Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT M16P0362

Grounding and abandonment

Passenger vessel *Stellar Sea*
Tofino, British Columbia
01 October 2016

Canada

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Summary

On the afternoon of 01 October 2016, the passenger vessel *Stellar Sea*, with 28 people on board, departed Tofino, British Columbia, on a bear-watching excursion. At approximately 1744 Pacific Daylight Time, in Warn Bay, the vessel struck a charted rock and went aground. The passengers and crew abandoned the vessel and were evacuated with the assistance of the passenger vessels *Pacific Springs* and *Rip Tide*. Two passengers sustained minor injuries. No pollution was reported.

Le présent rapport est également disponible en français.

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1.0 Factual information

1.1 Particulars of the vessel

Table 1. Particulars of the vessel

Name of vessel	*Stellar Sea*
Official/licence number	830007
Port of registry	Victoria, BC
Flag	Canada
Type	Passenger
Gross tonnage	27.89
Length	12.30 m
Draft	0.76 m
Built	2006, Québec, QC
Propulsion	Water jet, 522 kW power supplied by 2 diesel engines
Crew	2
Passengers	26
Registered owner	Jamie's Whaling Station Ltd., Tofino, BC

1.2 Description of the vessel

The *Stellar Sea* is a passenger vessel capable of travelling at a speed of 18 knots. The passenger seating area is located on the main deck, occupying approximately two thirds of the forward part of the vessel. The seating area consists of rows of seats arranged on either side of a centre aisle and is enclosed within a semi-transparent polycarbonate shell. The shell has windows on each side that can be opened to facilitate viewing and a polycarbonate door at the front of the vessel, near the bow, that lifts vertically (Figure 1).

Figure 1. The *Stellar Sea*, at 1859 Pacific Daylight Time, 75 minutes after the grounding (Source: Dmitry Cherov)

Behind the passenger seating area are the battery compartment, electrical switchboards, and stored lifejackets for adults and children. Further aft is an access hatch to the engine room, and an entryway by which the passengers may board the vessel. The vessel's liferaft and emergency position indicating radio beacon (EPIRB) are located at the stern and are easily accessible.

The wheelhouse is located a level above the main deck, just aft of the passenger seating area, and is accessible by ladder. The wheelhouse has room for the master to sit on a chair and for a lookout to stand beside the master. The conning station is equipped with propulsion controls, communications equipment, and navigation equipment, including radar, very high frequency (VHF) radiotelephone with digital selective calling features, a depth sounder, a magnetic compass, and a global positioning system interfaced with the chart plotter.[1] The wheelhouse provides a 360° view around the vessel.

Below the main deck, the aluminum hull is subdivided into 3 watertight compartments (from forward): a void space, a space that contains the vessel's fuel tank, and the engine room, which contains the vessel's 2 engines. The compartments can be accessed through watertight hatches located on the main deck that are closed while the vessel is in operation.

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1 A chart plotter is an electronic navigation system that interfaces the position feed from a global positioning system receiver with an electronic charts/maps overlay, enabling the master to monitor the vessel's position and movement.

1.3 Company operations

The company has been conducting tours out of Tofino and Ucluelet, British Columbia, since 1982. At the time of the occurrence, the company operated a fleet of 4 small passenger vessels and 5 rigid-hull inflatable boats, which included the *Pacific Springs* and the *Rip Tide*. The *Pacific Springs* and the *Rip Tide* each had a maximum capacity of 12 passengers and an operator.

1.3.1 Bear-watching tours

Bear-watching tours are conducted from April to October, with an average of 2 tours each day. A typical bear-watching tour departs when the tide is ebbing and takes 2 to 3 hours. The vessels travel from Tofino through Browning Pass to Fortune Channel and Warn Bay. The greatest concentration of bears is usually found on the land along the coastline of Fortune Channel and Warn Bay, which is typically the best wildlife sighting area. The company guarantees a bear sighting on every voyage; if a bear is not seen, the company offers passengers a free ticket that allows them to join another bear-watching tour.[2]

1.4 History of the voyage

On 01 October 2016, at about 1600,[3] a deckhand prepared the *Stellar Sea*[4] for a bear-watching tour along Fortune Channel. At around 1615, the passengers and the master, who had just returned from leading another excursion on the company passenger vessel *Lady Selkirk*, boarded the vessel. The master delivered a safety briefing to everyone on board, and at 1616, the vessel, with 2 crew members and 26 passengers on board, departed the wharf. The passengers varied in age; 3 were children.

During the voyage, the master navigated the vessel while, at times, looking out for wildlife and communicating with the company, the deckhand, and the passengers. A private VHF channel was used for communicating with the company.[5] Throughout most of the voyage, the deckhand stayed within the passenger seating area, tended to the passengers, and elaborated on the master's instructions. The deckhand, as the designated naturalist on board, provided commentary and tour information, scanned the coastline for wildlife, and shared that information with the master and passengers.

The master navigated the vessel from Tofino to Fortune Channel. At 1633, the vessel rounded Auseth Point, and arrived in Fortune Channel around 1700; the master reduced the vessel's speed to 8 knots. The front door and the windows of the shell were opened to

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2 Jamie's Whaling Station Ltd., "Jamie's Sightings Guarantee," at https://www.jamies.com/about/our-sightings-guarantee (last accessed on 16 June 2017).

3 All times are Pacific Daylight Time (Coordinated Universal Time minus 7 hours).

4 The vessel was berthed at Jamie's Whaling Station Ltd. at Tofino, British Columbia.

5 All subsequent communications between the master and the company reported in the *History of the voyage* took place over this private VHF radio channel.

facilitate viewing. At that time, some of the passengers stood up[6] and began to move around the vessel.

As the vessel moved north along Fortune Channel, with the coastline close to its starboard side, the crew alerted the passengers to the presence of a small bear on the beach. The bear disappeared into the forest as the vessel approached; the passengers did not get a good view of it.

The vessel proceeded further north and entered Warn Bay at 1725. The master navigated the vessel to pass through a narrow channel, with Vancouver Island to the east and an unnamed island to the west. The vessel stayed within a 5 m depth contour and passed without incident close to a number of drying reefs and rocks in this area.

The vessel exited the narrow channel at approximately 1742, moving on a northerly course in the general direction of a charted[7] but unnamed rock (Appendix A).[8] On previous voyages, the master passed the rock on the vessel's starboard side. The vessel's speed was approximately 5 knots.

For approximately the next 2 minutes, the master scanned the coast for bears, from the wheelhouse, while the deckhand scanned the coast from the aft open passenger deck; both used binoculars. The bear-sighting area that they were targeting was a shoreline on the far side of the water. It was an overcast day, and bears appear quite small at this distance. As well, there is little contrast between bears and their surroundings in such conditions.

The master observed a bear by the water's edge on the northwestern side of Warn Bay, approximately 0.9 nautical miles (nm) from the vessel. As the vessel continued to approach the rock at minimum speed, the master put down the binoculars, maintained visual attention on the bear, and instructed the passengers to sit and prepare for the vessel to increase speed. Some of the passengers remained standing.

