumulated ice. The captain of the *Scandies Rose* was familiar with the area around Sutwik Island, which was along his intended route. He was 7 miles away from the point where he would turn to starboard and head northwest towards the lee of the island.

About 2145, AIS showed that the *Scandies Rose* changed course to starboard, likely to shelter in the lee of Sutwik Island and to break ice off the vessel. With that course change, the 60–70 knot winds and rough seas out of the west, which had been acting on the vessel's starboard side, were now acting on the port side of the vessel (see figure 27). About the same time, the two surviving crewmembers were jolted from their bunks by a sudden sustained list to starboard, and just after the course change, the captain told the *Pacific Sounder* captain that his vessel's list had gotten worse and that he was concerned. The sudden increased list at the time of the course change indicates that the course alteration to starboard exposed the vessel's port side to the prevailing wind and waves, which exacerbated the starboard list. Although the captain's decision to proceed to Sutwik Island was reasonable, by the time he was close enough to turn into the lee, the icing conditions had accelerated and reduced the vessel's stability.

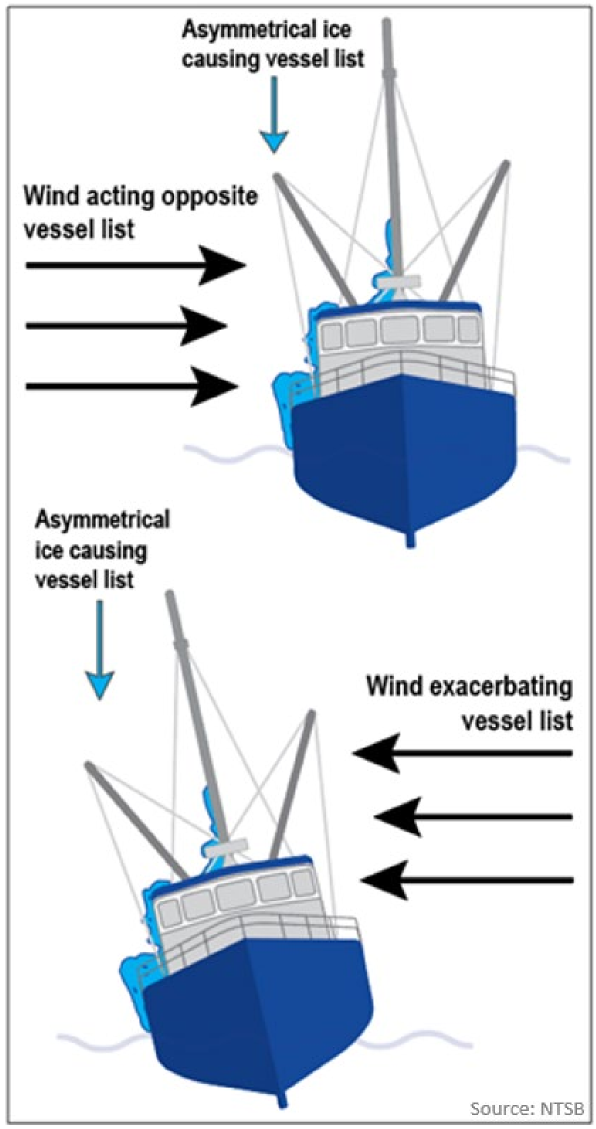


Figure 27. Diagram of ice and wind acting on the *Scandies Rose*.

The weight of the asymmetrical icing on the starboard side of the *Scandies Rose* pot stack and structure caused the vessel to develop a starboard list, which grew worse leading up to the time of the accident. As stated earlier, the captain's course change toward Sutwik Island at 2145 brought the 60–70 knot winds onto the port side, adding to the existing list from icing. By the time Deckhands 1 and 2 arrived at the bridge, after being jolted from their bunks due to the sudden increase in list, the vessel was heeled over so far that Deckhand 2 described a chair breaking and causing him to slide down the deck toward the starboard side, indicating that the vessel's stability had been overcome and that the vessel was capsizing.

The *Scandies Rose* was carrying a full stack of pots that reached about 20 feet above the main deck, and the survivors told the NTSB that ice from freezing spray was forming asymmetrically on the starboard side and building as the voyage progressed. Coast Guard safety bulletins and guidance alert mariners of the dangers of accumulated ice, stressing that the added weight of ice high on a vessel—in the case of the *Scandies Rose*, up the 20-foot stack of pots, the focsle, bulwarks, and portions of the house—will rapidly raise a vessel's center of gravity and diminish its stability. As previously discussed, the *Scandies Rose* could have accumulated between 6 and 15 inches of ice over portions of the vessel. Therefore, the NTSB concludes that the added weight from ice accumulating asymmetrically on the vessel and the stacked crab pots on deck raised the *Scandies Rose*'s center of gravity, reducing its stability, and contributing to the capsizing.

2.2.2 Stability Instructions

The *Scandies Rose* had stability instructions, per Coast Guard regulations, that had been completed by a qualified individual, in this case, a licensed naval architect. The stability instructions allowed for the *Scandies Rose* to carry a maximum of 208 crab pots; the vessel departed on the accident voyage loaded with 195 crab pots. The two surviving crewmembers stated that, per the stability instructions, all deck gear and crab pots were secured against shifting, all doors and hatches were closed, the bilges were inspected, and alarms had been tested. As loaded, the vessel left in accordance with the stability instructions.

However, the MSC forensic technical stability analysis of the *Scandies Rose*, which evaluated the stability instructions for the vessel, noted "differences when comparing tank capacities," "mathematical errors," omissions, as well as that the 2019 stability assessment "apparently neglected downflooding." The report concluded that the approximations of the accident voyage loading condition may have met the conditions of its stability instructions but failed regulatory stability criteria. The stability criteria have been developed to provide an adequate level of safety for vessels that are operated prudently, and a margin of safety is built into them intended to accommodate forces that can act on a vessel, such as rolling in waves, heeling due to wind, or limited degree of listing. The MSC also concluded that the *Scandies Rose* had "dangerously low righting energy"—the amount of energy that a vessel can absorb from external heeling forces (winds, waves, weight shifts, etc.) before it capsizes—when loaded in conditions similar to the time of the accident. Therefore, the NTSB concludes that although the crew loaded the *Scandies Rose* per the stability instructions on board, the stability instructions were inaccurate; therefore, the vessel did not meet regulatory stability criteria and was more susceptible to capsizing.

Because the vessel did not meet regulatory criteria, the captain had little room for error, particularly in the icing conditions that the vessel encountered on the voyage. The captain, relying on the stability instructions for his vessel loading, loaded his vessel in accordance with the stability instructions. Therefore, because the stability instructions were inaccurate, the captain was unaware that his vessel did not meet the margin of safety intended to be provided by the stability regulations.

