Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE TRANSPORTATION SAFETY INVESTIGATION REPORT M19P0029

GROUNDING

Search and rescue vessel (*Spirit of Sooke*)
Christie Point, Sooke Harbour
British Columbia
07 February 2019

Canada

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 3 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

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.

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Summary

On 07 February 2019, the Royal Canadian Marine Search and Rescue vessel *Spirit of Sooke* was returning to its station after a training exercise when it ran aground on Christie Point in Sooke Harbour, British Columbia. The vessel had 4 volunteer crew members on board and was proceeding at approximately 27 knots at the time of the grounding. The impact caused serious injuries to all of the crew members. The vessel sustained damage and was temporarily removed from service. No pollution was reported.

1.0 FACTUAL INFORMATION

1.1 Particulars of the vessel

Table 1. Particulars of the vessel

Name of vessel	*Spirit of Sooke*
Home port	Sooke, British Columbia
Flag	Canada
Type	Coast Guard Auxiliary rigid hull inflatable jet boat
Gross tonnage	4.94
Length (including swim grid)	11.1 m
Built	2013
Propulsion	2 inboard diesel engines, generating 648 kW in total, driving twin waterjets*
Crew	4
Owner	Juan de Fuca Marine Rescue Society

* A waterjet is an engine-driven impeller that generates propulsive thrust by drawing in water and then forcing it out at high velocity.

1.2 Description of the vessel

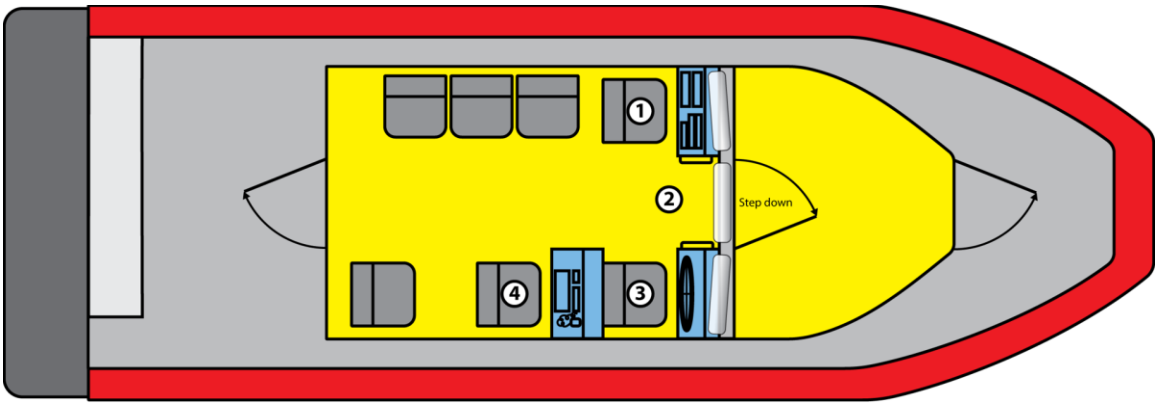
The *Spirit of Sooke* is a self-righting rigid hull inflatable jet boat specifically designed for search and rescue (SAR) operations and built by Kamma & Blake Industries Limited (Figure 1).

Figure 1. *Spirit of Sooke* (Source: Royal Canadian Marine Search and Rescue Station 37)

The vessel is constructed of aluminum and has an enclosed cabin and a hybrid -foam collar fender. Two searchlights are fitted forward on the cabin roof, one on the port side and one on the starboard side. The vessel's cruising speed is 32 knots, and its maximum speed is 40 knots.

The navigation station has a very high frequency (VHF) radiotelephone with digital selective calling (DSC), a VHF radio direction finder, and displays for the radar and chart plotter (Figure 2). The helm station has controls for the speed and controls for the direction of the waterjets, as well as a magnetic compass, a depth sounder, and controls for the navigational lights and wipers. The helm station does not have displays for the radar and chart plotter. The communications station has a single display for both the radar and chart plotter and a VHF-DSC radiotelephone. The vessel has a global positioning system and an automatic identification system (AIS).

Figure 2. *Spirit of Sooke* cabin layout. (1) Navigation station; (2) standing lookout station; (3) helm station; (4) communications station. (Source: TSB)



The *Spirit of Sooke* carried helmets and 6 audio headsets on board. The vessel also carried night-vision binoculars and a forward-looking infrared thermal imaging camera for use during SAR operations. None of these were used on the evening of the occurrence.

1.3 History of the voyage

On 07 February 2019, a refuelling trip and training exercise on the *Spirit of Sooke* was initiated at Royal Canadian Marine Search and Rescue (RCMSAR) Station 37 in Sooke, British Columbia (BC). During the day, the coxswain[1] reviewed member training requirements and availability, contacted and confirmed the attendance of 3 volunteer members (a crew member and 2 new crew[2]), and set a departure time for that evening.

Around 1900,[3] the coxswain and the 3 members met at the station. The coxswain briefed them on the plan for the trip. The plan was to train the 2 new crew members on navigation and communications procedures during the trip to the fuel dock, and one of the new crew members on how to fuel the vessel. The crew then conducted a risk assessment using the risk calculation worksheet identified on a poster at the station. The result of the risk calculation worksheet indicated that the crew could proceed with the training exercise.

The coxswain completed the pre-departure checklist,[4] and the vessel departed the station at approximately 2000 and proceeded toward the fuel dock (Figure 3).