The master began to turn the vessel toward the bear and increased the speed of the vessel to 7 to 8 knots. At this time, the *Stellar Sea* was approximately 5 to 6 m from the rock. As the vessel began navigating toward the bear, the master saw the top part of the rock in the water, very near to the starboard side of the vessel, and tried to avoid it. However, at 1744, the vessel's bottom made contact with the rock and the vessel grounded at position 49°14.5 N, 125°44.5 W. The master stopped the engines.

When the vessel stopped abruptly, 2 of the passengers fell and sustained minor injuries. The master came down from the wheelhouse to the main deck to assess the damage to the vessel. The master opened the 3 watertight hatches to access the vessel's compartments to check for

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6 All passengers were seated during the passage from Tofino to Fortune Channel.

7 Canadian Hydrographic Service, Clayoquot Sound, Chart number 3673, December 1995.

8 The rock upon which the *Stellar Sea* grounded is at a height of 2 m above the datum. At the time of the occurrence, the rock would have been just surfacing.

leaks, then returned to the wheelhouse and called the company. The deckhand remained on the main deck with the passengers. At this time, the tide was ebbing, and the vessel settled on the rock and began to heel[9] to port. The vessel's liferaft was not deployed.

Soon after, a company office employee dispatched 2 of its vessels, the *Pacific Springs* (C07488BC) and the *Rip Tide* (C12985BC), to assist in rescuing the passengers. After completing the sightseeing tour for the day, the master of *Pacific Springs* filled the vessel's fuel tanks and was about to dock the vessel at the company's wharf in Tofino. Upon hearing the VHF communication between the master of the *Stellar* Sea and the company's office employee, the master of the *Pacific Springs* went to assist the *Stellar Sea*.

The master of the *Rip Tide* was at home at the time of the occurrence. After receiving a call from a company employee, the master went to the company office, picked up the number of floater suits required for the potential evacuees, checked that the *Rip Tide* had enough fuel, and departed for Warn Bay. The employee also called the operations manager of the company.

At approximately 1748, as the tide continued to ebb, the vessel's port heel increased. The deckhand instructed the passengers to move to the starboard side of the vessel and, with the assistance of a passenger, handed out lifejackets, which everyone donned.

The *Pacific Springs* arrived on the scene approximately 36 minutes after the grounding. The passengers started transferring to the *Pacific Springs* from the port side of the *Stellar Sea*. The vessel heeled progressively onto its port side to approximately 45°. At this point, after 9 passengers had been transferred, the transfer of passengers was stopped. The *Pacific Springs* moved away from the *Stellar Sea.*

At approximately 1830, the master of the *Stellar Sea* instructed the remaining 17 passengers to abandon the vessel from the starboard side onto the rock. The vessel's freeboard on the starboard side was approximately 2 m. Two passengers jumped onto the uneven surface of the protruding rock, which was covered in marine growth and had puddles of water. The passengers and crew of the *Stellar Sea* rigged up a rope to assist the remaining passengers in disembarking onto the rock.

At about 1837, the Zodiac *Rip Tide* arrived on the scene. The master and deckhand helped the remaining 17 passengers to board the *Rip Tide* from the rock. The master returned to the *Stellar Sea* as the *Rip Tide* moved away. The *Rip Tide* approached the *Pacific Springs*, and 5 of the passengers and the deckhand were transferred to the *Pacific Springs*. The passengers of the *Rip Tide* donned the floater suits provided by the master of the *Rip Tide*.

At 1855, the *Pacific Springs,* with 14 passengers and the deckhand on board, departed Warn Bay. The *Rip Tide* returned to retrieve the master from the *Stellar Sea* and, at 1900, with 12 passengers and the master on board, departed Warn Bay. On the return voyage, the

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9 The word "heel" signifies the temporary inclination of a vessel to one side or another due to an external force.

master asked an office employee to call the owner of the tug *Beamsville* to assist in salvaging the *Stellar Sea*.

The *Rip Tide* met the *Beamsville* near Tofino. The master boarded the *Beamsville*, and the vessel returned to the *Stellar Sea*, which, at low tide,[10] was entirely out of the water. The *Beamsville*, with a draft of 3 m, was unable to get close enough to the vessel to allow the master to board the *Stellar Sea* or attempt to salvage it.

At 1930, both the *Rip Tide* and the *Pacific Springs* arrived at the company wharf in Tofino with all passengers of the *Stellar Sea*. At 2030, the *Pacific Springs* returned to Warn Bay with 2 company mechanics and an additional crew member. At approximately 2130, as the tide was rising, the master, salvor,[11] and 2 mechanics tried to refloat and dislodge the *Stellar Sea* from the rock. The salvage crew were unsuccessful in their efforts; they closed the *Stellar Sea*'s engine room vents and plugged its sounding pipes to prevent pollution.

At 2222, about 4.5 hours after the grounding, the master of the *Pacific Springs* informed the Canadian Coast Guard (CCG) of the occurrence by VHF and requested float booms.

On 02 October at 0030, the *Pacific Springs* and the *Beamsville* departed Warn Bay with the master and technicians. At 0118, the rising waters activated the *Stellar Sea*'s EPIRB. At 0148, the CCG fast rescue craft from the Tofino base arrived in Warn Bay. The CCG crew switched off the EPIRB, secured an oil pollution boom around the vessel, confirmed that there was no pollution, and departed back to Tofino.

On the morning of 03 October, the company technicians made temporary repairs to the hull of the *Stellar Sea* and refloated the vessel. The vessel was then towed to Ucluelet for further inspection and repairs.

1.5 Damage to the vessel

The *Stellar Sea*'s aluminum hull was damaged below the waterline. In addition to numerous scrapes, keel fractures, deformations, and indentations on the hull, there were 2 large puncture holes. One of the punctures extended across the 2 main watertight compartments below the main deck, the engine room, and the middle space. The vessel's echo sounder transducer, the diesel engines, gearboxes, electrical wiring, and bilge pumps were also damaged due to submersion.

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10 On 01 October 2016, low tide was at 2000 PDT (Source: Department of Fisheries and Oceans Canada, 7 Day Tidal predictions, Warn Bay [#8626]).

11 A salvor is a person who volunteers to assist or salvage when a vessel is in distress.

1.6 Environmental conditions

On the day of the occurrence, the Environment and Climate Change Canada weather report for Tofino had forecasted the conditions to be mostly cloudy, with scattered showers. Sunset was at 1901 and civil twilight[12] at 1933. The air temperature was 12°C.

At the time of the grounding, the tide was ebbing and the height of the water above chart datum[13] was approximately 1.95 m.

1.7 Vessel certification and inspection

The *Stellar Sea* was certified and equipped in accordance with existing regulations. The vessel had a valid Minimum Safe Manning Document issued on 07 March 2014 and a valid inspection certificate issued on 21 April 2016, which limited the vessel to Near Coastal Class 2[14] voyages.

The *Canada Shipping Act, 2001* (CSA 2001) and the *Marine Personnel Regulations* (MPR) require that vessels such as the *Stellar Sea* have at least 3 crew members on board: a master, a person in charge of machinery, and a deckhand. The vessel's Minimum Safe Manning Document also required a complement of 3 crew members. In April 2016, Transport Canada (TC) issued a vessel inspection certificate for a complement of 3 crew members and 39 passengers.