2.2.3 Stability Instruction Regulations

2.2.3.1 Effect of Icing on Stability Instruction Calculations

The regulations governing stability for vessels that operate in waters where there is a potential of icing, such as the *Scandies Rose*, factor in a minimum set amount of added weight for accumulated ice and specify that ice accumulation should be applied symmetrically to exposed continuous horizontal and vertical surfaces. This added icing thickness measurement and corresponding weight are used by naval architects and other qualified individuals when completing stability instructions.

The regulations do not provide guidance on how to apply ice accumulation on crab pots. Naval architects from the Coast Guard and private industry interviewed at the MBI public hearing, who had conducted stability instructions for fishing vessels similar to the *Scandies Rose*, agreed that, per the regulations, they calculate the added weight of ice on a stack of crab pots by applying ice uniformly to the continuous horizonal and vertical surfaces of the pot stack—like a "shoe box" of ice of the regulatory thicknesses placed over the stack. However, because crab pots are made up of tubular frames and mesh, they do not act as a continuous horizontal or vertical surface, and crab pot vessels operating in icing conditions have reported ice accumulating not only on the vertical and horizonal frames, but on all the external and internal mesh or webbing of the crab pot.

The naval architects interviewed during the MBI public hearing voiced concern that the current regulatory guidelines for calculating icing on crab pots was not a reflection of what was actually occurring on the water. All the mariners that spoke to the NTSB following the accident stated that when a stack of pots is exposed to icing conditions, ice rarely only accumulates on the exterior tubes and webbing of crab pots. As Deckhand 2 observed, it most often also accumulates on the interior webbing of not only the pots positioned on the outside of the stack but also on the pots in the inside—spaces that the current regulatory calculations do not account for. Only a pot stack that has been tarped would present the simple horizontal and vertical surfaces used in current icing regulatory assumptions. Fishing vessel captains also noted that, when a vessel's pot stack ices, it typically does so asymmetrically on one side of the vessel, as it did in the case of the *Scandies Rose* due to the wind direction relative to the vessel and the way the spray impacted the pots.

There is no method currently available for calculating crab pot icing weight that includes interior webbing and reflects actual ice accumulation on pot stacks. When the

Polar Star crew observed ice forming on a crab pot, as discussed in section 1.8.1, the added weight of ice was more than three times the weight of the pot. Similar to fishing vessel captains' accounts, the pot also formed ice in the pot's internal webbing—where it cannot be hammered off.

This single pot weight difference does not accurately replicate nor predict the effects of a full stack of pots on deck and exposed to asymmetrical icing. Additionally, mariners reported that freezing spray often results in ice asymmetrically accumulating on a vessel and its pot stack. Ice accumulation in individual pots' internal webbing is not explicitly accounted for in the current regulatory stability calculations, nor is ice accumulation in pots internal to a stack, nor asymmetric icing. Therefore, the NTSB concludes that current regulatory guidelines on calculating the effects of icing on a fishing vessel's stability do not take into account how ice actually accumulates on and in crab pots and crab pot stacks. Vessel stability is dependent on accurate accounting and placement of weights on board the vessel, including potential ice accumulations. Underestimating the weight and not accounting for the asymmetric accumulation of icing in stability calculations reduces the intended safety margin of the stability regulations. Therefore, the NTSB recommends that the Coast Guard conduct a study to evaluate the effects of icing, including asymmetrical accumulation, on crab pots and crab pot stacks and disseminate findings of the study to industry, by means such as a safety alert. Further, the NTSB recommends that the Coast Guard, based on the findings of the study recommended in Safety Recommendation M-21-05, revise regulatory stability calculations for fishing vessels to account for the effects of icing, including asymmetrical accumulation, on a crab pot or pot stack.

2.2.3.2 Crew Familiarity with Stability Instruction Calculations

Stability instructions are used by crews to operate vessels in compliance with applicable criteria. It is important that the vessel's stability instructions bring vessel vulnerabilities related to stability to the attention of the vessel's captain, officers, and operator. Stability instruction regulations also note that, because few operating personnel in the commercial fishing industry have had specialized training in stability, stability instructions should consider the conditions a vessel may encounter and provide simple guidance.

Throughout the MBI public hearing, captains of commercial fishing vessels testified that they frequently consulted their vessel's stability instructions while operating. But when they were asked if, prior to the sinking of the *Scandies Rose*, they were aware of the amount of accumulated ice the regulations prescribed to be factored into their stability instructions, none knew. When they learned that the regulations allotted for uniform icing of 1.3 inches on horizontal surfaces and 0.65 inches on vertical surfaces, and only on the external surfaces of their pots, they were all surprised how little it was. Many even acknowledged that they would typically carry much more ice than was allotted in the regulations. On the *Scandies Rose*, the crew noted a 1-inch ice accumulation as early as 0600 the morning of the accident, but the captain, likely not knowing the icing thickness used in his stability report, did not voice concern about the 2 inches of ice that had built on his vessel and delayed sheltering or taking other mitigative actions. Thus, the NTSB concludes that, if vessel captains were aware of the amount of icing that is factored into their stability instructions, they would be better prepared to make critical vessel safety decisions when operating in areas of potential icing.

Naval architects, acting as qualified individuals, follow stability regulations when developing a vessel's stability instructions. Had regulations required the inclusion of icing accumulation thickness used in calculations for applicable vessels, the *Scandies Rose*'s 2019 stability instructions likely would have included them. Therefore, the NTSB recommends that the Coast Guard revise 46 *CFR* 28.530 to require that stability instructions include the icing amounts used to calculate stability criteria.

The North Pacific Fishing Vessel Owners' Association (NPFVOA) is a non-profit organization focusing on safety awareness in the North Pacific fishing fleets. NPFVOA works with the Coast Guard, and keeps its members apprised of issues important to the safety of their crews and vessels. The NTSB has previously recommended that NPFVOA inform its members of safety issues relating to other relevant marine accidents. Therefore, the NTSB recommends that the North Pacific Fishing Vessel Owners' Association notify their members (BSAI Crabbers/Fishing Vessel fleet) of the specifics of this accident, the amount of ice assumed when developing stability instructions, and the dangers of icing.

2.2.3.3 Stability Training

Regulations do not require the owners, masters, or crew of commercial fishing vessels to receive formal stability training, and neither the majority owner, the captain, nor the crew of the *Scandies Rose* had taken formal stability training. Mariners must rely on experience and what they have learned independently. Coast Guard guidance indicates that operators "should" be provided training on stability, and schools and training facilities offer Coast Guard-approved stability courses specific to fishing vessels. But participation has been low. Following the sinking of the *Scandies Rose*, a representative from one of these schools worked with industry to develop a crab boat-specific stability course that included information on the icing calculations. All the captains who spoke to the NTSB about the course said they took great value from it and suggested that it should be made mandatory for all captains. The NTSB concludes that formal stability training would provide fishing vessel crews with a better understanding of the principles and regulatory basis of stability, including the effect of icing.