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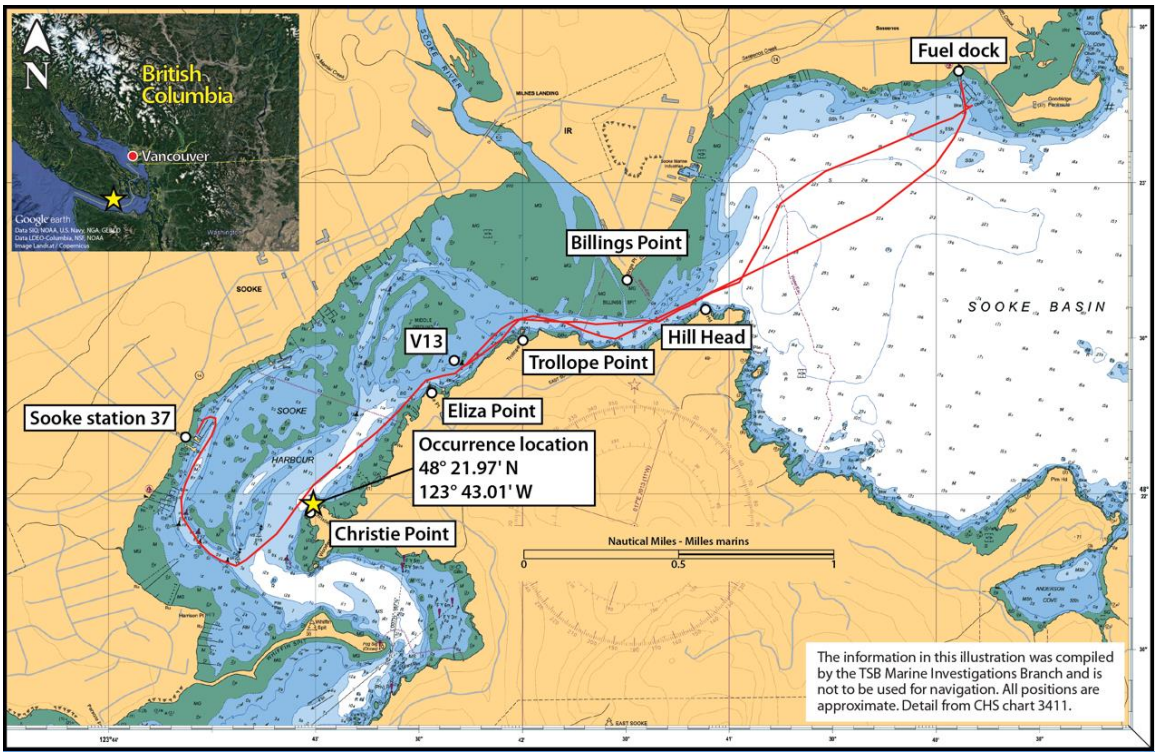
1 The coxswain, similar to a master, is the person in charge of a small boat.

2 Volunteers at RCMSAR begin as members and then progress through the following levels: new crew, crew member, advanced crew, and coxswain.

3 All times are Pacific Standard Time (Coordinated Universal Time minus 8 hours).

4 The pre-departure checklist, also referred to in Station 37's operating procedures as a daily inspection (D.I.) checklist, guides members to do a vessel walk-around, turn on the navigational and communication equipment, and perform a navigation systems check. Completion of this checklist must be noted in the vessel's logbook.

Figure 3. Area of the occurrence and the *Spirit of Sooke*'s route (Source: Canadian Hydrographic Service with TSB annotations)



The coxswain was at the helm, and the crew member was navigating. One new crew member (crew 1) was at the communications station, and the other new crew member (crew 2) was at the forward lookout station using the searchlights to locate the unlit navigational buoys that mark the inner harbour channel.

At around 2015, the vessel passed the last buoy that marked the end of the inner harbour channel and began heading toward Christie Point. At this point, the members switched positions and responsibilities in preparation for the training exercise. Crew 2 at the forward lookout station moved to the helm station, and crew 1 moved from the communications station to the navigation station. The coxswain began monitoring crew 1's navigation, while the crew member began overseeing the crew 2 at the helm.

The variable range marker[5] on the vessel's radar was set at approximately 97 m (0.05 nautical miles [NM]).

A few minutes into the training exercise, the vessel passed off Eliza Point at a distance of approximately 37 m. Crew 1 and crew 2 were instructed to practise closed-loop

5 A variable range marker provides distance information to help the navigator keep the vessel a certain distance from objects and the shoreline.

communication,[6] which they did throughout the training exercise. Through the narrow navigational channel from Eliza Point to Hill Head, the vessel's average speed was 5 knots, to facilitate training and to reduce wake. As the vessel passed Hill Head and proceeded into Sooke Basin, the radar range was increased[7] in order to locate the fuel dock on the radar screen and provide crew 2 at the helm with a course to steer. The searchlights were turned off, and the speed was increased to 27 knots with the vessel planing[8] while crossing Sooke Basin.

Just before the vessel arrived at the fuel dock, its speed was reduced and the training exercise ended. The members changed positions, with the coxswain now at the helm station, and the crew member at the navigation station. At 2045, the vessel came alongside the fuel dock and refuelled.

At approximately 2115, just before departing the fuel dock, the coxswain provided a briefing about the return trip and explained each crew member's responsibilities. The coxswain was to navigate, the crew member was to helm the vessel, crew 2 was to be the forward lookout, and crew 1 was to act as a lookout from the communications station.[9] The vessel then departed the fuel dock.

The coxswain used the radar to obtain an appropriate course from the fuel dock to Hill Head. He relayed the course to the crew member, along with a desired vessel speed of 20 to 25 knots. The vessel reached a speed of approximately 29 knots while crossing the basin. Once the vessel reached Hill Head, the speed was decreased to approximately 6.5 knots, and the radar range was reduced. The searchlights were turned on to locate shoreline features and navigational aids such as buoys and day markers.

Crew 2 operated one of the searchlights while the coxswain operated the other searchlight as the vessel proceeded through the channel from Hill Head to Eliza Point. The crew member made several course and speed alterations, mainly without instructions from the coxswain, by visually sighting the shoreline features lit by the searchlights. Crew 1 at the communications station was looking out the windows and also periodically glancing at the radar screen to check the vessel's position.