If the master holds a Small Vessel Machinery Operator (SVMO) certificate[15] for a particular vessel or for vessels of the same class, the MPR[16] allow the master to act in dual capacity as both master and a person in charge of machinery, which thereby reduces the manning level to 2 crew members. At the time of the occurrence, the master had an SVMO dispensation and, as a result, the manning level of 2 crew members on the *Stellar Sea* was deemed to have met the MPR requirements.

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12 Civil twilight is the time between sunset and the moment that the sun is 6° below the horizon. At that time, large terrestrial objects can be seen, but no detail can be distinguished. The sea horizon is clearly defined and the brightest stars and planets are visible.

13 Fisheries and Oceans Canada states that "depths on a chart are shown from a low-water surface or a low-water datum called chart datum. Chart datum is selected so that the water level will seldom fall below it and only rarely will there be less depth available than what is portrayed on the chart." (Source: Fisheries and Oceans Canada, "Vertical datums and water levels," at http://www.tides-marees.gc.ca/C&A/datums-eng.html, last accessed on 30 November 2017.)

14 Near Coastal Class 2 voyages are those voyages, other than sheltered waters voyages, during which the vessel is always within 25 nm from shore in coastal waters of Canada, the United States (except Hawaii), or Saint Pierre and Miquelon, and within 100 nm from a place of refuge.

15 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended 03 February 2017), Part 2: Crewing, section 151.

16 Ibid., section 226.

1.8 Personnel certification and experience

The master was certified as a master on passenger vessels of less than 60 gross tonnage operating in coastal areas of British Columbia, not more than 25 nm from shore. The certificate was originally issued in 2009. Additionally, the master held Radio Operator Marine Commercial, Marine Basic First Aid, and Marine Emergency Duties (MED) A1 and A2 certificates.

The master held an SVMO certificate issued on 06 July 2009, valid for 5 years, for vessels owned by another company, but did not have an SVMO certificate for the *Stellar Sea*. On 05 July 2016, at the request of the owner, TC issued a dispensation to the master exempting him from the requirement of holding the SVMO certificate. This dispensation was extended for another 4 months in September 2016.

The master had been working as a deckhand and as a master on various small tugs and passenger vessels in the marine industry on the west coast since 2006. He had started working for the company in May 2016 and received 5 days of familiarization, participated in safety drills, undertook individual training trips on each company vessel under the direction of the vessels' masters, and was overseen by the company safety officer. After this training, the master routinely conducted tours that included observing wildlife in Fortune Channel and Warn Bay.

The deckhand had started working with the company on whale-watching vessels in 2012 and held Marine Basic First Aid, Small Vessel Operator Proficiency, MED A1, MED A3, STCW[17] Bridge Watchkeeping, ship's mechanic, and STCW Firefighting training certificates.

1.9 Risk analysis: company and master responsibilities

The CSA 2001 requires an operator to develop procedures for the safe operation of the vessel and for dealing with emergencies. Further, as per the CSA 2001, the master, as the person in command of a vessel, is required to take all reasonable steps to ensure the safety of the vessel and the persons on board.[18]

A common risk-assessment method is to combine the probability of an accident with its potential consequences, thus obtaining a risk rating.

In the case of a passenger vessel such as the *Stellar Sea*, the risk of an accident is evaluated as high because both the probability of its occurring as well as the severity of its consequences are rated as high. The nature of tourism work requires navigating in shallow water, close to shore and hazards, which increases the probability of an accident. Additionally, the

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17 International Maritime Organization, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

18 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26), subsection 109(1).

consequences are rated as more severe because there are many passengers on board and passengers are not normally trained in marine emergencies.

There were 71 passenger vessel occurrences, resulting in 9 fatalities, reported to the TSB between 01 January 2014 and 15 October 2017.[19]

1.10 Accident reporting requirements

1.10.1 Canada Shipping Act, 2001

The *Shipping Casualties Reporting Regulations*, made under the CSA 2001, require

> the master, any certificated officer, operator, member of the crew, pilot or person responsible for the ship, or the vessel being towed [to] report the incident without delay […] by radio communication to a Canadian radio ship reporting station.[20]

Among other things, the report should indicate

> (a) the identity of the ship from which the report is being made;
>
> (b) the nature of the incident; […]
>
> (d) the date, time and location of the incident;
>
> (e) the number of persons killed, missing or injured as a result of the incident; […]
>
> (g) whether the incident has caused or is likely to cause […]
>
> (ii) pollution of any waters.[21]

1.10.2 Canadian Coast Guard

The CCG recommends that

> in the interest of ensuring the highest level of safety, mariners should immediately notify the CCG, through any MCTS [Marine Communications and Traffic Services] centre, of any situation which is or may be developing into a more serious situation requiring assistance from the SAR [search-and-rescue] system. The need for the earliest possible alerting of SAR authorities to potential maritime emergencies cannot be over-emphasized.[22]

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19 Statistics excluded occurrences involving ferries and "total failure of machinery" occurrences, but included occurrences with vessels involved in excursions, whale watching, sport fishing, entertainment, etc., as well as groundings, collisions, fires, etc.

20 Transport Canada, SOR/85-514, *Shipping Casualties Reporting Regulations* (last amended 01 July 2001), subsection 4(1) and paragraph 4(2)(a).

21 Ibid., subsection 4(4).

22 Canadian Coast Guard, Notices to Mariners 1-46, Annual Edition, April 2016 to March 2017, Section D – Search and Rescue, Subsection 29A.

The CCG has emphasized the importance of using the vessel's marine VHF radio as the primary means of alerting the CCG in the event of an emergency. This ensures that the alert goes directly to the local Marine Communications and Traffic Services (MCTS) centre, which has operators on standby at all times, thereby reducing the risk of a delayed response if the CCG is contacted by another means.

1.10.3 Company procedures

The September 2016 edition of the company's safety and operational procedures manual detailed the emergency procedures for the *Stellar Sea.* In the event of any emergency, the manual required office staff to call the CCG.

1.10.3.1 Master's requirements

The company's safety and operational procedures manual was on board the vessel at the time of the occurrence. It required that the master take the following actions in the event of grounding:

- Assess the situation
- Check on passengers' well-being and deckhand to notify master if professional medical assistance is required
- Confirm vessel stability and status
- Put on lifejackets […]
- Contact CCG and JWS [Jamie's Whaling Station] office […]
- Inform passengers, move them from danger as a precaution tell them to put on life jackets
- Investigate damage and watertight integrity
- Check for pollutants / spillage
- If possible navigate vessel to nearest, suitable and safe wharf and drop anchor or wait for help.
- Order PREPARE TO ABANDON SHIP and ABANDON SHIP as required[23]

In the event of needing to abandon the vessel, the master was to do as follows:

- Send Mayday
- Sound Vessel's horn and make announcement on public address system
- Stop vessel
- Tell crew to put on lifejackets
- Tell crew to help passengers put on lifejackets

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[23] Jamie's Whaling Station Ltd., *Jamie's Whaling Station Stellar Sea Safety and Operational Procedures*, September 2016, Section 8 (b), Collision/Grounding.