The issue of training fishing vessel crews on vessel stability was discussed at the NTSB's 2010 Fishing Vessel Safety Forum and led the NTSB to issue Safety Recommendation M-11-24, addressing fishing vessel stability training, to the Coast Guard.

> Require all owners, masters, and chief engineers of commercial fishing industry vessels to receive training and demonstrate competency in vessel stability, watertight integrity, subdivision, and use of vessel stability information regardless of plans for implementing the other training provisions of the 2010 Coast Guard Authorization Act. (M-11-24)

This recommendation is now associated with the NTSB's 2021–2022 Most Wanted List of Transportation Safety Improvements under the issue area, "Improve Passenger and Fishing Vessel Safety." On October 18, 2016, in response to Safety Recommendation M-11-24, the Coast Guard said that operator competency training required by the 2010 Coast Guard Authorization Act includes stability and that the Coast Guard's Commercial Fishing Vessel Advisory Committee developed goals and objectives for stability-related training and was developing an outline for a standard curriculum. When a standard curriculum was in place, training organizations would submit curricula for approval by the National Maritime Center to satisfy the legal requirement to conduct stability classes. When the operator training was implemented, the Coast Guard planned to consider whether there was a need to extend the requirements to owners and chief engineers through a new rulemaking. On February 17, 2017, the NTSB replied that although the operator training requirement represented progress, to satisfy this recommendation, owners and chief engineers must also undergo stability training. Given the age of Safety Recommendation M-11-24 (over 5 years at the time), it was classified "Open—Unacceptable Response." In the 4 years since that letter, the Coast Guard has not taken any action or provided any updates.

The capsizing and sinking of the *Scandies Rose* again shows the need for vessel stability training. Therefore, the NTSB reiterates Safety Recommendation M-11-24.

2.2.3.4 Stability Instruction Review

As an uninspected commercial fishing vessel 79 feet or more in length that had gone through conversions and alterations after construction, the *Scandies Rose* was required to have stability instructions completed by a qualified individual; there was no requirement for the instructions to be reviewed.[44] In the case of the *Scandies Rose*, a licensed naval architect completed the stability instructions with no oversight or technical review from the Coast Guard. If the *Scandies Rose* had been required to carry a load line certificate, meaning the vessel had to adhere to different standards in inspection, maintenance, and stability, then its stability instructions would have received additional oversight. Classification societies such as the American Bureau of Shipping review vessel stability instructions and issue load line certificates on behalf of the Coast Guard, and the Coast Guard periodically audits the classification society's load line and stability oversight program to ensure compliance with regulations.

As part of the postcasualty investigations of both the *Destination* and *Scandies Rose*, the Coast Guard's MSC conducted stability assessments and vessel stability instruction review. Both vessels' stability instructions had been created by qualified individuals but were not subject to technical oversight or review from a classification society or the Coast Guard. Ultimately, the MSC concluded that both the *Destination* and *Scandies Rose*'s stability instructions failed to meet regulatory stability criteria. Therefore, the NTSB concludes that an oversight program to review and audit stability instructions produced for uninspected commercial fishing vessels, like the *Scandies Rose*, that are not

[44] See section 1.8.1, "Coast Guard Stability Regulations."

required to carry a load line certificate, could identify and reduce potential errors in stability instructions, which in turn may reduce the chance that vessels are sailing without the intended margin of safety provided by applicable stability criteria. Therefore, the NTSB recommends that the Coast Guard develop an oversight program to review the stability instructions of commercial fishing vessels, which are not required to possess a load line certificate, for accuracy and compliance with regulations.

2.3 Weather Forecasts and Data

During the accident voyage, a developing storm force low in the Gulf of Alaska led to increasing northwest wind over time after the accident voyage departed. By the time of the accident, the surface and buoy stations nearest to the accident site recorded wind speed at 30 to 40 knots, with gusts to 45 knots. The NTSB's WRF weather computer modeling indicated sustained surface winds between 40 and 55 knots, with the strongest winds in areas downstream from bays and passes along the Alaska Peninsula (northwest of the accident vessel track). Around the accident time, the accident captain reported winds of 60 to 70 knots, a temperature of 12°F, and "really bad icing" on the vessel.

The NWS forecast zone that included the accident site included a gale warning on December 31, the night of the accident, with a warning for heavy freezing spray conditions; these weather conditions were forecast to begin the morning of the accident. As the accident voyage progressed, the weather forecast remained the same. The surface and buoy stations nearest to the accident site south of the Alaska Peninsula (which were 95 and 125 miles away, respectively) recorded comparable wind speed at 30 to 40 knots, with gusts to 45 knots. The closest buoy to the accident site recorded wave heights between 8.4 and 9.2 feet.

However, during the investigation, the NTSB found that the *Scandies Rose* experienced wind conditions exceeding those that were forecast or measured by the closest weather stations. The captain reported that he was observing winds of 60 to 70 knots and heavy icing on the vessel around the accident time, and the surviving crewmembers testified that they estimated winds gusting at 50 to 60 mph (43–52 knots) during the accident. The crewmembers and the helicopter rescue crew estimated seas at 30 feet at the time of the accident and during the rescue. The NTSB's weather model, which used data from the nearest weather stations and other meteorological sources to simulate weather conditions, indicated sustained surface winds between 40 and 55 knots in the accident area, with the strongest winds in areas downstream from bays and passes along the Alaska Peninsula (williwaws) northwest of the accident vessel track.

The NWS uses the weather data from the stations along the Alaska Peninsula for forecasting, and mariners use the data to make real-time decisions, but, as illustrated with the winds reported compared to the winds experienced by *Scandies Rose*, data from these weather observation stations do not fully match the conditions in the Sutwik Island and Chignik Bay region. Observation sites that are more spread out in remote areas like Alaska can result in data that do not accurately represent the entire area and can lead to inaccurate and less precise forecasts and weather modeling. The NTSB concludes that, due to the limited surface observation resources near Sutwik Island and the Chignik Bay region along the fishing vessel route from Kodiak to Dutch Harbor, the NWS cannot accurately forecast the more extreme localized wind and sea conditions for the area, which can lead to vessels encountering conditions that are worse than expected.

