

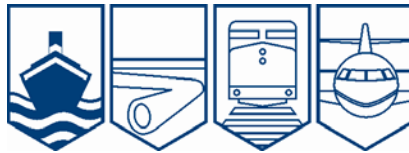
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

MARINE INVESTIGATION REPORT

M12W0062



CAPSIZING AND SINKING

SMALL FISHING VESSEL *PACIFIC SIREN*
OFF BANKS ISLAND, HECATE STRAIT, BRITISH COLUMBIA
09 MAY 2012

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Marine Investigation Report

Capsizing and Sinking

Small Fishing Vessel *Pacific Siren*

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Summary

On 09 May 2012 at approximately 2030 Pacific Daylight Time, the small fishing vessel *Pacific Siren*, loaded with prawn gear, heeled to starboard and capsized off Banks Island, British Columbia. All 3 crew members abandoned the vessel into a small inflatable boat and were stranded at Terror Point on Banks Island for 9 days until they were rescued by the Canadian Coast Guard.

Ce rapport est également disponible en français.

Factual Information

Particulars of the Vessel

Name of Vessel	<i>Pacific Siren</i>
Official/Licence Number	803083/VRN 29342
Port of Registry	Victoria, British Columbia
Flag	Canada
Type	Small fishing vessel, trap and longline
Gross Tonnage	14.55
Registered Length ¹	10.58 m
Built	1984, by R.H. & K.A. Herlinveaux, North Saanich, BC
Propulsion	6-71 Detroit diesel engine, 135 kW, driving a single fixed-pitch propeller
Cargo	Approximately 1500 kg of fishing gear and 45 kg of prawns
Crew	3
Registered Owner	Private owners, Prince Rupert, BC

Description of the Vessel

The *Pacific Siren* was a small carvel-built fishing vessel of closed construction with a rounded bilge and steel hull (Photo 1). It was constructed in 1984 as a trawler/troller and was modified to a longline/trap vessel in 2007. The main deck was surrounded by solid bulwark and railings. A fibreglass-over-plywood deckhouse contained the galley, dinette, and helm station and was located forward of amidships on the main deck. The deckhouse was accessible through a door on the starboard side of the main deck.

Below the main deck, the hull was subdivided by 3 transverse watertight bulkheads into 4 compartments: a forward crew accommodation space, an engine room, an insulated and refrigerated fish hold, and a lazarette.

The vessel was fitted with an aluminum stern platform that extended approximately 1.5 m aft of the main deck. An aluminum baiting claim ² spanning the width of the vessel covered the stern extension. A longline drum was fitted forward of the baiting claim, and a sorting table was

¹ Units of measurement in this report conform to International Maritime Organization Standards or, where there is no such standard, are expressed in the International System of units.

² A baiting claim is an enclosure at the stern of a vessel where fishermen bait their hooks during longline fisheries.

located aft of the deckhouse. The vessel had two 1800 L fuel tanks located on either side of the main engine and a water tank of approximately 380 L located in the lazarette.

The deckhouse was equipped with the following navigation and communications equipment:

- 1 satellite telephone
- 2 radars
- 2 very high frequency (VHF) radiotelephones, 1 with a digital selective calling (DSC) feature
- 1 GPS
- 1 autopilot interfaced with 1 chart plotter
- 1 echo sounder

The vessel carried a 4 m recreational inflatable boat secured to the top of the baiting claim and a 4-person liferaft located on top of the deckhouse. The vessel also carried 2 lifejackets stowed in the galley, 4 immersion suits stowed in a locker on the port aft side of the deckhouse, and 1 personal flotation device (PFD) stowed near the longline drum on the main deck. The vessel was equipped with a pair of outrigger booms rigged with roll-dampening paravanes.



Photo 1. The *Pacific Siren's* general arrangement.

History of the Voyage

On 06 May 2012, the *Pacific Siren's* master/owner and 2 crew members topped up the vessel's fuel tanks in preparation to travel to Cumshewa Inlet in Haida Gwaii to begin the prawn fishery (Appendix A). They loaded 350 prawn traps, anchors, ground line and other gear on board the vessel, a combined weight of approximately 2500 kg. The prawn traps and gear were stowed on or above the main deck, and the anchors and ground line were stowed in the fish hold. They departed Prince Rupert the following morning, planning to cross Hecate Strait en route to Cumshewa Inlet. However, as the weather in Hecate Strait was poor and was not forecasted to improve until later in the week, the course was altered to fishing grounds at Verney Passage, 75 nautical miles (nm) south of Prince Rupert (Appendix A).

The vessel arrived at Verney Passage late in the afternoon on 07 May.³ The crew members set the prawn gear and strung tarps up on the main deck to block the wind and rain from the prawn sorting area. The tarps extended from the deckhouse to the baiting claim on the port side and across the main deck.