- Direct passengers to muster stations
- Launch survival gear […]
- Control passenger transfer and conduct head count
- Try to assemble passengers and crew together
- Confirm that all passengers have abandoned ship[24]

1.11 *Vessel monitoring and abandonment*

MCTS provides services that include distress and safety call monitoring and tracking vessel movements in Canadian waters. The *Stellar Sea* was not operating in an MCTS radar coverage area. Also, it was not equipped with an automatic identification system, nor was it required to be by regulation. However, it was equipped with an EPIRB.

The CCG's *Radio Aids to Marine Navigation* recommends the following steps for crew to take if a vessel is sinking or has to be abandoned:

> Transmit, if time allows distress call by HF/MF/VHF DSC or INMARSAT[25]
>
> Embark in survival craft with VHF, [SART] and if possible EPIRB
>
> Switch on EPIRB and SART immediately and leave on[26]

1.12 *Keeping a lookout*

According to the CSA 2001, the master of a vessel should ensure that there is a sufficient number of competent crew members for a given voyage.[27] Furthermore, the MPR state that a master/owner is required to evaluate the number of additional persons required on board a vessel to ensure the normal, safe operation of that vessel.[28]

The STCW[29] states that "the master of every ship is bound to ensure that watch keeping arrangements are adequate for maintaining a safe navigational watch."[30] It further states

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24 Ibid., Section 8 (j), Abandon Ship.

25 HF: high frequency. MF: medium frequency. VHF: very high frequency. DSC: digital selective calling. INMARSAT: International Maritime Satellite Organization.

26 Canadian Coast Guard, *Radio Aids to Marine Navigation 2017*, Part 4.2.5, Figure 4-1, at http://www.ccg-gcc.gc.ca/Marine-Communications/Home (last accessed on 03 November 2017).

27 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26), subsection 82(2).

28 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended 03 February 2017), Part 2: Minimum complement, subsection 207(3).

29 The *Marine Personnel Regulations*, which are applicable to the *Stellar Sea*, require the master to ensure that the vessel's intended voyage is planned and that a deck watch is maintained in accordance with International Maritime Organization, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, Section AVIII/2, parts 2, 3, 3-1.

30 International Maritime Organization, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 7 July 1978, Part A, Section VIII, part 4-10.

that "[a] proper look out shall be maintained at all times to serve the purpose of fully appraising the situation and the risk of collision, stranding and other dangers to navigation."[31]

The lookout must be able to give full attention to the keeping of a proper lookout, and no other duties must be undertaken or assigned that could interfere with that task.[32]

For small vessels such as the *Stellar Sea*, the duties of lookout can be performed by the master in the hours of daylight, provided that on each such occasion a full account has been taken of all relevant factors, including the proximity of dangers to navigation. The operator of the *Stellar Sea* had determined that a 2-member crew met the MPR requirements and was adequate for the type of operation they were conducting.

1.13 Navigation and passage planning

Subsection 14(1) of the *Charts and Nautical Publications Regulations, 1995* requires the master of a Canadian vessel to ensure, before proceeding on a voyage, that the voyage has been planned using the most recent editions of the charts, documents, and publications that are required to be used. The person responsible for voyage planning is required to take into account the annex to International Maritime Organization Resolution A.893(21), *Guidelines for Voyage Planning*.

As per the *Charts and Nautical Publications Regulations, 1995*, the master and/or owner of a vessel with a gross tonnage of less than 100 is not required to have the charts on board, provided they have sufficient knowledge of information that includes the navigational hazards in the area.[33]

Although not required to carry navigation charts, the *Stellar Sea* did have a chart plotter that displayed electronic navigation charts for the area.

The *Small Commercial Vessel Safety Guide* (TP 14070E, 2010) issued by TC is applicable to vessels smaller than the *Stellar Sea* (having a gross tonnage of less than 15 and fewer than 12 passengers). Information regarding passage planning is provided in the guide, which also makes reference to the International Maritime Organization *Guidelines for Voyage Planning*, and it is presented in an easy-to-read format. At the time of the occurrence, the company did have smaller vessels to which the *Small Commercial Vessel Safety Guide* was applicable. The guidance is also helpful to vessels like the *Stellar Sea.*

Voyage planning involves 4 distinct stages: gathering all information relevant to the contemplated passage, detailed planning of the whole passage from the point of departure to

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31 Ibid., Part 4-14.

32 Ibid., Part 4-14.

33 Transport Canada, SOR/95-149, *Charts and Nautical Publications Regulations, 1995* (last amended 01 July 2007), subsection 4(2).

the point of arrival, execution of the plan, and the monitoring of the vessel's progress as the plan is executed.

A voyage plan may be informal or documented, and the degree of detail is dependent upon the size of the vessel and type of voyage. Effective voyage planning may include the following:

- the plotting of the intended route or track of the passage on available charts;
- an assessment of hazards and their proximity to the planned track;
- the marking of no-go areas based on a risk assessment;
- an assessment of the minimum under-keel clearance, and the available depth of water under different conditions of tide and draft of the vessel; and
- an assessment of other factors that can affect the safety of the voyage, such as the weather forecast, limitations of the vessel, manoeuvring characteristics of the vessel, dangers of navigation, and options available in the event of a contingency.

In this occurrence, on the day of the voyage, the master informally chose the exact route to be taken for the bear-watching trip. The route was normally adjusted in accordance with local conditions, such as a fish farm or crab traps along the way, and to ensure the best possible opportunities for observing wildlife. Given that the objective of the tour was to see animals that could appear anywhere along the coast, the master moved the vessel through the water primarily by observing the vessel's position in relation to visual landmarks.

The company and crew had not calculated the minimum safe passing distances from those known landmarks or from other charted navigational hazards, or taken into account draft of the vessel, height of tide, available depth of water, and navigation information on the chart.

Examination of the vessel's chart plotter after the occurrence revealed the following:

- The vessel's route for that day had not been planned on the chart plotter.
- The off-course alarm had been enabled for a position deviation of 0.08 nm.
- The echo sounder shallow water alarms had been disabled.
- The safety zone alarms had been disabled.
- The trackline extension vector displayed the vessel's projected position up to 5 nm while the vessel was navigating within metres of navigation hazards.

The master had conducted another tour on a different vessel. Within 15 minutes of completing that tour, the master conducted the safety briefing for the passengers on board the *Stellar Sea* and departed Tofino.

1.14 Canadian Hydrographic Service charting

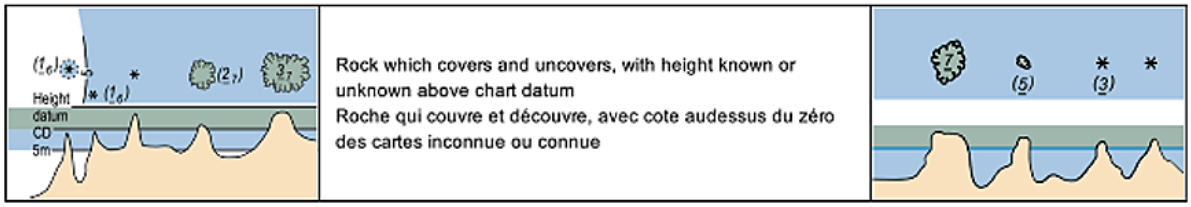
The area around Warn Bay was surveyed by Canadian Hydrographic Service (CHS) from 1987 to 1989 using a single-beam echo sounder with a line spacing of 160 m.[34] CHS

[34] Canadian Hydrographic Service, Clayoquot Sound, Chart 3673, December 1995.

resurveyed the area with a limited exploratory multibeam survey in 2005 and found that the depths had not changed to a degree that would warrant an inclusion in the chart. CHS navigation chart number 3673 has a scale of 1:40 000. This scale does not provide adequate detail to inform the navigator of navigational hazards present in harbours or intricate, shoal-infested waters.