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6 Closed-loop communication is a communication technique used to avoid misunderstandings. Essentially, when the sender communicates a message, the receiver repeats the message back, and the sender confirms whether the message has been received accurately.

7 Increasing the radar range means that a larger geographical area is visible on the radar screen, while decreasing the radar range means that a smaller geographical area is visible.

8 At higher speeds, the vessel's bow rises up, which reduces the hull area in the water and thus also reduces drag. This is referred to as "planing."

9 Transport Canada, CRC c. 1416, *Collision Regulations*, Schedule 1, *International Regulations for Preventing Collision at Sea, 1972, with Canadian Modifications,* at https://laws-lois.justice.gc.ca/eng/regulations/c.r.c.,_c._1416/ (last accessed on 07 May 2020). Rule 5 requires that all vessels must maintain a lookout at all times by all available means appropriate in the conditions so as to avoid collisions.

The last recorded AIS signal for the vessel was near buoy V13, which indicated that, at approximately 2132, the vessel's speed was about 14 knots. Shortly afterward, as the vessel approached buoy V13, the coxswain checked that the crew member could see the buoy. The crew member acknowledged passing buoy V13. The coxswain instructed the crew member to bring the vessel up to a speed that the crew member was comfortable with and set a course that would take them to the entrance of the inner harbour channel. The coxswain turned off the port searchlight and, moments later, crew 2 operating the starboard searchlight turned it off as well. The crew member slowly increased the vessel's speed as it passed off Eliza Point at a distance of about 35 m. He also selected a light on shore in the general direction of the inner harbour channel as a reference point to steer by.

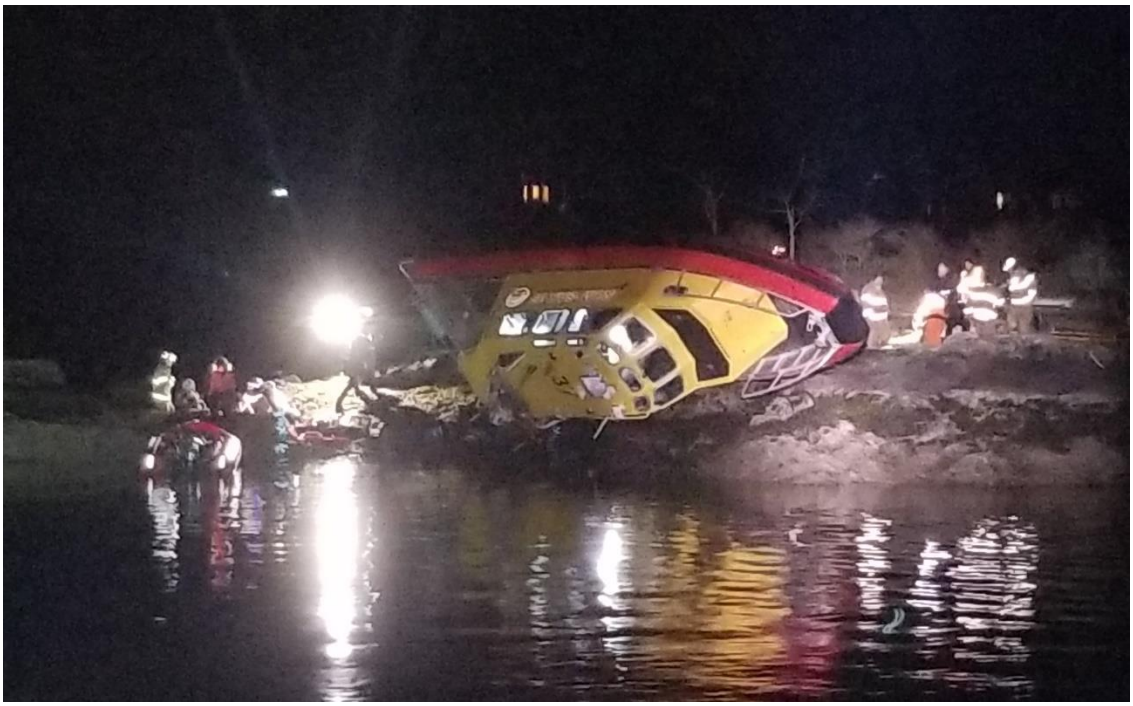
At this time, the coxswain focused on the radar and plotter displays to verify whether the vessel's course was clear of Christie Point. At approximately 2133, the coxswain indicated to the crew member that the course was good. Crew 1 and crew 2 were maintaining a lookout, with crew 2 looking out the forward windows and crew 1 looking out the aft door. Neither lookout had adequate visibility, given the environmental conditions, to spot shoreline features.

The coxswain continued to monitor the radar and plotter for a few seconds, until Christie Point appeared on the radar display. Shortly afterward, he instructed the crew member to make a 30° starboard course alteration. The crew member selected a light on shore to reference and initiated the turn. Meanwhile, the coxswain kept monitoring the radar and, seconds later, urgently shouted the course change to the crew member. However, almost immediately at approximately 2134, the *Spirit of Sooke* ran into the shoreline rocks and grounded on Christie Point (48°21.97' N, 123°43.01' W) at a speed of about 27 knots.

Upon impact, the vessel launched into the air and hit the ground stern-first. The vessel then continued moving forward along the shore for approximately 25 m before before coming to rest on its starboard side (Figure 4). All of the crew were thrown out of their seats and around the vessel's cabin, leading to serious injuries.[10]

[10] Section 1 of the *Transportation Safety Board Regulations* define a serious injury as "(a) a fracture of any bone, except simple fractures of fingers, toes or the nose; (b) lacerations that cause severe hemorrhage or nerve, muscle or tendon damage; (c) an injury to an internal organ; (d) second or third degree burns, or any burns affecting more than 5% of the body surface; (e) a verified exposure to infectious substances or injurious radiation; or (f) an injury that is likely to require hospitalization."