The crew fished for 2 days at Verney Passage and then, at approximately 1600⁴ on 09 May, departed for Cumshewa Inlet in calm sea conditions. The weather forecast for Hecate Strait had improved, and the catch at Verney Passage had been poor. All of the prawn gear was hauled, loaded, and secured on the main deck and stern extension of the vessel. The catch, weighing approximately 45 kg, was loaded in the fish hold. The tarps were left strung up on the main deck as the vessel departed for Otter Passage en route to Cumshewa Inlet.

At approximately 1900 the vessel exited Otter Passage, where it had encountered rough seas caused by opposing tide and swell. The tidal sea conditions improved once the vessel entered Hecate Strait and the course was altered to clear Banks Island. This starboard course alteration exposed the *Pacific Siren* to the sea and wind approaching from the port bow, causing the vessel to roll. The crew members deployed the paravanes.

At approximately 1945, the vessel cleared Banks Island. A second starboard course alteration was made to allow the vessel to take a direct route to Cumshewa Inlet, and the autopilot was set to NAV mode.⁵ The sea and wind from the port bow caused water to ship on deck and, combined with the force of the wind on the tarps and baiting claim, the vessel developed a starboard heel.

Shortly thereafter, the vessel was simultaneously subjected to a large swell and a gust of wind, shipping more water on deck. The vessel heeled further to starboard and the deck edge submerged. The *Pacific Siren* began to roll onto its beam ends as the master used the VHF radiotelephone channel 16 to broadcast a Mayday. The master then switched to manual steering and, in an effort to right the vessel, placed the wheel hard to starboard. As water streamed into the deckhouse, the master broadcast a second Mayday.

As the vessel rolled onto its beam ends, both crew members jumped into the water. They swam and climbed onto the port side of the vessel's hull. The vessel continued to rapidly capsize, and the rising water forced the master to swim out of the deckhouse. He climbed on board the hull with help from 1 of the crew members. Due to the speed of the capsizing, the crew members were unable to access their lifejackets, immersion suits, or the PFD; as well, they were unable to manually deploy the liferaft.

The crew members awaited rescue on the hull of the capsized vessel for approximately 1 hour. During this time, 1 crew member managed to retrieve a tarp and the inflatable boat which had partially broken free from the baiting claim. The crew members tied the inflatable boat on the vessel's hull and remained in the inflatable awaiting rescue. The liferaft floated free of the vessel and was at a distance of approximately 10 m; it remained attached to the top of the deckhouse by the painter and had not inflated.

³ The 2012 prawn fishery ran from 03 May to 15 June.

⁴ All times are in Pacific Daylight Time (Coordinated Universal Time minus 7 hours) unless otherwise noted.

⁵ The autopilot's NAV mode keeps a vessel on a pre-programmed course line.

The hull of the sinking vessel began chafing the inflatable boat, so the crew members released the inflatable from the hull and floated free. The *Pacific Siren* slowly downflooded through the deckhouse door and tank vents on the main deck until it sank at approximately 2300 on 09 May in position 52°06.00' N, 130°02.00' W, approximately 5.5 nm southwest of Terror Point (Appendix A). The crew members passed the night drifting in the inflatable boat, using the tarp to cover themselves. The following day, they used the tarp as a sail to propel themselves towards shore.

On 10 May, after approximately 20 hours at sea in the inflatable boat, the crew reached Terror Point on Banks Island. Nine days later, they were spotted by the sailing vessel *Macoma*. The *Macoma* notified the Canadian Coast Guard (CCG), and an hour later the CCG rescued the crew members.

Damage to Vessel

The vessel sank and was not recovered.

Environmental Conditions

At the time of the occurrence, there were moderate-to-strong southwest winds and a moderate southwest swell. The southwest winds were 14 knots gusting to 20 knots and the seas had been diminishing from 1.4 m earlier in the day to 1.2 m at the time of the occurrence.

Vessel Certification

As a small fishing vessel not exceeding 15 gross tonnage, the *Pacific Siren* was subject to Part II of the current *Small Fishing Vessel Inspection Regulations* (SFVIR). As such, the vessel was not required to undergo inspection by Transport Canada (TC), nor was it required to be assessed for stability.

Personnel Certification and Experience

The master possessed a Marine Emergency Duties (MED) A3 certificate. He also possessed a Small Vessel Operator Proficiency (SVOP) training certificate, which included 1 hour of stability training. The SVOP was not required by regulation. The master had been in command of the *Pacific Siren* since 2006, and had owned the vessel since 2007.

The crew members held MED A3 training certificates; no further qualifications were required by regulation. All of the crew had at least 6 years of fishing experience. The master and crew members were familiar with the vessel and had worked together in previous prawn fisheries.

Lifesaving Appliances

The *Pacific Siren* carried a 4-person liferaft that was held in deep chocks, ⁶ allowing the liferaft to float free or be deployed manually. There were 2 lifejackets and 1 PFD on board. The vessel also carried fire extinguishers, emergency flares, and 4 immersion suits, as required by regulation.