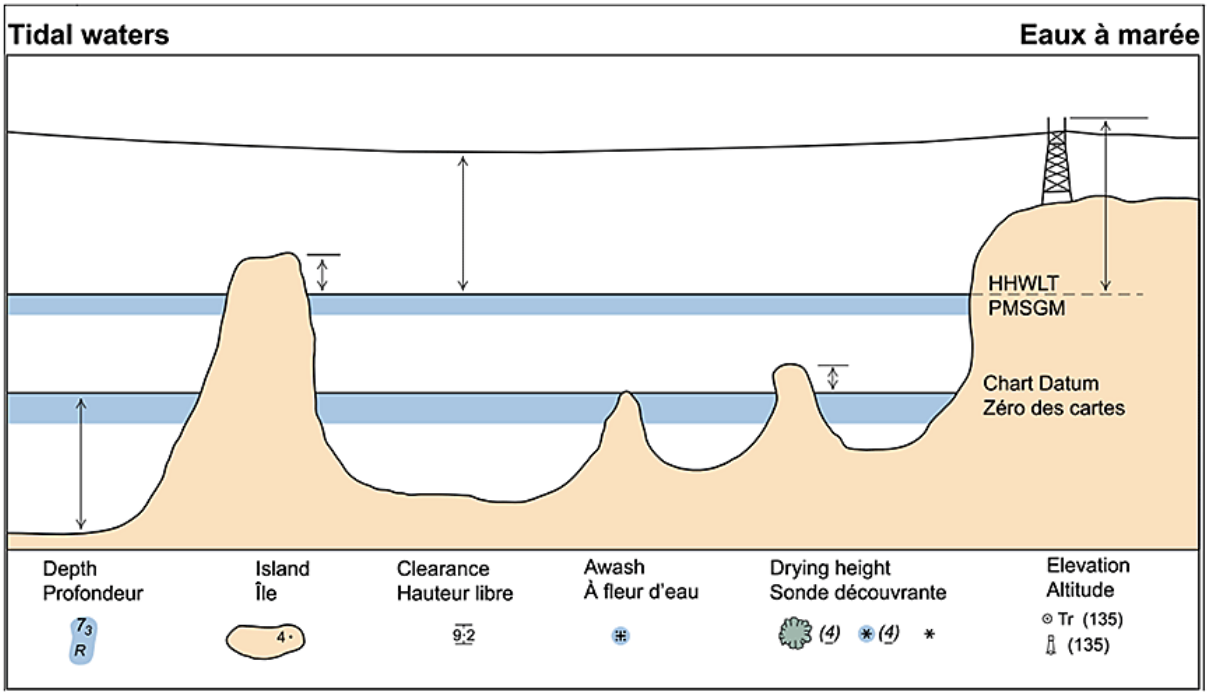
A rock, such as the one the *Stellar Sea* grounded upon, is represented on the chart by an asterisk (*). The asterisk does not describe the underwater dimensions of the rock (Figures 2 and 3).

Figure 2. Illustration of rock symbols on navigational charts (Source: Fisheries and Oceans Canada)



The rock had a drying height of 2 m and is marked on the navigation chart.

Figure 3. Illustration of drying heights for tidal waters (Source: Fisheries and Oceans Canada)



HHWLT high water large tide

PMSGM pleine mer supérieure grande marée

1.15 Attention, perception, and positional awareness

1.15.1 Positional awareness and the role of peripheral vision

Navigation in confined waters involves moving from one point to another in a particular environment and performing tasks such as identifying and avoiding hazards. To be fully aware of their position, individuals must first perceive external features or landmarks and then update their inner knowledge of where they are by integrating information about their speed, direction, or acceleration.

Orientation, or positional awareness, is knowing where one is relative to elements in the environment. The ability to navigate and orient requires forming a mental map[35] of the environment and updating one's position within this map while moving through the environment.

The master typically relied on a mental map of the area and used visual landmarks to locate the vessel's position relative to those landmarks. While navigating, the master complemented his mental map with the use of navigational aids, such as a chart plotter.

Maintaining positional awareness relative to known hazards requires mostly visual attention, which includes peripheral vision to sense the direction and speed at which one moves through the environment.[36] Although binoculars are useful navigational devices that allow users to search for navigational landmarks or hazards that are too far away to see with the naked eye, they obstruct peripheral vision and reduce the informational content of the visual scene, preventing users from maintaining positional awareness as they move through the environment.[37]

1.15.2 Master's mental map

The master was aware of the presence of a partially protruding rock, located close to the shoreline. Its surface colour blended in with that of the water. The master relied on known nearby landmarks, namely a pebble beach located east of the rock along the shoreline, to locate the rock and navigate around it. The master's understanding of the dimensions of this rock was that it only slightly protruded above the water, and he was not aware of its substantial dimensions below the surface.

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35 A mental map is a cognitive representation of the environment that consists of the knowledge of spatial relations between objects and places in the environment.

36 C. D. Wickens, "Multiple resources and performance prediction," *Theoretical Issues in Ergonomic Science*, Vol. 3, No. 2 (2002), p. 165.

37 M. Gauthier, A. Parush, T. Macuda, et al., "The impact of night vision goggles on navigation and way-finding and the acquisition of spatial knowledge," *Human Factors*, Vol. 50, No. 2 (2008), pp. 311–321.

1.15.3 Hazard detection

Drying reefs and rocks are the hazards most likely to be encountered in the shallow waters of Fortune Channel and Warn Bay. From a distance, they can appear as dark masses in certain lighting conditions. They can be difficult to spot visually if there is low contrast between dark water and the surface of the hazard, and especially if the hazard is barely above the water's surface. Specifically, these hazards can be difficult to detect using peripheral vision, and it may be necessary for the master or a lookout to look directly at them or at landmarks near them to ascertain their position in the water.

1.15.4 Focused attention and workload

While operating a vessel, a master must be alert, constantly monitor the surroundings, and continually process information. A master's attention, which is a set of cognitive processes that allows a person to select specific types of information for further processing, must be focused on the information that is most important and relevant to the task being performed at the time.

If a master is required to perform multiple tasks that require the same attentional resource, such as the visual system, and one task suddenly requires more attention from that resource, performance of the remaining tasks could be hampered.[38] For example, performing a visual search task for an object that is difficult to detect and identify would increase demands on visual attention, increase workload, and reduce the available capacity for other visual tasks, such as navigation. High resource workload can therefore lead to a breakdown of multi-tasking.