Figure 4. *Spirit of Sooke* after grounding (Source: Canadian Coast Guard)



Crew 2, who had been on forward lookout, found a handheld VHF radio and made a Mayday call but received no response. Crew 2 then climbed out of the vessel and onto a nearby rock with higher elevation and called again. In the meantime, at 2137, the crew member pushed the DSC button on the VHF radio, activating a distress call. Marine Communications and Traffic Services (MCTS) in Victoria received the DSC call and, shortly afterward, received a Mayday call from crew 2.

At 2140, MCTS Victoria transmitted a Mayday relay requesting assistance from mariners in the area. The Canadian Coast Guard SAR lifeboat *Cape Calvert* was deployed from the Victoria Canadian Coast Guard station. The Joint Rescue Coordination Centre in Victoria notified the Royal Canadian Mounted Police, Emergency Health Services, RCMSAR Station 35's fast rescue craft, and the East Sooke Fire Department of the situation. At 2220, these emergency resources began to arrive. By 2340, one of the crew members had been evacuated by air ambulance and 2 others had been transported to Emergency Health Services at the Sooke Harbour Marina. The coxswain sought medical attention the next morning.

1.4 Environmental conditions

At the time of the occurrence, the winds were light and the seas calm. It was dark, and the sky was overcast with no moonlight. The tide had been high (2.7 m) at 1405, and a low tide of 1 m was predicted at 2205.

1.4.1 Sooke Harbour and Sooke Basin

Sooke Harbour is part of a natural narrow channel that leads into Sooke Basin. The channel is subject to strong tidal streams and has fluctuating water depths. During low tide, areas of the harbour seabed and the Sooke River delta become exposed.

The channel is marked by unlit buoys and kelp patches that front the shoreline. The narrowest portion of the channel is from Trollope Point to Eliza Point, where the centre of the channel is approximately 30 m from shore. The route from the fuel dock to Christie Point has no lit navigational aids. Eliza Point is marked with a navigational marker, whereas Christie Point has no such marker.

1.5 Personnel certification and experience

The coxswain held a Small Vessel Operator Proficiency (SVOP) training certificate,[11] a Radio Operator's Certificate – Marine (ROC-M), a marine emergency duties (MED) A3 certificate, and a First Aid – Marine Basic certificate. He had joined RCMSAR in 2013 and achieved temporary coxswain status[12] in 2017 and permanent coxswain status in 2018. He had obtained a total of 277 hours of sea time[13] since joining, which included 62 mission hours and 215 training hours. In the 12 months before the occurrence, he had completed 49 hours of sea time. The coxswain had made the voyage into Sooke Basin numerous times and was familiar with the route. In 2015, the coxswain obtained a Simulated Electronic Navigation-Limited certificate. In 2016, the coxswain took the Canadian Coast Guard (CCG) Rigid Hull Inflatable Operators Training. He also obtained his Transport Canada (TC) marine medical certificate[14] which had expired in March 2018. He had participated in the Royal Canadian Sea Cadets program for 2 years.

The crew member held a Pleasure Craft Operator Card, an ROC-M, and a Standard First Aid certificate. He first joined RCMSAR in 2013 at a different station, where he spent 2 years. In 2018, he was reactivated at the Sooke station, where he achieved crew level status. He had 74 hours of total sea time with RCMSAR, which included 16 mission hours and 58 training hours. In the 12 months before the occurrence, he had achieved 49 hours of sea time. He had obtained some marine experience though his occupation and had been a deckhand on a commercial tuna-fishing vessel during the summers of 2003 and 2004. The crew member had made the voyage into Sooke Basin about 4 times.

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11 At the time of the occurrence, the training for an SVOP training certificate was delivered in 26 hours and did not require participants to have any previous sea time or a medical examination. An SVOP training certificate qualified an individual to be master of commercial vessels of less than 5 GT carrying up to 12 passengers.

12 RCMSAR headquarters can grant temporary coxswain status to an advanced crew member, which allows that member to act as coxswain with certain operational restrictions.

13 This is equivalent to about 6 days per year, based on an 8-hour day. Transport Canada assesses sea time based on 8-hour days.

14 A TC marine medical certificate is valid for 2 years and is a prerequisite for the CCG Rigid Hull Inflatable Operators Training. A valid TC marine medical certificate is not required to maintain coxswain level status at RCMSAR.

Crew 1 held an SVOP, an ROC-M, an MED-A3, and a Standard First Aid certificate. She had joined RCMSAR in May 2018 and had a total of 9 hours of RCMSAR sea time, all of which were training hours. She had a small amount of previous marine experience obtained though her occupation. She had previously completed a few voyages into Sooke Basin.

Crew 2 held an SVOP, an ROC-M, an MED-A3, and a Standard First Aid certificate. He had joined RCMSAR in December 2018 and had a total of 6 hours of RCMSAR sea time, all of which were training hours. He had previous marine experience obtained through a part-time occupation. He had previously completed a few voyages into Sooke Basin.

1.6 Vessel certification and inspection

The *Spirit of Sooke* was subject to the *Small Vessel Regulations,*[15] as well as a TC policy, implemented in 2004, under which "vessels owned by a community and operated by a Canadian Coast Guard Auxiliary (CCGA) community will be treated as pleasure craft, providing that they do not undertake any operations outside of SAR operations that could be considered non-pleasure in nature."[16,17] Under the policy, the *Spirit of Sooke* was required to be registered as a commercial vessel but was not required to undergo periodic inspections by TC. The policy was made under TC authority and does not affect the requirements of any other act or regulations, other than the *Canada Shipping Act*, *2001*. The *Spirit of Sooke* had never been registered with TC.