The vessel was not equipped with an Emergency Position Indicating Radio Beacon (EPIRB), nor was one required by regulation. EPIRBs are required for vessels over 8 m in length travelling outside Home Trade Class III waters. ⁷ When activated, an EPIRB sends out a distress signal that aids in the location of vessels and crew.

The vessel was equipped with a registered VHF/DSC radiotelephone as required by regulation; however, the DSC feature was not hooked up to a GPS. Instead, the 1 onboard GPS was interfaced with the chart plotter program. DSC is a feature that sends pre-defined digital messages via a VHF maritime radio system. Once registered and programmed with a Maritime Mobile Service Identity (MMSI), a VHF/DSC radiotelephone that is connected to a GPS allows the master to send out a distress signal that automatically identifies the vessel and its position.

Vessel Stability

There are a number of factors that affect a vessel's stability, such as load distribution, windage, the use of paravane stabilizers, and vessel modifications. ⁸

Load Distribution

When small fishing vessels are not assessed for stability, fishermen have minimal knowledge of a vessel's limitations. In these situations, a good practice of basic seamanship is to keep weight low on the vessel, thereby keeping the vessel's centre of gravity low as well. It is important that masters understand how load distribution impacts a vessel's stability and recognize that moving weights from below a vessel's centre of gravity to above it generally reduces stability. In this occurrence, the master had completed the SVOP, which included 1 hour of stability training. The master had no other stability training; as such, his awareness of how load distribution impacts vessel stability was minimal.

On the *Pacific Siren*, storage space was limited. Items such as a portable generator, provisions, and personal gear were stowed on the top of the deckhouse. The vessel departed Prince Rupert with an empty water tank, and later departed Verney Passage with wet prawn gear and heavier items such as the anchors and ground line stowed on the main deck and stern extension.

Windage

The force of the wind has greater effects on the stability of vessels with large superstructures and/or other significant surface area. On the *Pacific Siren*, superstructures such as the

⁶ Chocks are U-shaped frames that hold a liferaft in place. In the case of a capsizing, a liferaft resting in chocks is intended to float free.

⁷ Home Trade Class III refers to waters within 25 nm from shore.

⁸ Transport Canada, Ship Safety Bulletin 04/2006, Stability Information Questionnaire.

deckhouse and baiting claim were subject to windage. As well, the *Pacific Siren* had tarps strung up on the main deck. The tarps extended from the deckhouse to the baiting claim on the port side and across the main deck. The tarps were strung up when the vessel arrived at Verney Passage and were left up for the remainder of the voyage.

Paravane Roll-Dampening Devices

Paravane roll-dampening devices, commonly known as paravane stabilizers, are used for dampening the rolling motion of a vessel, thereby improving the crew's comfort and reducing fatigue and injuries. The safe functioning of the submerged paravanes is largely dependent on the vessel's speed and the paravanes' complementary dragging action on either side of the vessel as it rolls in a seaway.

However, paravane roll-dampening devices do not improve the stability of a vessel. The additional rigging to house the paravane system increases the vessel's top-side weight, raising the vessel's centre of gravity over that of a similar vessel without paravane stabilizers. In addition, the dragging force of the paravanes acting high above the main deck further raises the vessel's centre of gravity. In 2000, TC issued Ship Safety Bulletin (SSB) 15/2000 warning vessel owners of the risks associated with the use of roll-dampening devices.

Modifications

Fishing vessel owners are required to provide a record to the Registrar of Ships of any modifications that change a vessel's gross tonnage. The Registrar of Ships in turn provides this record to TC. The *Pacific Siren's* owners made modifications to outfit the vessel to trap prawns and longline halibut. Modifications included the removal of 2 trawl winches and a steel trawl drum. A longline drum, stern extension, and baiting claim were also added on the main deck. As these modifications did not change the *Pacific Siren's* gross tonnage, they were not reported to the Registrar of Ships or TC. In 2008, TC issued SSB 01/2008, providing guidelines for owners and masters for recording modifications and highlighting the potential negative effect of modifications on vessel stability.

Fisheries Resource Management

Before designating a prawn licence to a vessel, the Department of Fisheries and Oceans (DFO) requires a vessel's buoyant hull to comply with licence length restrictions. However, the measurement of the buoyant hull does not include the stern extension. The length of the *Pacific Siren's* buoyant hull met the DFO's licence length restrictions. The stern extension enabled the vessel to accommodate the 300 prawn traps allocated to this licence.