1.15.5 Master task analysis

The investigation determined that, at the time of the occurrence, the master was performing tasks that included the following:

- operating the vessel, including navigation and monitoring the vessel's instruments
- tracking wildlife visually and relaying information to the deckhand and the passengers
- repositioning the vessel and maintaining the vessel's position where necessary
- avoiding obstacles such as rocks or other hazards
- maintaining positional awareness
- communicating via VHF and with the deckhand where required
- maintaining continual awareness of the overall situation on board the vessel and with regard to the vessel's surroundings (Appendix B)

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38 C. D. Wickens, "Multiple resources and performance prediction," *Theoretical Issues in Ergonomic Science*, Vol. 3, No. 2 (2002), pp. 159–177.

1.16 Marine tourism regulators

In British Columbia, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development regulates land-based wildlife tour operators. The British Columbia Conservation Officer Service, working in partnership with the British Columbia Ministry of Environment and Climate Change Strategy, enforces the British Columbia *Land Act* by focusing on human–wildlife conflicts and response.[39] The Conservation Officer Service does not proactively monitor the activities of marine tourism companies.

Guidelines intended for use by commercial tourism operators tenured under the British Columbia *Land Act* provide useful guidance for all backcountry recreational users, and operators are encouraged to formulate their management plans based on these guidelines. Among other things, the guidelines require vessels to remain in areas with water deep enough to prevent disturbance to substrate material or aquatic vegetation.[40]

The company was not tenured under the British Columbia *Land Act* and had a business-operating licence from the District of Tofino.

The federal Department of Fisheries and Oceans is responsible for management and conservation of tidal waterways, such as Warn Bay. The Department does not have programs to monitor marine tourism company activities or track the movement of individual tour vessels in Clayoquot Sound.[41]

1.17 Previous occurrences

On 17 September 1997, the passenger vessel *Macdonald III*,[42] with 2 crew members and 26 passengers on board, made contact with a semi-submerged concrete pillar that pierced the hull. The TSB's investigation found that the master had left the vessel's control position to point out seals to the passengers while the vessel was in close proximity to known hazards.

On 23 July 2009, the passenger vessel *Explorathor*,[43] with 2 crew members and 34 passengers on board, was returning from a whale-watching voyage when it struck a submerged rock and sank near Saturna Island, British Columbia. The TSB's investigation of the occurrence found that the master was navigating largely by visual means and did not make full use of

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39 British Columbia Ministry of Environment and Climate Change Strategy, "Conservation Officer Service – Program Plan," at http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resource-law-enforcement/conservation-officer-service (last accessed on 28 June 2017).

40 A water level of 1 m beneath the keel is recommended for propeller-driven craft, and 0.5 m for jet vessels.

41 Aaron Heidt, *Tourism Operators Guidebook on Crown Land*, Wilderness Tourism Association (January 2007), Section 2(d), p. 23.

42 TSB Marine Investigation Report M97M0112.

43 TSB Marine Investigation Report M09W0147.

the available navigation equipment to track or verify the position of the vessel. Furthermore, the investigation identified that the fact that a distress was not declared in a timely manner delayed the response from search-and-rescue operations or any nearby vessels, thereby placing vessels, passengers, and crew at risk.

On 16 May 2013, the passenger vessel *Louis Jolliet*,[44] with 21 crew members and 57 passengers on board, went aground off Sainte-Petronille, Île d'Orléans, Quebec. The TSB's investigation concluded that the chief officer was navigating using visual references and did not use the bridge navigation equipment to monitor the vessel's progress.

1.18 Outstanding recommendations

On 25 October 2015, the passenger vessel *Leviathan II*,[45] with 27 people on board, capsized off Plover Reefs in Clayoquot Sound, British Columbia, while on a whale-watching excursion. There were 6 fatalities. It was determined that the company had not implemented risk management processes to identify and address environmental hazards in the area. Therefore, the Board recommended that

> the Department of Transport require commercial passenger vessel operators to adopt explicit risk management processes, and develop comprehensive guidelines to be used by vessel operators and Transport Canada inspectors to assist them in the implementation and oversight of those processes.
>
> **TSB Recommendation M17-02**

The occurrence involving the *Stellar Sea* took place before this recommendation was published.

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44 TSB Marine Investigation Report M13L0067.

45 TSB Marine Investigation Report M15P0347.

1.19 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

Safety management and oversight is a Watchlist 2016 issue. Following the capsizing of one of its passenger vessels, the *Leviathan II*,[46] the company took numerous safety actions, including amending its operating procedures to provide additional direction to the office staff and master in the event of an emergency. Despite these new procedures, the company did not perform an effective risk analysis for the operation of vessels such as the *Stellar Sea* or implement mitigations.

Safety management and oversight will remain on the TSB Watchlist until

- Transport Canada implements regulations requiring all commercial operators in the air and marine industries to have formal safety management processes and effectively oversees these processes;
- transportation companies that do have SMS demonstrate that it is working—that hazards are being identified and effective risk-mitigation measures are being implemented; and
- Transport Canada not only intervenes when companies are unable to manage safety effectively, but does so in a way that succeeds in changing unsafe operating practices.

46 Ibid.

2.0 Analysis

The investigation found that the *Stellar Sea* ran aground because the master lost positional awareness due to the focus that was required to search the coastline for wildlife while the vessel made way in confined shallow waters.

A vessel such as the *Stellar Sea*, operating in shallow, confined waters with passengers on board, is at a high risk for an accident with serious consequences. However, companies and masters can mitigate risks in vessel operations by identifying them and proactively managing them through the effective implementation of risk management processes.

The analysis will focus on 2 specific risk management processes for passenger vessels: passage planning and keeping a lookout. It will explore the attentional workload on masters of small passenger vessels and examine the benefits of timely alerting of search-and-rescue resources.

2.1 Factors leading to the grounding and abandonment

The investigation determined that there was insufficient passage planning prior to the occurrence voyage: neither the company nor the master assessed the risks of the planned voyage. Therefore, no risk mitigation was in place to guide the master's conduct of the vessel during the tour. During the voyage, the master was alone in the wheelhouse and performed multiple continuous and sequential tasks that required his attentional resources (Appendix B). While the vessel was navigating close to the coastline in shallow waters, he searched for wildlife on the coastline through binoculars. The use of binoculars affected the master's ability to maintain positional awareness by removing his peripheral vision and reducing the informational content of the visual scene as the vessel idled toward the rock.

After spotting the bear, the master lowered the binoculars and redirected the vessel to approach the bear's location, without first verifying the vessel's position in relation to the rock. As the vessel began navigating toward the bear, the master saw the top part of the rock in the water, very near to the starboard side of the vessel, and tried to avoid it. However, it was too late to take evasive action and the vessel went aground.

As the ebbing tide caused the vessel to progressively heel to port, the passengers were directed to move to the starboard side in an attempt to arrest the heel. As the vessel further heeled 45° to port, the evacuation of passengers to the *Pacific Springs* became unsafe and was stopped. Given the heel, the master was concerned that the *Stellar Sea* might capsize or slide off the rock, so he directed the passengers to abandon the vessel onto the rock on the starboard side.

The timely arrival of the vessels *Pacific Springs* and *Rip Tide* resulted in the successful rescue of the passengers and crew from the grounding site.