1.6.1 Transport Canada policy on community-owned vessels operated by the Canadian Coast Guard Auxiliary

TC is responsible for regulations and standards for commercial vessels and crew, as well as oversight of certifications, vessel registrations, and inspections. The 2004 TC policy that community-owned, CCGA-operated vessels are treated as pleasure craft exempts them from TC's commercial vessel oversight. The policy's objective is to provide a level of safety appropriate for the operations involved without reducing SAR capacities. The policy mentions that training volunteers to an MED-A3 level and incurring marine service fees could strain the CCGA's operating budget, forcing vessels out of service and reducing SAR capabilities. The policy indicates that these vessels assist the CCG in SAR operations and boating safety operations.

The policy was to be reviewed 24 months following the date of its approval and at least every 3 years thereafter. TC has indicated that the policy has been informally discussed with CCG, but it has not been formally reviewed since it was issued in 2004. The policy is stored on an internal TC website and is not publicly accessible.

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15 Transport Canada, SOR/2010-91, *Small Vessel Regulations* (last amended 06 December 2017).

16 Transport Canada, TP 13585, Policy –Pleasure vessel status of community owned, Canadian Coast Guard Auxiliary (CCGA) operated vessels (06 December 2004).

17 The *Canada Shipping Act, 2001* defines a pleasure craft as "a vessel that is used for pleasure and does not carry passengers, and includes a vessel of a prescribed class."

1.7 Injuries

All of the crew members on the *Spirit of Sooke* sustained serious injuries:

- The coxswain had injuries to his head, leg, and ankle.
- The crew member had injuries to his neck.
- Crew 1 had a leg injury.
- Crew 2 had head injuries and an ankle injury.

1.8 Damage

The *Spirit of Sooke* was damaged as a result of the grounding and the subsequent salvage operations. The vessel's hull had various scrapes, deformations, and indentations below the waterline, and the vessel's hybrid-foam collar fender was damaged. One of the cabin windows was broken, and some electrical wiring inside the cabin had water damage, as did the 2 inboard diesel engines. The *Spirit of Sooke* has since been repaired and RCMSAR is in the process of putting the vessel back in service.

1.9 Royal Canadian Marine Search and Rescue program

RCMSAR is a volunteer-based organization that provides marine SAR services in BC coastal and inland waters 24 hours a day, 7 days a week. Most of RCMSAR's services involve assisting CCG with SAR response. RCMSAR operates 33 stations and has more than 1100 volunteer members. RCMSAR manages approximately 45 community-owned vessels.[18] Of these vessels, 7 are of the same design as the *Spirit of Sooke*. RCMSAR also relies on another 5 vessels that are managed by owner-operators who provide SAR services on behalf of RCMSAR.

CCG deploys RCMSAR to assist with a wide variety of marine emergencies. These range from assisting a pleasure craft that has run out of fuel in good weather to assisting a vessel with a major incident involving injuries, fatalities, or people in the water in hazardous conditions (including adverse weather and sea conditions, limited visibility, and remote or dangerous geographical areas).[19] Between 2014 and 2018, on average, RCMSAR vessels conducted 774 SAR missions per year, accounting for about 36% of all marine-related incidents reported to CCG in BC.

The history of volunteer marine SAR services in BC dates from 1978, when the CCG organized volunteers across Canada to provide SAR assistance and education. Originally, Canadian Coast Guard Auxiliary-Pacific (CCGA-P) provided volunteer SAR services in BC. In

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18 The exact number could not be determined because of discrepancies between RCMSAR's asset list and TC's Canadian Register of Vessels. Some RCMSAR vessels have not renewed their TC registration since 2016.

19 CCG deploys RCMSAR resources under the guidance of the Canadian Aeronautical and Maritime Search and Rescue Manual, which states that these units are to be considered in the absence of more appropriate and readily available SAR resources. Before deploying an RCMSAR resource, CCG conducts a risk assessment to ensure the safety of the unit. It is fairly common for a volunteer SAR vessel to be the sole vessel conducting SAR.

2012, CCGA-P was transitioned into RCMSAR, in part, to address a decrease in owner-operator vessels and an increase in use of community-owned vessels. The change was also intended to raise awareness about the community-based nature of the service, to increase autonomy from CCG to assist with fundraising efforts, and to allow RCMSAR to diversify funding partnerships. CCGA continues to provide SAR services throughout the other regions of Canada.

Volunteers who join RCMSAR have skill levels and experience that vary widely. Between 2018 and the occurrence, Station 37 experienced a decrease in operational members, from 18 members to 9, that resulted in fewer certified coxswains available to conduct training. Between 2017 and 2018, RCMSAR also experienced a decrease in the number of times they were deployed. Both of these factors affected Station 37's retention, recruitment, and availability of volunteers as well as opportunities for volunteers to obtain on-water training and experience.