In the BC prawn fishery, there is no limit on the allowable prawn catch for each licence. Without such limits, fishermen compete against each other for the resource until the coast-wide spawner index reference point ⁹ is reached, at which time the season is closed. The fishery is restricted to 0700 and 1900 hours daily, and fishermen are permitted to haul their traps only once per day. Some of the factors that affect profit include the number of days fished and the speed at which

⁹ A spawner index is a biological reference point that measures the number of female prawns remaining for spawning. When the specified reference point is reached, specific "area closures" occur before the fishery is closed for the season.

fishermen can harvest and process their catch. In this occurrence, the *Pacific Siren*, delayed by the completion of the refit, was 4 days late departing for the prawn fishery, thus reducing the number of fishing days and limiting their potential catch.

The Cost of Safety

Over the years, Transportation Safety Board (TSB) investigations into fishing vessel safety have shown that actions that maximize profit at the expense of safety are common and have contributed to accidents and loss of life.¹⁰ A profitable prawn fishing operation allows a fisherman to recover start-up and operational costs, as well as make a living. Costs may include, but are not limited to, any necessary refits, upgrades, or repairs; a vessel survey; insurance; the lease of licences or quota; and the purchase of gear, safety equipment, and provisions. As well, in many cases, the profit from a prawn fishing season represents a significant percentage of a fisherman's annual income. A fisherman's ability to operate a profitable prawn fishery is often dependent on minimizing start-up costs and maximizing fishing time to the extent possible given the fisheries resource management (FRM) measures on the BC prawn fishery.

The *Pacific Siren's* owners had borrowed extensively to cover a refit of the vessel's main engine, as well as the start-up costs of the 2012 fishing operation. The start-up costs included a regular refit and upgrade of the vessel, the purchase of prawn traps and provisions, and the lease of the prawn licence. The purchase of a second GPS unit had been intended to enable the VHF/DSC radiotelephone to function as required; however, when the master went to purchase the unit, he found that none were available and that he would need to wait a week before one came in. As such, the vessel departed Prince Rupert to begin the fishery without a properly fitted VHF/DSC radiotelephone.

Safety Information

Over the years, the TSB, TC, and WorkSafeBC have published safety information on the adverse effects of modifications, improper loading procedures, and unsafe work practices on vessel stability, as well as the importance of lifesaving appliances. TC's primary method of distributing safety information is through SSBs. TC issued 2 SSBs that contained information relevant to the *Pacific Siren's* operations.

SSB 04/2006 and its accompanying stability information questionnaire were mailed to owners of small fishing vessels not exceeding 15 gross tonnage, strongly encouraging them to have their vessel's stability assessed if certain risk factors are present, such as roll-dampening devices, liquid cargo, substantial modifications and/or addition of topside weights, and/or significant windage.

SSB 15/2000 cautions masters of vessels that are equipped with roll-damping systems of the risk associated with their use, their effects on stability, and the effect of system failures.

SSB 01/2008 highlights the potential negative effect of modifications on vessel stability and provides guidelines for owners and masters for recording modifications.

¹⁰ TSB investigations M07M0088 (*Big Sister*), M02W0102 (*Fritzi-Ann*), M95W0013 (*HiliKum*), M98L0149 (*Brier Mist*)

Safe Work Practices

Safe work practices are generally documented in writing and specify how to perform a task with minimal risk to people, equipment, materials, and the environment. The *Pacific Siren* had instructions for fire and abandon ship emergency procedures. By regulation,¹¹ small fishing vessels must carry documented safe work practices, in addition to emergency procedures.

Sailing Plan

TC advises that fishermen prepare a sailing plan¹² prior to a voyage and leave a copy of the plan with a designated contact person on shore. Once the vessel has departed, daily communication with the contact person ensures that this individual remains apprised of any changes to the sailing plan. In the event the vessel is overdue, the contact person can then notify the appropriate authorities. A sailing plan provides essential information to assist search and rescue in the event of an emergency. The *Pacific Siren's* master regularly used the satellite telephone or the VHF radiotelephone to contact family members. However, the vessel did not have a documented sailing plan.

Previous Occurrences

Past trap fishing occurrences investigated by the TSB have raised similar safety issues as that of the *Pacific Siren* occurrence.¹³ The cumulative effects of added weight above a vessel's centre of gravity, vessel modifications, a lack of vessel stability assessments, and FRM measures that do not use a systematic risk-based approach were identified as contributing factors in these accidents.

Safety Issues Investigation into Fishing Safety in Canada

In August 2009, the TSB undertook an in-depth safety issues investigation into fishing vessel safety in Canada. The *Safety Issues Investigation into the Fishing Industry in Canada* (SII) report was released in June 2012 and provides an overall, national view of safety issues in the fishing industry, revealing a complex relationship and interdependency among these issues. The Board identified the following safety significant issues requiring attention: stability, lifesaving appliances, FRM, the cost of safety, safety information, safe work practices, the regulatory approach to safety, fatigue, training, and fishing industry statistics.¹⁴

Watchlist

On 16 March 2010 and again in June 2012, the Board released its *Watchlist*, identifying critical safety issues investigated by the TSB that pose the greatest risks to Canadians. One of these critical safety issues is the loss of life on fishing vessels. With an average of nearly 13 fatalities

¹¹ WorkSafeBC, *Occupational Health and Safety Regulations*, Section 24.73.