2.2 Master's visual task load and mental map

2.2.1 Visual task load

To be fully aware of the vessel's position, in addition to using navigation aids such as the chart plotter and the echo sounder, a master must first perceive visual landmarks to determine the vessel's current position and then continuously update the position relative to those landmarks as the vessel moves through the water.

Upon exiting the narrow channel, the master began visually scanning the surrounding environment for wildlife. Once he had located a bear on the western shore, the master continued to maintain a focused direct line of sight on the bear for most of the time that the vessel idled past the small island toward the rock.

Navigating and operating the vessel also involves a number of visual tasks, including cross-checking the position using the navigational aids, referencing the instruments to monitor speed and heading, and scanning the water's surface for hazards. All of these visual tasks require continuous and sequential fast-paced, focused attention, which has to adapt from near to far images. In addition to navigating and operating the vessel, the master was also performing the task of visually searching for and tracking wildlife.

The demands of visual attention required to track the bear would have required most of the master's attentional resources while the vessel moved toward the rock. As a result, other priority tasks (maintaining positional awareness and navigating around the rock) were essentially neglected.

Consequently, the attentional focus required to track the bear contributed to the grounding, as it prevented the master from reacquiring the vessel's position in time to navigate around the rock as he had done on previous voyages.

2.2.2 Master's mental map

The ability to navigate visually and orient oneself using local knowledge requires forming a mental map of the environment and updating one's position within this map while moving through the environment. While the master also used a chart plotter, he typically relied on a mental map of the area and visual landmarks to understand the vessel's position relative to those landmarks. As the master navigated the vessel through the environment, the known position was continuously updated and compared to this mental map.

The master's normal navigational practice in shallow waters was to navigate close to and around hazards, primarily relying on visual landmarks to locate those hazards since they are difficult to spot, especially when just below or just above the surface. Given that the rock in Warn Bay was hard to see and was just above or below the surface (depending on the tide), the master relied on a pebble beach nearby to locate the rock and navigate close around it.

Due to the master's understanding of the dimensions of the rock, which did not include the underwater shape and extent of the rock, the master's practice was to navigate close to the

rock. Having done this successfully in the past, the master did not perceive the risk associated with this navigational practice.

2.3 Risk management

Depending on the marine environment in which a passenger vessel is operating, it may be subject to any number of hazards. These hazards may result in marine emergencies such as fire, collision, person overboard, grounding, swamping, and capsizing. The risks associated with such operations are high. It is therefore essential that operators of passenger vessels be cognizant of the risks involved in their operations and proactively manage them through the effective implementation of risk management processes by reducing risks to the lowest possible level. Two such risk management strategies are effective passage planning and having an adequate number of crew members on board to post a lookout.

2.3.1 Passage planning

Passage planning is one component of the risk management process for vessel owners and/or masters. It involves thoroughly planning a voyage to identify hazards that a vessel may be exposed to and,, based on an assessment of the effect of those hazards on the vessel, proactively implementing measures to eliminate or reduce exposure.

On the occurrence voyage, as on similar trips conducted before, the master was navigating alone in a challenging marine environment with numerous rocks, reefs, and a large tidal range while searching for wildlife that might appear at different locations on any given day. Under such circumstances, making and executing an effective passage plan is key to making sound decisions governing the movement of the vessel and managing the risks involved. The investigation determined that the passage planning was insufficient and the risks inherent in the occurrence voyage were not assessed, recognized, or addressed through mitigating strategies.

The terrain and the sea bed along Fortune Channel and Warn Bay are such that, within 100 m of the coast, there is sufficient deep water where a vessel such as the *Stellar Sea* can safely navigate. If the company or master defines minimum safe passing distances from known and charted hazards, the safety zone alarms can be enabled to sound when the vessel breaches those distances. By enabling the available alarms on the echo sounder and the chart plotter, a master can ensure that the vessel always stays in the deep water zone.

The investigation found several missed opportunities that could have assisted the master during the voyage:

- The chart plotter was not used to its full potential. Planning the general route for the tour on the plotter would have given the master an opportunity to consider the hazards along the chosen route and to plan mitigating strategies accordingly.
- There was no minimum under-keel clearance defined by the owners or master or programmed into the echo sounder system. Had this been the case, the master would have been actively alerted if the vessel had moved into waters that were too shallow.

- As the vessel's route for that day had not been planned on the chart plotter, the chart plotter off-course alarm would not have alerted the operator to a deviation in position.
- The trackline extension vector is a useful tool to visualize the predicted path of the vessel and the possible hazards that might be encountered. However, the *Stellar Sea*'s extension vector was set to a scale that was outside that of the chart display.

The charts loaded on the chart plotter were displaying information whose source data did not provide adequate detail to sufficiently inform the master of navigational hazards for navigating in intricate, shoal-infested waters. Where sufficient detail was not available, additional precautions could have been taken, such as posting lookouts or giving the navigational hazards a wide berth by using passage-planning techniques.

The practice of navigating close to shore and to navigational hazards put the vessel at an increased risk of an accident, such as running aground. However, because there was insufficient passage planning prior to the occurrence, strategies to identify and mitigate the risks posed by potential navigational hazards were not identified.

2.3.2 Safe manning and lookout

While a vessel's Minimum Safe Manning Document, in accordance with the *Marine Personnel Regulations*, indicates the minimum number of crew members required to operate a vessel, it is incumbent upon the vessel owner and/or master to ensure that there is a sufficient number of well-trained crew members on the vessel to manage routine and emergency situations while taking into account the operational requirements for each voyage.

The investigation found that at the time of the occurrence, the master was alone in the wheelhouse and needed to perform multiple tasks concurrently that interfered with his ability to maintain an adequate lookout. As per the regulations, a lookout must be able to give full attention to the keeping of a proper lookout, and no other duties must be undertaken or assigned that could interfere with that task unless a full account has been taken of all relevant factors, including the proximity of dangers to navigation.

The deckhand was working in the passenger area, one deck below the wheelhouse, to supervise passengers and to perform tour guide activities. Although he did occasionally come up to the wheelhouse to speak with the master, the deckhand's activities were focused on the search for wildlife from the passenger area and not on maintaining a lookout for navigational hazards.

Although the reduced manning level of 2 was allowed by Transport Canada, the investigation found that 2 crew members were insufficient to maintain an adequate lookout for navigational hazards and ensure that the master was able to focus on navigating and avoiding hazards during the voyage. There was no lookout posted and, because the master was required to perform multiple continuous and sequential tasks, no one saw the rock in time to prevent the vessel from running aground.

2.4 Alerting search-and-rescue services

It is critical that masters and companies of small passenger vessels alert search-and-rescue services as soon as possible after an accident takes place. Doing so provides search-and-rescue resources with more time to plan the rescue and increases the chances of a successful rescue. For example, in situations where people have entered the water, timeliness is paramount, given the high risk of hypothermia and drowning.

In this occurrence, although the crew and the passengers were evacuated safely, there was nonetheless a risk to them, because the vessel was heeling over on the rock and had to be abandoned.

The company had developed procedures to prepare for and respond to emergencies. These procedures dictated that vessel crew and other company personnel should alert rescue services as soon as possible to ensure timely assistance. However, when the *Stellar Sea* ran aground, neither the master nor the company informed the Canadian Coast Guard (CCG) or broadcasted any kind of general distress signals as required by the *Shipping Casualties Reporting Regulations* and company procedures.