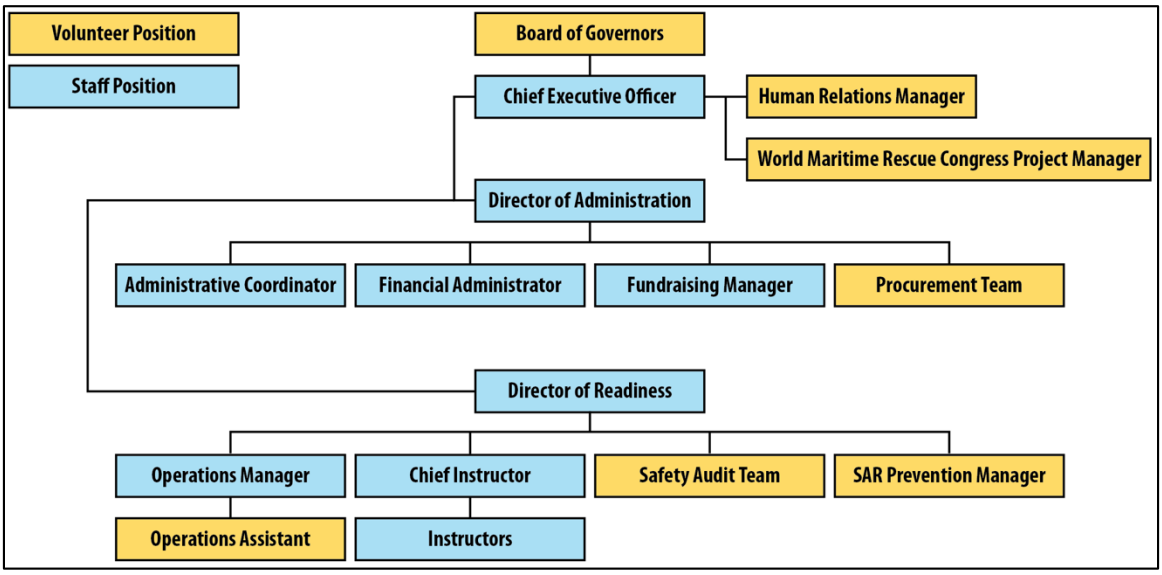
In 2017, RCMSAR began providing services for Emergency Management BC[20] in inland and coastal waters. As part of these services, RCMSAR provides transportation services for accident casualties and Emergency Management BC personnel. For 2017 and 2018, RCMSAR provided services on approximately 33 occasions in the interior waters of BC (Shuswap Lake) and on 4 occasions in BC coastal waters.

1.9.1 Royal Canadian Marine Search and Rescue organizational structure

RCMSAR has its headquarters in Sooke, BC, where there is an office and training facility. The organizational structure of RCMSAR headquarters is shown in Figure 5.

[20] Emergency Management BC is a division of the Ministry of Public Safety and Solicitor General of BC. Emergency Management BC works with local governments and other provincial and federal agencies to provide coordination and support during emergencies.

Figure 5. RCMSAR headquarters organizational structure (Source: RCMSAR)



In 2016, RCMSAR established a safety and training board (STB) to assess, develop, and implement safety and training standards for RCMSAR. The STB is made up of 2 staff from the headquarters operational team, a CCG SAR program officer, and 7 volunteer members from various stations.

To date, the STB has been involved in updating a readiness framework, helping to transition information from the old CCGA website to the new RCMSAR website, reviewing new policies and bylaws, and reviewing station requests for new personal protective equipment and other equipment.

In 2017, a standing safety and risk committee was established. The committee, which is made up of 3 members from the board of governors, is focused on ensuring that the board of governors fulfills its legal, ethical, and functional responsibilities relating to safety and risk management using best governance practices. The committee meets quarterly, and some of its responsibilities include

- providing guidance and support to the CEO and the STB to identify risks and ensure the organization implements plans to mitigate these risks;
- reviewing the activities of the STB; and,
- ensuring that all accidents, near misses, or lessons learned are appropriately investigated and that any recommendations are acted on to mitigate further risk to members.

1.9.2 Station organizational structure

Each RCMSAR station is operated by volunteers and ordinarily includes a station leader, deputy station leader, training officer, safety officer, coxswain, and duty crew. Depending on the number of volunteers available and their experience levels, not all of these positions are occupied.

Station leaders are elected by station members. The RCMSAR policy states that it is preferable for prospective station leaders to have "three years progressive service with RCMSAR at the Station level".[21] Station leaders have a number of responsibilities, including

- ensuring vessels' readiness at all times,
- identifying the need for station-specific standard operating procedures (SOPs) and developing them,
- ensuring members observe all RCMSAR guidance,
- ensuring all new members receive the required training and that training records are up-to-date in the SAR management system,
- ensuring that all incidents and accidents are reported and investigated,
- ensuring that marine incident forms and logbook entries are completed appropriately, and
- promoting communication among all members so that lessons can be learned from incidents and accidents to prevent recurrence.

1.9.3 Volunteer suitability assessment

When a person volunteers to become a SAR member, RCMSAR provides information about the risks involved, specifically mentioning the physical forces that affect crew on board a SAR vessel and the harsh environmental conditions they may encounter. RCMSAR specifies that new applicants must consider their own physical and mental abilities before volunteering.

RCMSAR has several steps in place to assess whether an applicant is suitable to be a member:

- Applicants must fill out a SAR crew membership form, which includes general information about the applicant and confirmation that the applicant has the support of their family and employer, among other things. The RCMSAR bylaws note that this form is used to help the board of governors determine applicant suitability.
- Applicants must sign a memorandum of understanding (MOU) that outlines the responsibilities of both the applicant and RCMSAR. As part of the MOU, applicants are responsible for assessing whether participation in any SAR activity would be hazardous to their health due to existing medical conditions, disabilities, or diseases.
- Applicants are required to pass a standard volunteer criminal record check. This check needs to be completed only once, when the applicant joins, and does not expire. RCMSAR requires applicants to disclose any criminal charges or convictions following the initial criminal record check.
- Applicants must complete course requirements for membership eligibility, which includes demonstrating knowledge of RCMSAR policies.

[21] Royal Canadian Marine Search and Rescue, Policy manual (29 June 2018), p. 30.

- Within their first 6 months, applicants must complete a fitness test focused on operational tasks. The fitness test must be repeated annually. Applicants are not required to undergo a marine medical examination.

In addition to the application process, RCMSAR has other policies intended to reduce the risks that applicants and members pose to operational safety and to the reputation of the organization.