¹² Transport Canada, TP 10038 E, 2003.

¹³ TSB investigations M02W0102 (*Fritzi-Ann*), M05W0110 (*Morning Sunrise*), M07M0088 (*Big Sisters*), M09L0074 (*Le Marsouin I*), M10M0014 (*Craig and Justin*)

¹⁴ TSB Safety Issues Investigation Report Number M09Z0001, *Safety Issues Investigation into Fishing Safety in Canada*. The report can be accessed on the TSB website at www.tsb.gc.ca

per year between 1999 and 2011, the Board remains concerned about vessel modifications and their impact on stability; the use and availability of lifesaving appliances; regulatory oversight; the impact of FRM measures; and the lack of both a safety culture and a code of best practices. The *Watchlist* highlights the need for the industry to adopt and promote safe operating procedures and practices to increase the safety knowledge of fishing vessel operators.

Analysis

Events Leading to the Capsizing and Sinking

On the afternoon of 09 May 2012, after the crew had hauled the prawn gear on board, the *Pacific Siren* departed Verney Passage for fishing grounds in Cumshewa Inlet that were anticipated to be more productive. The wet prawn gear was secured to the main deck and stern extension, and heavier items such as the anchors and ground line were placed on the main deck, increasing the vessel's top-side weight.

Upon entering Hecate Strait, the vessel took a direct route to Cumshewa Inlet, increasing its exposure to the sea and wind on the port bow and causing the vessel to roll. The force of the wind on the tarps and the baiting claim, combined with the water shipped on deck, caused the vessel to develop a starboard heel.

The *Pacific Siren* was subsequently subjected to a large swell from the port side and a simultaneous gust of wind. More water shipped and remained on deck, as the freeing ports on the starboard side were submerged. The cumulative effects of the vessel's load distribution, deployed paravanes, and a free surface effect¹⁵ raised the vessel's centre of gravity. The combined force from the wind and sea pushed the vessel further to starboard, changing the vessel's centre of buoyancy and reducing its righting energy to a point where the vessel was unable to recover.

Eventually the vessel sank as a result of downflooding through the deckhouse door and tank vents on the main deck. Since the vessel was not recovered, the Transportation Safety Board (TSB) was unable to determine the exact cause of the sinking or conduct a post-occurrence stability assessment.

Safety Issues Investigation into Fishing Safety in Canada

Accidents like the one involving the *Pacific Siren* are the cumulative effect of unsafe practices, environmental factors, and operational conditions that align to form a window of opportunity for an accident to occur. The *Safety Issues Investigation into Fishing Safety in Canada* (SII) categorized actions impacting safety into 10 safety significant issues and found that there are complex relationships and interdependencies among them.¹⁶ Below is an explanation of how 6 of these 10 safety significant safety issues affected the *Pacific Siren*.

¹⁵ A free surface effect occurs when on-board liquids shift in their tanks with the vessel's movement, or when water is shipped on deck.

¹⁶ TSB Safety Issues Investigation Report Number M09Z0001, Safety Issues Investigation into Fishing Safety in Canada. The report can be accessed on the TSB website at www.tsb.gc.ca

Stability

Operator Knowledge of Stability

Proper training and knowledge of stability enables masters to understand the detrimental consequences of improper weight distribution, environmental conditions, and paravane stabilizers on a vessel's stability.¹⁷ It also enables them to recognize the free surface effects of even a few inches of shipped water on deck, as well as the free surface effects of liquids contained below deck in tanks, bilges, or holds.

There is no requirement for fishermen to have competency-based training or certification to operate a vessel of the *Pacific Siren's* size. The *Pacific Siren's* master held a Small Vessel Operator Proficiency (SVOP) training certificate, although it was not required by regulation. SVOP provides 1 hour of stability training. The extent of the master's stability training was not sufficient to provide him with adequate knowledge of the principles of stability and as such, these principles were not applied to the fishing operations. Based on this occurrence and many others investigated by the TSB,¹⁸ it is apparent that fishing vessel masters are not always aware of the basic principles of vessel stability.

Paravane Roll-Dampening Devices

The *Pacific Siren* was fitted with roll-dampening devices that reduced the vessel's motion in a seaway to increase crew comfort. At the time of the occurrence, the *Pacific Siren's* roll-dampening paravanes were deployed. The use of paravanes is not without risk.¹⁹ Roll-dampening paravane systems have been developed on an ad hoc basis, and there have been few formal studies to determine the precise correlation between the righting effect induced by the paravanes and a vessel's inherent transverse stability. The *Pacific Siren's* master was unfamiliar with the risks associated with paravane use.

Windage

Upon entering Hecate Strait, the *Pacific Siren's* direct course increased the vessel's exposure to the sea and wind on the port side. The port side of the deckhouse, the baiting claim, and the tarps strung up on the main deck created a large surface area that produced additional windage. This additional windage adversely affected the vessel's stability.