The investigation determined that although not contacting the CCG in a timely manner was not a causal or contributory factor, it could increase the risk of injury to the passengers and crew in other circumstances. For example, the grounding damage to the hull was large enough that if the vessel had slipped off the rock, it would have sunk, resulting in passengers or crew in the water. The 2 rescue vessels that assisted in this occurrence, the *Pacific Springs* and the *Rip Tide*, also transported more people than they were certified to carry safely. Although this was permitted by legislation[47] and the practice of good seamanship to assist persons in distress, the risk to the passengers and crew could have been reduced if the vessel had relayed information to the CCG in a timely manner or used the very high frequency radiotelephone with digital selective calling features to obtain assistance from nearby vessels.

If companies or masters do not alert search-and-rescue resources in a timely manner, there is an increased risk that the response will not be timely, effective, or coordinated.

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47 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26), subsection 110(1).

3.0 Findings

3.1 Findings as to causes and contributing factors

1. There was insufficient passage planning prior to the occurrence, as it did not include strategies to identify and mitigate the risks posed by potential navigational hazards.

2. There was no lookout posted and, because the master was required to perform multiple continuous and sequential tasks, no one saw the rock in time to prevent the vessel from running aground.

3. While in shallow waters, the master was looking through the binoculars and closing in on the nearby rock. As the binoculars temporarily removed the master's peripheral vision, the master did not have effective positional awareness at that time.

4. After spotting a bear, the master lowered the binoculars and redirected the vessel toward the bear without first verifying the vessel's position in relation to the rock.

5. The attentional focus required by the master to keep the bear in sight and get closer to it quickly prevented the master from visually reacquiring the vessel's position in time to navigate around the rock as he had done on previous voyages.

6. The master's mental map of the rock did not include the underwater shape and extent of the rock. Therefore, the master's practice was to navigate close to the rock because the risk of this navigation practice was not assessed.

7. The master did not see that the rock was close on the starboard side in time to take adequate evasive action before the vessel ran aground.

8. The ebbing tide caused the vessel to heel progressively to port.

9. The master was concerned that the *Stellar Sea* might capsize or slide off the rock, so he directed the passengers to abandon the vessel onto the rock on the starboard side.

3.2 Findings as to risk

1. If companies or masters do not alert search-and-rescue resources in a timely manner, there is an increased risk that the response will not be timely, effective, or coordinated.

3.3 Other findings

1. In Clayoquot Sound, neither the Department of Fisheries and Oceans nor the British Columbia Ministry of Forests, Lands, and Natural Resource Operations monitors marine vessels that conduct tours for sighting terrestrial wildlife.

2. Although the emergency position indicating radio beacon was easily accessible, it was not manually activated during the occurrence.

4.0 Safety action

4.1 Safety action taken

4.1.1 Jamie's Whaling Station Ltd.

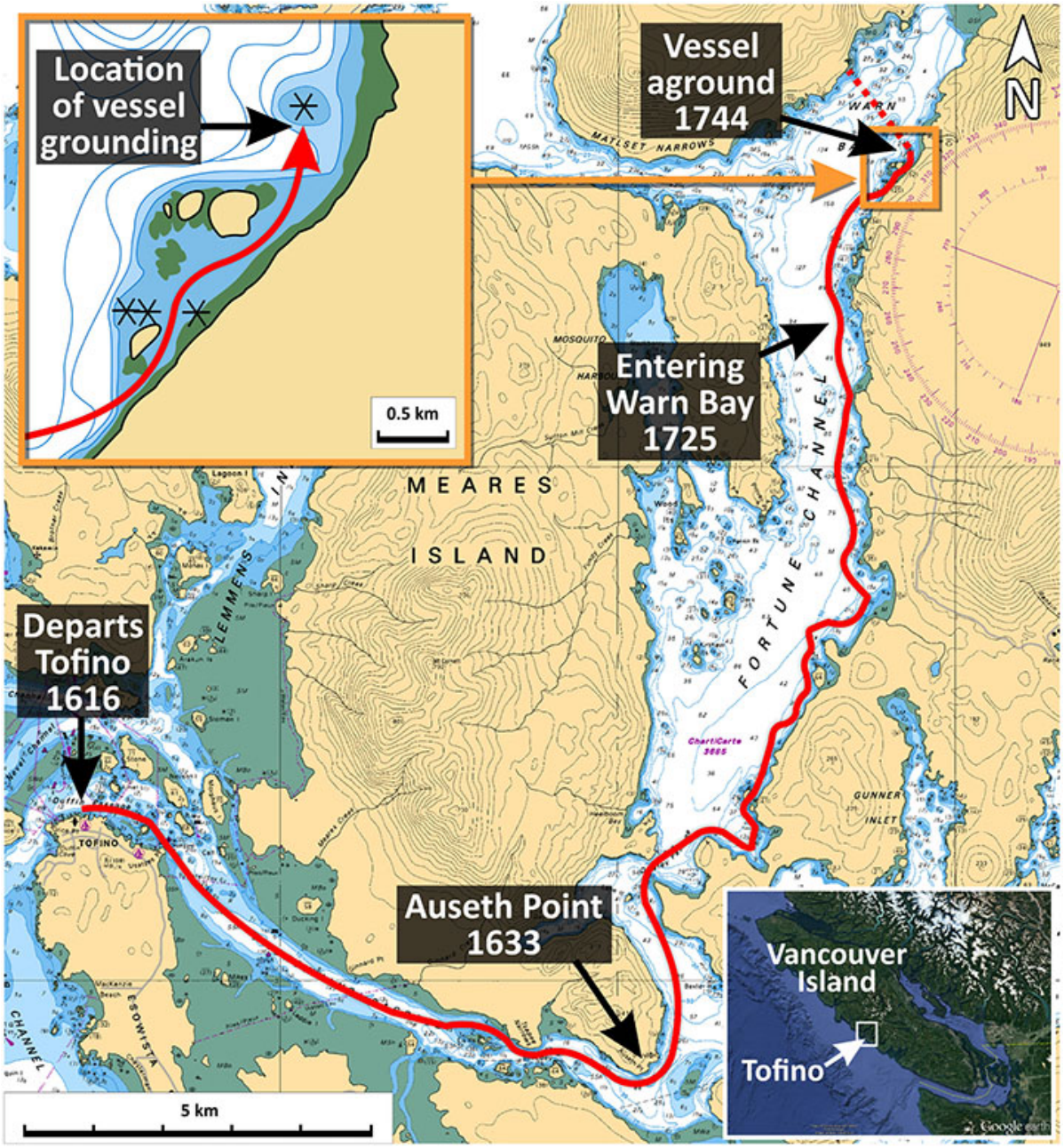
In March 2017, Jamie's Whaling Station Ltd. updated the *Stellar Sea*'s emergency and operational procedures manual to emphasize the requirement to contact the Canadian Coast Guard in an emergency. The safety drills program was also updated to increase the frequency of drills conducted.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 06 December 2017. It was officially released on 04 January 2018.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. 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.

Appendices

Appendix A – The Stellar Sea*'s navigation route*



Appendix B – Tasks conducted by the master