A number of mariners told the NTSB that the freezing spray, icing, and weather conditions west of Kodiak Island, near Sutwik Island, and Chignik Bay pose an increased risk and hazard to the marine community. Many said that the "worst icing" they had ever seen was near Sutwik Island as the colder wind from the northwest flows across the area. The commanding officer of the *Mellon* stated that the worst icing experience of his career was in the area. Due to the recognized danger of Sutwik Island and the Chignik Bay region and the lack of sources of weather data, the NTSB, therefore, recommends that NOAA increase the surface observation resources necessary for improved local forecasts and for the Sutwik Island and Chignik Bay region in Alaska.

Currently, if weather conditions warrant, the NWS issues either a freezing spray advisory or heavy freezing spray warning to alert mariners to the potential for sea spray icing conditions. The heavy freezing spray warning is issued when ice accumulation rates exceed 2 cm/hr (0.79 inches per hour). In contrast to the text information, the NWS OPC experimental icing forecast graphical website provides more categories and details on sea spray icing levels above 2 cm/hr, giving mariners in the Bering Sea, Gulf of Alaska, and around Sutwik Island more precise information on the higher rates of sea spray icing accumulation they may encounter. None of the captains of fishing vessels operating in the area interviewed at the MBI public hearing were aware of the NWS OPC freezing spray website. They agreed that it would be a useful resource when operating in areas where freezing spray was prevalent. Currently, the NWS OPC freezing spray website remains experimental and therefore would not operate as robustly as an operational NWS website, nor is the NWS OPC freezing spray website advertised as an available resource for mariner use.[45] Based on mariners' lack of awareness of these additional resources, the NTSB concludes that the NWS OPC website could provide mariners with more detailed, graphical icing information not currently available elsewhere, which would help them make decisions based on more accurate weather information. Therefore, the NTSB recommends that NWS make the NWS OPC freezing spray website operational and promote its use in the industry.

2.4 Survival Factors

SAR operations in remote areas like Alaska are always challenging. The weather conditions made the SAR operations for the *Scandies Rose* additionally challenging. Before the vessel sinking, the captain called the Coast Guard to report distress and passed the vessel coordinates, facilitating SAR operations. Without that distress call, the Coast

[45] Per the NWS, an "Operational" Product/Service is "a product/service defined in a product specification, directive, or a regional or local supplement with institutional commitment to deliver the product/service on a sustained, systematic, reliable and continuous basis." National Weather Service Instruction 10-102.

Guard likely would have been initially unaware of the accident because, when the vessel sank, the GPS-equipped EPIRB did not broadcast a receivable signal. The EPIRB would have provided additional real-time information to searchers as it drifted in water (or with a survivor if one had been able to grab it). However, with two liferafts and the potential for crewmembers in survival suits in the water, a single EPIRB, had it worked as designed, could not have provided locations for all potential survivors.

Advancements in technology have resulted in affordable PLBs with GPS location functionality. These devices are meant to be carried by individuals and can provide SAR operations with an accurate, continuously updated location of each person carrying a PLB. In the case of the *Scandies Rose*, a communication error about the coordinates of the rescued survivors resulted in a search pattern that was carried out in a location with reduced probability of locating persons in the water. PLBs can reduce or eliminate SAR errors by providing multiple current GPS coordinates of survivors to searchers. Because of the ability of PLBs to result in the faster location and rescue of survivors of marine accidents, the NTSB issued Safety Recommendation M-17-45, addressing PLB requirements, to the Coast Guard:

> Require that all personnel employed on vessels in coastal, Great Lakes, and ocean service be provided with a personal locator beacon to enhance their chances of survival. (M-17-45)

This recommendation is associated with the NTSB's 2021–2022 Most Wanted List of Transportation Safety Improvements under the issue area, "Improve Passenger and Fishing Vessel Safety." On July 17, 2018, the Coast Guard said that it was very interested in ensuring that persons in distress have the most efficient means of alerting their distress, initiating an appropriate SAR response, and providing responders with an accurate location for rescue. However, the Coast Guard did not believe that a PLB would provide the location accuracy necessary for this purpose.

On April 30, 2019, the NTSB replied that it disagreed with the Coast Guard that PLBs did not provide the needed location accuracy. The NTSB's *El Faro* accident report, in which this recommendation was issued, pointed out that available 406-MHz PLBs determine location accuracy within 3 miles using the 406-MHz satellite system and have a low power homing beacon that transmits on the 121.5-MHz frequency to help locate someone in need of rescue when the SAR asset arrives (NTSB 2017). Further, newer 406-MHz PLBs use GPS input to achieve a location accuracy of about 300 feet and nearly instant SAR notification when activated. The NTSB continues to believe that PLBs are an available, affordable technology that ensures that mariners in distress have the most efficient means of alerting rescuers, initiating an appropriate SAR response, and providing an accurate location for rescue. The NTSB asked the Coast Guard to reconsider the suitability of modern 406-MHz PLBs and to take the recommended action. Pending a requirement that mariners use available SAR technologies, Safety Recommendation M-17-45 was classified "Open—Unacceptable Response."

When the *Scandies Rose* capsized and sank, the second Coast Guard rescue helicopter that arrived searched an incorrect area due to an inadvertent miscommunication of the coordinates of the search area. Such miscommunication may occur in a high-stress SAR environment when the crews are experiencing severe weather. By broadcasting the current position of a survivor in need of rescue, a PLB that includes GPS capabilities is a mitigation to the risk of a delayed SAR response due to type of miscommunications in this accident.

Based on the NTSB's previous findings and recommendation, the failure of the *Scandies Rose*'s EPIRB to provide a position after crewmembers were forced to abandon the vessel into water without means of communicating with SAR personnel, and the inadvertent miscommunication of the correct search area, the NTSB concludes that PLBs would aid in search and rescue operations by providing continuously updated and correct coordinates of crewmembers' locations. Therefore, the NTSB reiterates Safety Recommendation M-17-45.

3. Conclusions

3.1 Findings

1. None of the following were safety issues for the accident voyage: (1) the captain's predeparture decision-making, (2) operational pressures, (3) fatigue, (4) drug and alcohol use, (5) the vessel's propulsion and steering systems, or (6) the vessel's hull integrity.

2. Based on the voyage timeline and the estimated ice accumulation over that period, the *Scandies Rose* likely accumulated between 6 and 15 inches of ice on surfaces exposed to wind and icing during the accident voyage.

3. Although the captain's decision to proceed to Sutwik Island was reasonable, by the time he was close enough to turn into the lee, the icing conditions had accelerated and reduced the vessel's stability.

4. The added weight from ice accumulating asymmetrically on the vessel and the stacked crab pots on deck raised the *Scandies Rose*'s center of gravity, reducing its stability, and contributing to the capsizing.

5. Although the crew loaded the *Scandies Rose* per the stability instructions on board, the stability instructions were inaccurate; therefore, the vessel did not meet regulatory stability criteria and was more susceptible to capsizing.