Stability Assessments

The *Pacific Siren* did not have a stability booklet, which is intended to provide guidance to the master and crew members about the safe limits of the vessel under various operating conditions. Currently, there is no requirement for fishing vessels under 15 gross tonnage to

¹⁷ Fishing safety suffers when the principles of stability are not well understood, applied, or presented in a practical format. This safety significant issue is further analyzed in the SII.

¹⁸ TSB investigations M02W0147 (*Cap Rouge II*), M04N0086 (*Ryan's Commander*), M06W0039 (*BC Safari*), and M07N0117 (*Sea Urchin*)

¹⁹ TSB investigation M98N0064 (*Atlantic Prize*) and TC SSB 15/2000.

submit trim and stability data to Transport Canada (TC) for information, review, or approval. This information is necessary for the production of a stability booklet. Stability assessments, along with simplified information, help the master with operational decision-making on board fishing vessels.

Changes to fisheries resource management (FRM) measures and operational requirements mean that ongoing fishing vessel modifications are a reality.²⁰ In 2008, TC issued Ship Safety Bulletin (SSB) 01/2008 urging owners and masters of small fishing vessels to voluntarily record modifications to a vessel's structure, equipment, or gear that added, removed, or relocated more than 100 kg.

The *Pacific Siren's* modifications did not change the vessel's gross tonnage and therefore were not recorded. However, modifications may affect a vessel's stability and are often carried out without any assessment by a naval architect or regulatory body.²¹ TC's proposed *Fishing Vessel Safety Regulations*, due to be released in the fall of 2014, would require authorized representatives to ensure that records are kept with respect to fishing vessel modifications. Without comprehensive stability assessments, operational decisions may be based on imprecise or incomplete information to the detriment of safety.

Lifesaving Appliances

At the time of the occurrence, the master's 2 Maydays on the VHF radiotelephone went unanswered. The VHF/DSC radiotelephone was on board as required, but it was not fitted correctly. A Mayday sent out on a VHF/DSC radiotelephone that is fitted correctly automatically identifies the vessel and its location. This information helps rescuers reach the vessel as quickly as possible.²²

The vessel was not carrying an EPIRB, nor was one required. When the 2 Maydays were not received, the crew had no other means of sending out a distress signal. As a result, they were stranded for 9 days until they were spotted by chance. Lifesaving appliances such as properly fitted VHF/DSC radiotelephones and EPIRBs increase the chances of survival during an emergency at sea.

The vessel was carrying immersion suits, lifejackets, and a PFD, but these items became inaccessible after the capsizing due to their storage locations. Lifesaving appliances need to be accessible to increase the chances of survival.

Fisheries Resource Management

The length of the *Pacific Siren's* buoyant hull met the Department of Fisheries and Ocean's (DFO) licence length restrictions; however, a stern extension was necessary to accommodate the 300 prawn traps allocated to this licence. At the time of the occurrence, approximately 100

²⁰ TSB investigation M05W0110 (*Morning Sunrise*)

²¹ TSB investigations M08W0189 (*Love and Anarchy*), M05W0110 (*Morning Sunrise*), M04M0002 (*Lo-Da-Kash*), M02W0147 (*Cap Rouge II*), and M04W0025 (*Prospect Point*)

²² Lifesaving appliances that are not properly designed, carried, fitted, used, or maintained for fishing operations put lives at risk. This safety significant issue is further analyzed in the SII.

prawn traps were loaded on the stern extension, raising the vessel's centre of gravity. The DFO does not require an assessment of the vessel for its intended purpose prior to designating the licence.²³ However, comprehensive vessel assessments provide owners with valuable information about the stability limitations of their vessels.

FRM measures create a competitive environment which may affect a fisherman's willingness to accept risks in order to optimize fishing operations. In this occurrence, the risk-taking activities, such as loading traps on the stern extension, travelling in poor weather conditions, and operating without properly-fitted safety equipment placed the crew and vessel at risk.

Cost of Safety

The economic reality of fishing is that most owners and masters try to minimize cost and maximize profit. As such, operational decisions can be influenced by start-up costs, the need to make a living, and the operation of the prawn fishery,²⁴ resulting in the acceptance of risks to the detriment of safety.²⁵

To maximize fishing time, the *Pacific Siren* travelled the shortest route to Cumshewa Inlet, increasing the vessel's exposure to the sea and wind. Furthermore, the vessel's departure from Prince Rupert without the second GPS unit meant that the VHF/DSC radiotelephone was not fitted to function as intended, which delayed their rescue.

In this occurrence, there was a lack of knowledge of the vessel's limitations and the effects that the environmental conditions would have on the vessel. As a result, the operational decisions to maximize the fishing days precluded other options, such as taking a longer but safer route, trucking the traps to the fishing ground, and ensuring all safety equipment was properly fitted. Operational decisions that are focused on maximizing fishing days may negatively impact the safety of a vessel and its crew.