RCMSAR has a policy stating that members who are actively on call or involved in training must not use alcohol or drugs that would in any way impair them during duty. RCMSAR also has a policy stating that members who are prohibited from driving a motor vehicle, as directed by the police or any other appropriate authority, due to alcohol or drug impairment are prohibited from helming RCMSAR vessels. The policy guidelines indicate that members must immediately report the prohibition to their station leader or supervisor.

The TSB obtained information during the investigation that the coxswain had been detained by the Royal Canadian Mounted Police in June 2014 for not providing a breath sample. The coxswain was subsequently charged and convicted under the *Criminal Code*[22] for refusing to comply with a police order, and his driver's licence was suspended. The suspension began in July 2014 and was still in place at the time of the occurrence; however, RCMSAR was not aware of this information.

1.10 Royal Canadian Marine Search and Rescue training program

The RCMSAR in-house training program includes the following levels: new crew, crew member, advanced crew, and coxswain. To progress from one level to the next, the member must complete training objectives and demonstrate skills described in the SAR management system. The RCMSAR training program uses in-class, on-the-water, and simulator training with a focus on SAR operations to provide members with knowledge about seamanship, navigation, the *Collision Regulations,* SAR, communications, leadership, teamwork, critical incident stress, and management techniques.

1.11 Royal Canadian Marine Search and Rescue management

RCMSAR has various systems and documents in place to manage operations and safety. These include a crew training manual, a readiness framework, a policy manual, SOPs, bylaws, a SAR management system, and a voluntary safety management system (SMS). Several of these systems and documents were carried over from the CCGA-P at the time of the transition in 2012.

22 The conviction was pursuant to section 254(5) of the *Criminal Code*, which was subsequently repealed in 2018 and replaced with section 320.15(1).

1.11.1 Safety management system

The International Safety Management Code is an international standard for the safe management of ships and prevention of pollution. The Code establishes safety objectives and sets out the key elements of an SMS, including

- clearly defined responsibilities, obligations, and authorities for an organization and its vessel operators;
- operating procedures for the vessel and the use of checklists;
- documentation and record-keeping procedures;
- procedures for identifying hazards and managing risks;
- drills, training, and familiarization for vessel crews; and
- a system for self-assessment and improvement.

RCMSAR is not required to follow the International Safety Management Code by regulation, but it had a voluntary SMS that had been carried over from the CCGA-P. The SMS contained, amongst other things, information on marine operations, risk assessment, document control, and incident/accident investigation and reporting. The SMS also contained an instruction that the document was to be reviewed every year. It was last reviewed in 2016.

1.11.1.1 Readiness framework

RCMSAR has a readiness framework that outlines the state of preparedness RCMSAR must maintain to provide SAR services. Headquarters uses the readiness framework to evaluate each station's operating environment and determine the appropriate vessels, training, and operating restrictions. The stations then use the framework to assess their readiness in relation to headquarters' evaluation.

The readiness framework document had been revised since its initial development, but the document had no version date or revision history. Although it was referred to in the SMS, it was not found in the SMS that is available to RCMSAR members.

1.11.1.1.1 Crewing standards

Crewing standards within the readiness framework are intended to ensure enough qualified crew are on board to carry out the responsibilities of navigating, helming, and monitoring the vessel's position.

At the time of the occurrence, the readiness framework indicated that enclosed cabin vessels, such as the *Spirit of Sooke*, must always have a minimum of 3 crew on board, who must meet the following requirements:

- One of the crew must have obtained a coxswain level, hold the required certificates, and have a minimum of 25 hours of sea time in the previous 12 months. The coxswain met these requirements.
- One of the crew must have obtained at least a crew level and have a minimum of 20 hours of sea time in the previous 12 months. The crew member met these requirements.

- One of the crew can be a new crew.

The crewing standards also specify that, to be considered active and current, all certified crew must accumulate 20 hours of sea time within the previous 12 months. Neither of the 2 new crew had accumulated 20 hours of sea time. In August 2019, the readiness framework was updated to require a minimum of 20 hours of sea time for new crew.

One of the new crew had completed the annual fitness test that is required within 6 months of joining RCMSAR. The other was still within the 6-month window of joining and had not yet completed the fitness test.

In addition to the readiness framework, some stations have SOPs for crewing. The Station 37 SOPs indicate that the preferred crewing arrangement for *Spirit of Sooke* is 5 crew on board.

1.11.2 Standard operating procedures

Station-specific SOPs can be developed at the discretion of individual RCMSAR stations and vary widely in number and scope between stations. Stations are prohibited from developing SOPs that contradict information found in any of the documentation used by RCMSAR to manage safety and operations.

At Station 37, there were station-specific SOPs for vessel start-up, shutdown, fuelling, maintaining watertight integrity, towing, crew standards and complement, and the use of personal protective equipment.

Some examples of SOPs from other stations include response to emergency situations and operation of vessel equipment (such as operation of the electronic navigational equipment).

In January 2019, the safety audit team started checking each station's SOPs during ride-alongs to ensure they do not differ from headquarters' guidance.

1.11.3 Search and rescue management system

RCMSAR has a computerized SAR management system that is used to keep track of member and station information. The system contains member contact information and records of each member's sea time (training and missions), classroom training, and certifications. It also contains descriptions of the skills covered by RCMSAR training; resources to assist crew members in obtaining these skills; information about the skills, knowledge, and attitudes that need to be demonstrated to show the skill has been acquired; and the method of evaluation or equivalent.

At RCMSAR, the initialism "SMS" is used to refer to the SAR management system rather than to a safety management system, which is typically what this initialism stands for in marine operations.