6. Because the stability instructions were inaccurate, the captain was unaware that his vessel did not meet the margin of safety intended to be provided by the stability regulations.

7. Current regulatory guidelines on calculating the effects of icing on a fishing vessel's stability do not take into account how ice actually accumulates on and in crab pots and crab pot stacks.

8. If vessel captains were aware of the amount of icing that is factored into their stability instructions, they would be better prepared to make critical vessel safety decisions when operating in areas of potential icing.

9. Formal stability training would provide fishing vessel crews with a better understanding of the principles and regulatory basis of stability, including the effect of icing.

10. An oversight program to review and audit stability instructions produced for uninspected commercial fishing vessels, like the *Scandies Rose*, that are not required to carry a load line certificate, could identify and reduce potential errors in stability instructions, which in turn may reduce the chance that vessels are sailing without the intended margin of safety provided by applicable stability criteria.

11. Due to the limited surface observation resources near Sutwik Island and the Chignik Bay region along the fishing vessel route from Kodiak to Dutch Harbor, the National Weather Service cannot accurately forecast the more extreme localized wind and sea conditions for the area, which can lead to vessels encountering conditions that are worse than expected.

12. The National Weather Service Ocean Prediction Center website could provide mariners with more detailed, graphical icing information not currently available elsewhere, which would help them make decisions based on more accurate weather information.

13. Personal locator beacons would aid in search and rescue operations by providing continuously updated and correct coordinates of crewmembers' locations.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the capsizing and sinking of the commercial fishing vessel *Scandies Rose* was the inaccurate stability instructions for the vessel, which resulted in a low margin of stability to resist capsizing, combined with the heavy asymmetric ice accumulation on the vessel due to localized wind and sea conditions that were more extreme than forecasted during the accident voyage.

4. Recommendations

4.1 Recommendations

As a result of its investigation of this accident, the National Transportation Safety Board makes the following seven new safety recommendations:

To the US Coast Guard:

> Conduct a study to evaluate the effects of icing, including asymmetrical accumulation, on crab pots and crab pot stacks and disseminate findings of the study to industry, by means such as a safety alert. (M-21-05)
>
> Based on the findings of the study recommended in Safety Recommendation M-21-05, revise regulatory stability calculations for fishing vessels to account for the effects of icing, including asymmetrical accumulation, on a crab pot or pot stack. (M-21-06)
>
> Revise Title 46 *Code of Federal Regulations* 28.530 to require that stability instructions include the icing amounts used to calculate stability criteria. (M-21-07)
>
> Develop an oversight program to review the stability instructions of commercial fishing vessels, which are not required to possess a load line certificate, for accuracy and compliance with regulations. (M-21-08)

To the North Pacific Fishing Vessel Owners' Association:

> Notify your members (Bering Sea/Aleutian Islands Crabbers/Fishing Vessel fleet) of the specifics of this accident, the amount of ice assumed when developing stability instructions, and the dangers of icing. (M-21-09)

To the National Oceanic and Atmospheric Administration:

> Increase the surface observation resources necessary for improved local forecasts for the Sutwik Island and Chignik Bay region in Alaska. (M-21-10)

To the National Weather Service:

> Make your Ocean Prediction Center freezing spray website operational and promote its use in the industry. (M-21-11)

4.2 Previously Issued Recommendations Reiterated in This Report

As a result of its investigation of this accident, the National Transportation Safety Board reiterates Safety Recommendations M-11-24 and M-17-45, which are currently classified "Open—Unacceptable Response":

To the US Coast Guard:

> Require all owners, masters, and chief engineers of commercial fishing industry vessels to receive training and demonstrate competency in vessel stability, watertight integrity, subdivision, and use of vessel stability information regardless of plans for implementing the other training provisions of the 2010 Coast Guard Authorization Act. (M-11-24)
>
> Require that all personnel employed on vessels in coastal, Great Lakes, and ocean service be provided with a personal locator beacon to enhance their chances of survival. (M-17-45)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

ROBERT L. SUMWALT, III
Chairman

JENNIFER HOMENDY
Member

BRUCE LANDSBERG
Vice Chairman

MICHAEL GRAHAM
Member

THOMAS CHAPMAN
Member

Report Date: July 13, 2021

5. Appendixes

Appendix A: Investigation

The Coast Guard was the lead federal agency in this investigation. The National Transportation Safety Board (NTSB) learned of the accident from the Coast Guard on the morning of January 1, 2020. The Coast Guard conducted in-person preliminary interviews with the two surviving crewmembers, in Kodiak, Alaska, on the morning of January 1. The NTSB participated in a telephonic interview of the vessel's majority owner the following day. The NTSB launched the investigator-in-charge to Kodiak on January 3; he arrived on scene January 4. While on scene, the investigator-in-charge and Coast Guard investigator interviewed family members of the *Scandies Rose*'s captain, company management, welders who had recently completed work on the vessel, and a fellow fishing vessel captain who had spoken to the accident voyage captain. In addition, investigators gathered documentation relevant to the accident.

Fourteen months later, from February 22 to March 5, 2021, the Coast Guard conducted a formal hearing into the accident. During the hearing, Coast Guard and NTSB investigators questioned 43 individuals, including the surviving crewmembers, company management, commercial fishing workers, industry safety educators and advocates, naval architects, Coast Guard personnel, and commercial fishing industry stakeholders.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* (*USC*) 1117(b) requires the following information on the recommendations in this report.

> For each recommendation—
>
> (1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;
>
> (2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and
>
> (3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the US Coast Guard:

M-21-05

> Conduct a study to evaluate the effects of icing, including asymmetrical accumulation, on crab pots and crab pot stacks and disseminate findings of the study to industry, by means such as a safety alert.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.2.3.1, Effect of Icing on Stability Instruction Calculations. Information supporting (b)(1) can be found on pages 53–54; (b)(2) is not applicable; information supporting (b)(3) can be found on page 40.

M-21-06

> Based on the findings of the study recommended in Safety Recommendation M-21-05, revise regulatory stability calculations for fishing vessels to account for the effects of icing, including asymmetrical accumulation, on a crab pot or pot stack.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.2.3.1, Effect of Icing on Stability Instruction Calculations. Information supporting (b)(1) can be found on pages 53–54; (b)(2) and (b)(3) are not applicable.

M-21-07

> Revise Title 46 *Code of Federal Regulations* 28.530 to require that stability instructions include the icing amounts used to calculate stability criteria.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.2.3.2, Crew Familiarity with Stability Instruction Calculations. Information supporting (b)(1) can be found on pages 54–55; (b)(2) and (b)(3) are not applicable.

M-21-08

> Develop an oversight program to review the stability instructions of commercial fishing vessels that are not required to possess a load line certificate for accuracy and compliance with regulations.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.2.3.4, Stability Instruction Review. Information supporting (b)(1) can be found on pages 56–57; (b)(2) and (b)(3) are not applicable.