Safety Information

TC's primary method of distributing safety information is through Ship Safety Bulletins (SSB). TC issued SSB 04/2006 and SSB 15/2000, both of which contained information relevant to the *Pacific Siren's* operations. The *Pacific Siren's* master did not receive nor seek out SSB 04/2006 and its accompanying stability information questionnaire. The vessel was never assessed for stability risk factors and the SSB questionnaire was never completed. The *Pacific Siren's* master

²³ Fishermen are put at risk when fisheries resource management (FRM) measures do not consider safety at all levels, from policy through to practice. This safety significant issue is further analyzed in the SII.

²⁴ FRM measures limit the duration of the prawn fishery, the hours of fishing, and the number of hauls.

²⁵ The fishing community often sees safety as an obligatory cost of time and money rather than a key part of managing fishing operations. This safety significant issue is further analyzed in the SII.

was unaware of SSB 15/2000 and the stability risks associated with paravane stabilizers. Safety information that does not reach its intended audience puts vessels and their crew at risk.²⁶

Safe Work Practices

The master and crew had worked with each other previously and were familiar with the vessel. However, the master had not provided the crew with documented safe work practices, nor did he provide them with a pre-fishery vessel familiarization.

On the *Pacific Siren*, some unsafe work practices were evident:

- Gear and provisions were stored on and above the vessel's main deck, raising the vessel's centre of gravity.
- The tarps strung up on the main deck were left up while the vessel was en route to Cumsheva Inlet, exposing the vessel to additional windage.
- The paravane stabilizers were deployed, raising the vessel's centre of gravity in its already reduced state of stability.
- The use of the autopilot's NAV mode to steer the vessel in adverse weather conditions reduced the master's control over the vessel's course alterations.
- The vessel did not have a sailing plan; as such, there was no contact person on shore to alert the appropriate authorities that the vessel had not checked in following the occurrence.

Unsafe work practices continue to put fishermen and their vessels at risk.²⁷

Interdependency of Safety Issues

The safety of fishermen is compromised by numerous issues which are interconnected (Appendix B). The following safety issues share a complex relationship and contributed to this occurrence:

- stability awareness;
- requirements for stability knowledge;
- unsafe work practices;
- access to and comprehension of safety information; and
- the cost of safety.

Past attempts to address these safety issues on an issue-by-issue basis have not led to the intended result: a safer environment for fishermen. The SII emphasizes that in order to obtain real and lasting improvement in fishing safety, change must address not just one of the safety issues involved in an accident, but all of them, recognizing that there is a complex relationship

²⁶ Safety information is not always practical or communicated in an easy-to-understand way, and does not always reach its target audience. This safety significant issue is further analyzed in the SII.

²⁷ This safety significant issue is further analyzed in the SII.

and interdependency among those issues. Removing a single unsafe condition may prevent an accident, but only slightly reduces the risk of others.

Findings

Findings as to Causes and Contributing Factors

1. A combination of the *Pacific Siren's* load distribution, deployed paravanes, and a free surface effect raised the vessel's centre of gravity.
2. The direct course across Hecate Strait increased the vessel's exposure to the wind and sea conditions, causing the vessel to heel over far enough to submerge the deck edge.
3. The submerged deck edge changed the vessel's centre of buoyancy and this, in conjunction with the vessel's raised centre of gravity, reduced the righting energy to a point where the vessel was unable to recover.

Findings as to Risk

1. The safety of fishermen will be compromised until the complex relationship and interdependency among safety issues is recognized and addressed.
2. Without comprehensive stability assessments, operational decisions may be based on imprecise or incomplete information to the detriment of safety.
3. Fishermen who are not aware of the adverse effects of paravane stabilizers on vessel stability put their crew and vessel at risk.

Safety Action

Safety Action Taken

Five days prior to the capsizing of the *Pacific Siren*, a similar accident involving the small prawn fishing vessel *Jessie G* ²⁸ occurred.

In light of these 2 occurrences, the Pacific Prawn Fisherman's Association (PPFA) assembled a committee of prawn fishermen to work with Fish Safe to develop a code of best practices for the BC prawn fishery. Early in 2013, a code of best practices for the prawn fishery was developed and approved by the PPFA board of directors for publication and was distributed to fishermen. The code of best practices ²⁹ is intended to address unsafe work practices that continue to put fishermen, their crew, and vessels at risk.