To the North Pacific Fishing Vessel Owners' Association:

M-21-09

> Notify your members (Bering Sea/Aleutian Islands Crabbers/Fishing Vessel fleet) of the specifics of this accident, the amount of ice assumed when developing stability instructions, and the dangers of icing.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.2.3.2, Crew Familiarity with Stability Instruction Calculations. Information supporting (b)(1) can be found on pages 54–55; (b)(2) and (b)(3) are not applicable.

To the National Oceanic and Atmospheric Administration:

M-21-10

> Increase the surface observation resources necessary for improved local forecasts for the Sutwik Island and Chignik Bay region in Alaska.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.3, Weather Forecasts and Data. Information supporting (b)(1) can be found on pages 57–58; (b)(2) and (b)(3) are not applicable.

To the National Weather Service:

M-21-11

> Make your Ocean Prediction Center freezing spray website operational and promote its use in the industry.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in section 2.3, Weather Forecasts and Data. Information supporting (b)(1) can be found on pages 57–58; (b)(2) and (b)(3) are not applicable.

Appendix C: Principles of Stability

The principles of ship stability reflect the relationship between buoyancy (the force pushing on a ship allowing it to float) and gravity (the force pushing the ship into the water).

The righting moment, when the ship returns to an even keel, is the product of the force of buoyancy times the distance that separates the forces of buoyancy and gravity. That distance is known as the ship's righting arm. The righting arm can be expressed as a curve plotted at successive angles of heel. The length of the righting arm generally increases with the angle of heel to a maximum point, after which it decreases, reaching zero at a very large angle of heel. The area under the righting arm curve represents the energy available to the ship to right itself. A reduction in the size of the righting arm usually means a decrease in stability.

Intact stability refers to how an intact, or undamaged, vessel will respond when heeled over in calm conditions. The specific stability characteristics of a vessel are calculated based on the model of its hull form (hydrostatics), developed from plans and lightship characteristics (which are determined through an inclining experiment in which precise measurements are taken on board the vessel to determine its displacement and center of gravity). Stability analysis generally requires the services of a naval architect.

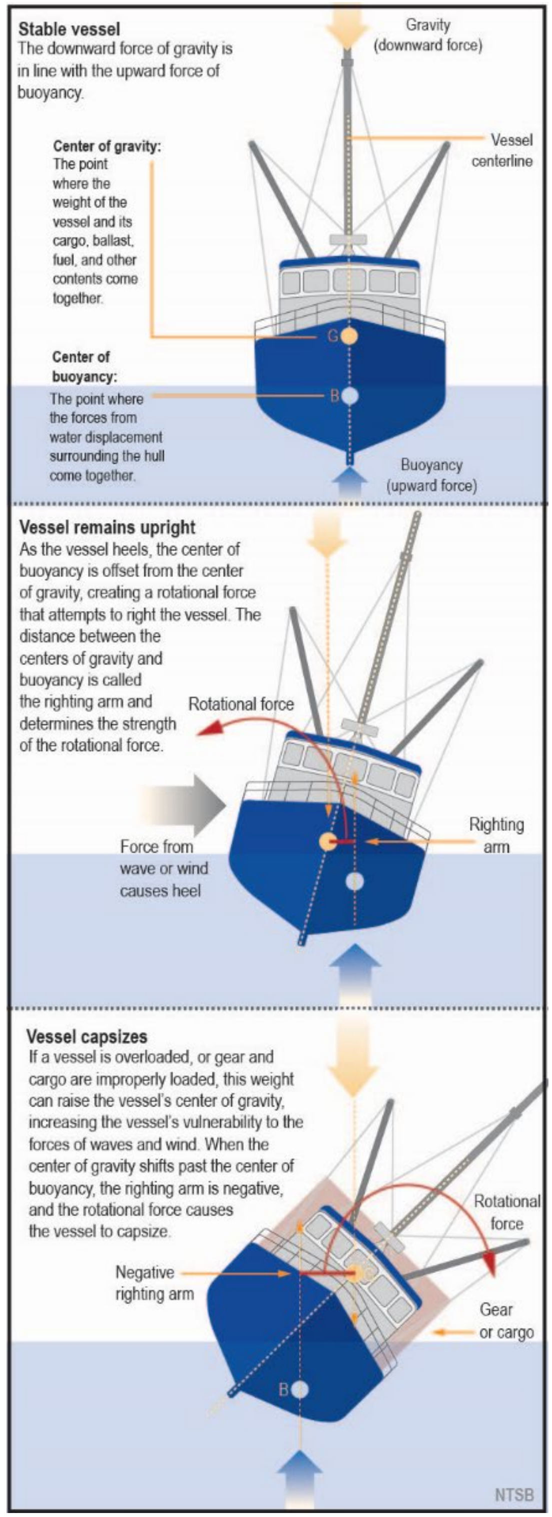


Figure 28. Principles of stability.

Appendix D: Coast Guard Stability Guidance on Icing

In 2005, the Coast Guard published *A Best Practices Guide to Vessel Stability* for commercial fishing workers. The guide provides a general overview of fishing vessel stability and addresses icing caused by winds and waves.

Operating in icing conditions significantly reduces a fishing vessel's stability because the weight of the accumulating ice affects two crucial factors:

> (1) The *center of gravity* rises rapidly from the weight of ice added high on the vessel, especially on vessels carrying crab pots. The higher and wider the stack, the more surface area is available for freezing spray to accumulate as ice on and in the pots.
>
> (2) The *freeboard* is reduced because, as ice accumulates, the additional weight of ice results in the vessel sitting lower in the water, causing the deck edge to submerge at smaller heel angles than original.[48] Accumulating ice has the same effect on a crab fishing vessel as if it was overloaded with pots that had been stacked above the main deck (above the vessel's original center of gravity).

The loss of stability from ice may go unrecognized because, similar to overloading a vessel, initial stability levels at small angles of heel are only slightly reduced, which the crew may not notice as the vessel heels at smaller angles and returns. However, initial stability does not indicate the vessel's overall stability, as shown in a righting arm curve, which icing can significantly reduce. For example, a vessel that could return from a heel of 80° without the added weight of ice can capsize at lesser heel angles, such as 60°, as shown in figure 29.

The *Best Practices Guide to Vessel Stability* recommends corrective actions when icing conditions are encountered, including keeping freeing ports clear of ice to allow rapid draining of water off the decks.

[48] The *freeboard* is the vertical distance between the waterline and the highest watertight deck.

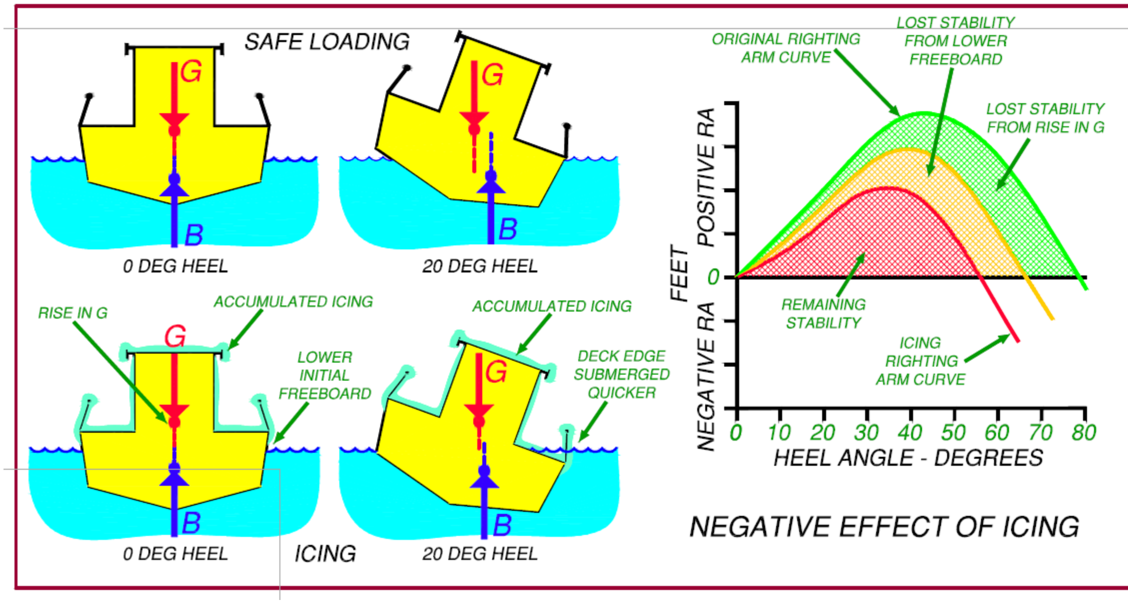


Figure 29. Icing effect diagram from *A Best Practices Guide to Vessel Stability*, page 49.

Appendix E: Comparison of 2019 Stability Instructions and MSC Calculations for Accident Voyage

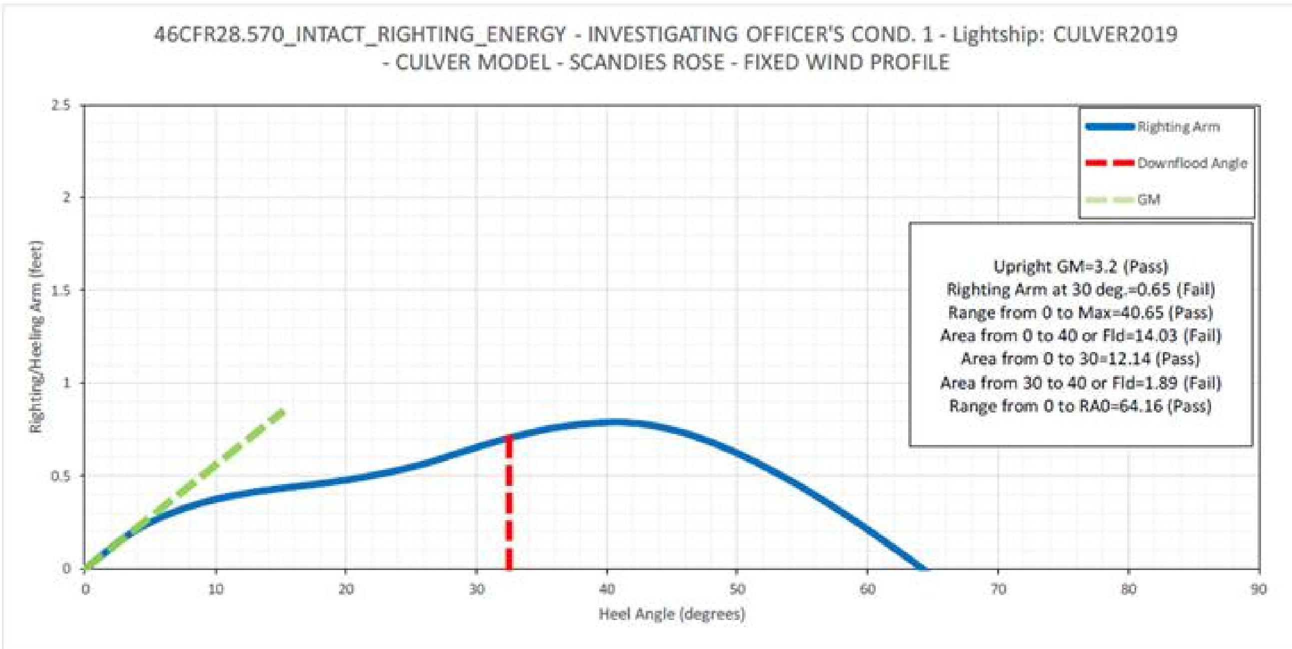


Figure 30. IO Condition 1, with 195 pots (ranging from 835, 844, 856 pounds) in tiers different than MSC Large Pots (4 tiers, 87, 39, 39, 30)

Loading Condition: Accident Voyage, Coast Guard Investigating Officer's Estimate
Hydrostatic Model: From the vessel's stability assessment used to develop the 2019 stability instructions
Lightship Characteristics: From the vessel's stability assessment used to develop the 2019 stability instructions
Pots: 195 (ranging from 835, 844, 856 pounds) (Pots different than MSC "large" pots)
Pot Stack: 4 tiers (pots per tier: 87, 39, 39, 30)