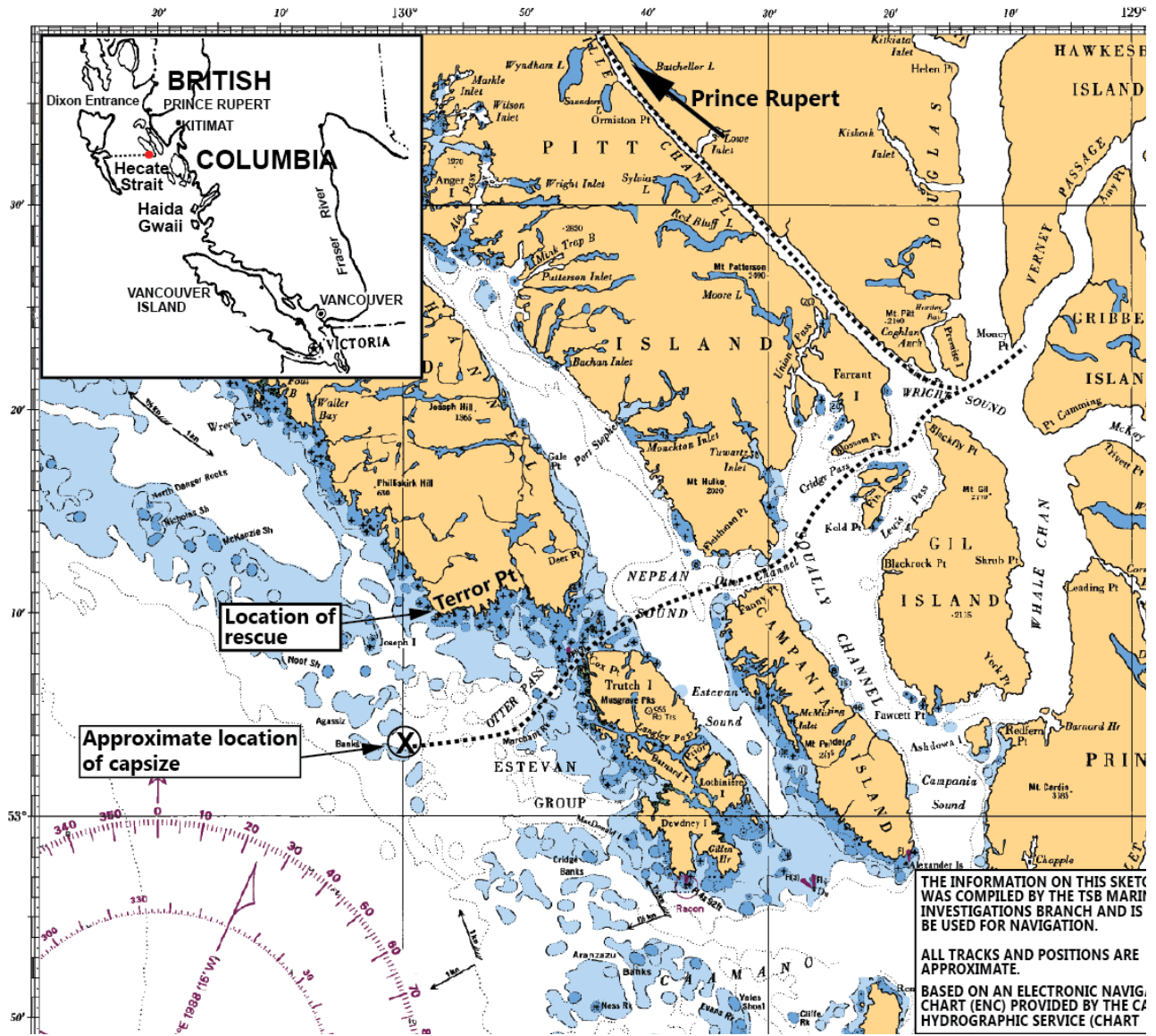
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 May 2013. It was officially released on 06 June 2013.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

²⁸ TSB investigation M12W0054 (*Jessie G*)

²⁹ Fish Safe, *Prawn Fishery: Best Industry Recommended Practices*, https://www.fishsafebc.com/_customelements/uploadedResources/PrawnBestPractices.pdf last accessed 3 June 2013.

Appendix A - Area of the Occurrence



Appendix B - Unsafe Conditions and Associated Safety Issues

Unsafe conditions	Safety issues						
	Stability	FRM	LSA	Training	Info	Cost	Work practices
Vessel modified to accommodate multiple fisheries, gear, and licence length restrictions	X	X		X	X	X	X
Vessel modifications never approved or recorded despite SSB 01/2008	X			X	X	X	X
Windage created by tarps strung up and across the main deck	X			X	X		X
Participated in a fishery which the vessel was not suited for	X	X		X	X	X	X
Distress call incomplete; no life raft, EPIRB, lifejackets, or sail plan available			X	X	X	X	X
Vessel operated outside safe stability limits: no stability assessment despite SSB 04/2006	X	X		X	X	X	X
Unsafe gear and equipment loading practices: excess traps, raised centre of gravity	X	X		X	X	X	X
Travelled in a direction that increased the vessel's exposure to wind and sea conditions	X	X		X	X	X	X