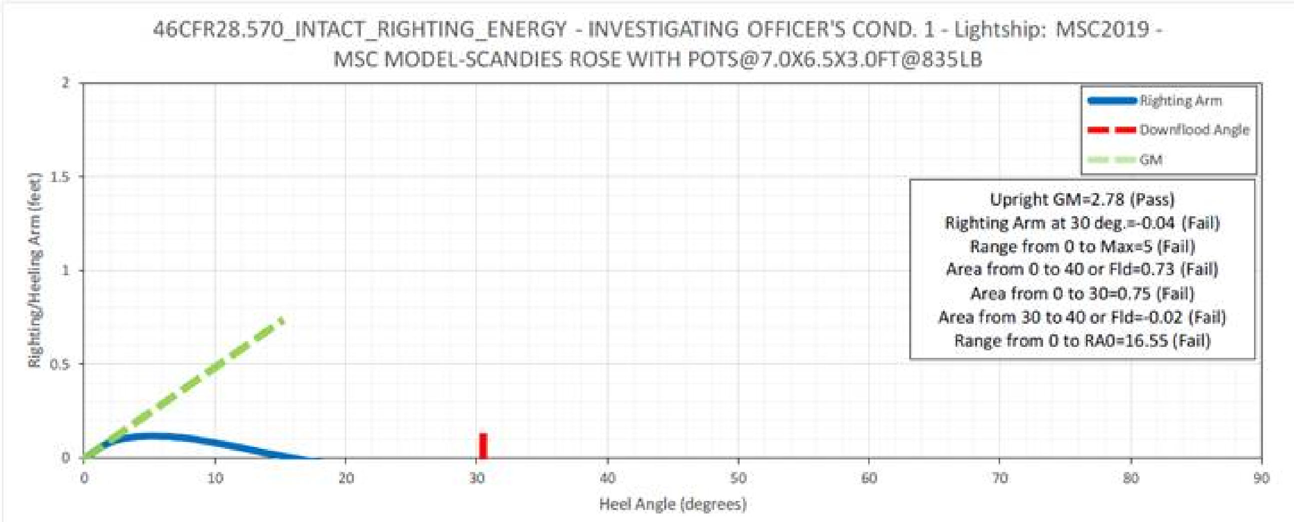


Figure 31. IO Condition 1, with 195 “small” 835 lb.-pots (4 tiers- 98, 44, 44, 9)

Loading Condition: Accident Voyage, Coast Guard Investigating Officer’s Estimate
Hydrostatic Model: From new (post-accident) MSC forensic analysis
Lightship Characteristics: From new (post-accident) MSC forensic analysis
Pots: 195 (“small” 835-pound pots)
Pot Stack: 4 tiers (pots per tier: 98, 44, 44, 9)

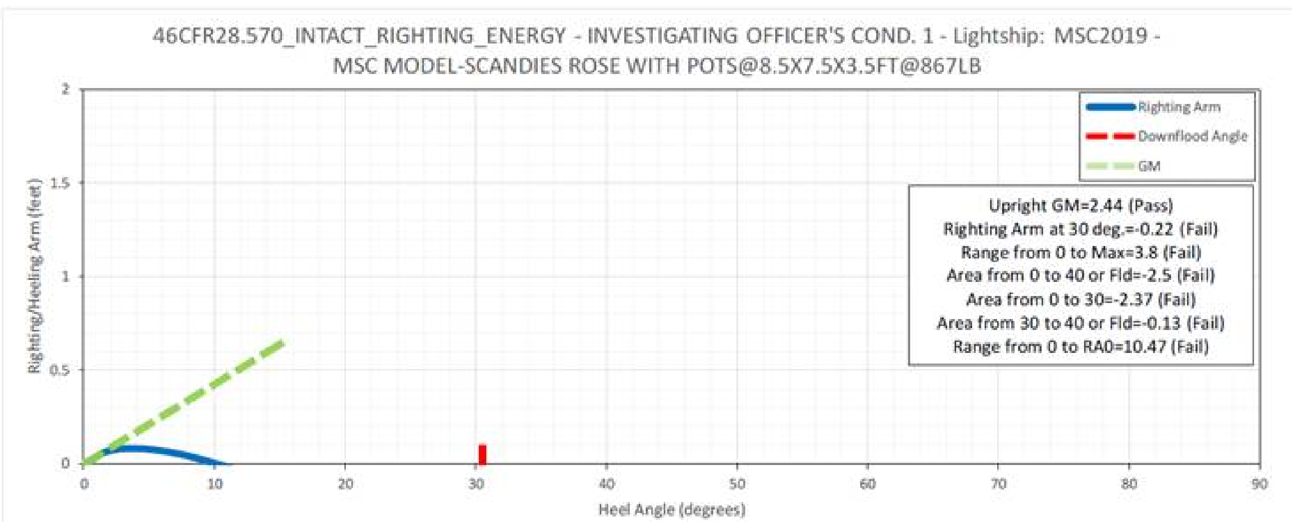


Figure 32. IO Condition 1, with “large” 867 lb.-pots (5 tiers, 72,32, 32, 32, 27)

Loading Condition: Accident Voyage, Coast Guard Investigating Officer’s Estimate
Hydrostatic Model: From new (post-accident) MSC forensic analysis
Lightship Characteristics: From new (post-accident) MSC forensic analysis
Pots: 195 (“large” 867-pound pots)
Pot Stack: 5 tiers (pots per tier: 72, 32, 32, 32, 27)

References

National Oceanic and Atmospheric Administration (NOAA). 2005. *Vessel Icing*. Mariners Weather Log Vol 49, No 3. Washington, DC: NOAA.

———. 2015. *WANTED: Freezing Spray and Icing Observations Freezing Spray Project*. Mariners Weather Log Vol 59 no 3. Washington, DC: NOAA.

———. 2020. *United States Coast Pilot, Alaska: Cape Spencer to Beaufort Sea*. 2020 (38th) Edition. Washington, DC: NOAA.

National Transportation Safety Board (NTSB). 2009. *Sinking of U.S. Fish Processing Vessel* Alaska Ranger, *Bering Sea, March 23, 2008.* Marine Accident Report NTSB/MAR-09/05. Washington, DC: NTSB.

———. 2017. *Sinking of US Cargo Vessel SS* El Faro*, Atlantic Ocean, Northeast of Acklins and Crooked Island, Bahamas, October 1, 2015*. Marine Accident Report NTSB/MAR-17/01. Washington, DC: NTSB.

———. 2018. *Capsizing and Sinking of Fishing Vessel* Destination. Marine Accident Brief NTSB/MAB-18/14. Washington, DC: NTSB.

———. 2018. *Safety Alert 74 Ice Accumulation*. SA-074. Washington, DC: NTSB.

Overland, J.E. 1990. *Prediction of Vessel Icing for Near-Freezing Sea Temperatures.* Weather and Forecasting, 1990, pp. 62–77.

Transport Canada. 2003. *Survival in Cold Waters: Staying Alive*, report TP13822E. Ottawa, Ontario: Transport Canada.

US Coast Guard. 2011. *Remain Upright by Fully Understanding Vessel Stability*. SA 11-17. Washington, DC: Coast Guard.

———. 2017. *Report of the Marine Board of Investigation into the Commercial Fishing Vessel* Destination *Sinking and Loss of the Vessel with all Six Crewmembers missing and Presumed Deceased Approximately 4.4 NM Northwest of St. George Island, Alaska on February 11, 2017*. Report of Marine Board 6088430. Washington, DC: Coast Guard.

———. 2017. *U.S. Coast Guard Marine Safety Center Technical Report,* Scandies Rose *Sinking*. Washington, DC: Coast Guard.