1.11.3.1 Crew manual

RCMSAR uses the CCGA-P Search and Rescue Crew Manual as its training manual. The manual provides information about becoming a volunteer crew member and is intended to

accompany a competency-based training program. It provides the knowledge required for volunteers to meet the challenges of becoming a mariner. It includes an overview of volunteer search and rescue operations, as well as sections on personal safety, vessel fitness and safety, electronic communication and record-keeping, practical seamanship, boat handling, as well as foundations of navigation, towing, search, and rescue.

1.12 Royal Canadian Marine Search and Rescue operations

1.12.1 Operational risk assessment

To keep volunteer members safe, RCMSAR's SMS requires crew to conduct an operational risk assessment before each trip and continuously assess and communicate risks throughout a trip so that the crew will make sound, safe decisions. This risk assessment is done with the risk calculation worksheet, which incorporates the Green, Amber, Red (GAR) model. The GAR model is a risk assessment method that results in the following risk ratings for a given voyage: green (low risk: 1–23 points), amber (medium risk: 24–44 points), or red (high risk: 45–60 points). Crew members receive training on the GAR model and must demonstrate they understand it before they can become new crew members. However, the risk calculation worksheet is subjective.

Station 37 had a laminated poster of a risk calculation worksheet for crew members to use in completing risk assessments (Appendix A). To assist crew members in evaluating risk, RCMSAR has 2 other worksheets, both in the SAR management system. These additional worksheets, along with some information found in the SMS, highlight risk considerations that were not included on the laminated poster, as follows:

- **Crew selection**: Direction to assess whether the crew complement exceeds, meets, or does not meet the minimum crew complement. An amber score should be given if there is a moderately poor team/activity match; for example, if a team is 50% unqualified for tasks; somewhat experienced, but with limited time within the unit doing this task; or still developing teamwork management skills. A red score should be given if the crew complement is below the minimum requirement.
- **Crew fitness**: Direction to ensure the crew is physically and mentally capable to undertake the task and to ensure that all have passed the physical fitness test.
- **Environment**: Prompts to consider additional environmental risks, such as the time of day and the vessel's proximity to navigational hazards such as the shoreline.

Before the occurrence voyage, the 4 RCMSAR members completed the risk calculation worksheet using the poster. The result was a score of 20 (green).

At the time of the occurrence, RCMSAR instructors were in the process of reinforcing the importance of completing a risk assessment before voyages. As part of this reinforcement, in January 2019, RCMSAR initiated a new process requiring stations to submit completed risk assessment scores to headquarters for review.

1.12.2 Personal protective equipment

1.12.2.1 Four-point harnesses

The *Spirit of Sooke* has 4 shock-mitigating seats (at the navigation station, the helm station, the communications station, and behind the communications station), as well as 3 bench seats. All of the seats were equipped with 4-point harnesses. At the time of the occurrence, the crew members were not wearing the harnesses. The normal practice at RCMSAR was for crew members to only wear harnesses when the prevailing weather conditions required their use.

The SMS does not mention the use of harnesses. Some RCMSAR stations, including Station 37, have an SOP requiring that seatbelts (harnesses) be worn on vessels with enclosed cabins, such as the *Spirit of Sooke*, when the seas are 1 m or more, or when the wind speed exceeds 30 knots.

If the occupants of a vessel such as the *Spirit of Sooke* are not wearing harnesses and are free to move around within the cabin, then the vessel's centre of gravity moves as well. When the centre of gravity moves, it affects the vessel's righting lever and metacentric height, and thus it affects the vessel's self-righting capabilities. A vessel's self-righting capability is designed to function when the vessel's watertight integrity is maintained and everyone on board is secured in their seats.

1.12.2.2 Helmets

A number of RCMSAR documents refer to the use of helmets. The crew manual and the policy manual indicate that crew members must wear helmets if there is a risk of head injuries. The SMS states that, for vessels with fully enclosed cabins, such as the *Spirit of Sooke*, the coxswain determines whether helmets are required. At the time of the occurrence, the 4 crew members were not wearing helmets, which is the normal practice for Station 37.

1.12.2.3 Audio headsets

The vessel was also equipped with audio headsets, which are intended to allow members to communicate with each other, since it can be difficult to hear one another over the noise of the vessel's engines. In this occurrence, the crew were not wearing headsets, and some of the communication was not clearly heard by all of the crew.

1.12.3 Navigation

Navigation, at its basic level, is a process of creating and maintaining awareness of the position of a moving vessel in relation to its surrounding environment. To navigate safely, operators must use and manage all resources available to them effectively, continuously

monitor the vessel's position, and maintain a safe speed.[23] It is important to configure navigational equipment to optimize the information available to assist with safe navigation and predict the vessel's track. Cross-checking the vessel's position with a second piece of navigational equipment can also help maintain awareness of the vessel's position and identify navigational errors.

The crew manual indicates that all operators must have comprehensive knowledge of and apply the *Collision Regulations*, which are intended to help prevent collisions at sea.

1.12.3.1 Communication

RCMSAR has some specific guidance on communication. The crew manual notes that crew must be in constant communication with the coxswain during a voyage and that communication among all crew members—and especially between the crew members at the navigation and helm stations—must be fluid, continuous, clear, and regimented. The manual also emphasizes the importance of closed-loop communication.

The investigation identified that, in this occurrence and on other RCMSAR voyages, crews had a tendency to relax their adherence to communication protocols.

1.12.3.2 Monitoring

The crew manual notes that one crew member should be assigned to monitor the vessel's navigation by all available means, such as charts, radar, and plotter. The crew member responsible for monitoring should be aware of the intended route and routinely check the vessel's position against it. The SMS requires vessels to develop a passage plan when RCMSAR is assisting CCG on a SAR mission, but not for training exercises. A passage plan requires the development of an intended route and enables crew to monitor the vessel's progress along the plotted route. The SMS also indicates that routes can be used for regular trips that the vessel makes. During the voyage, the SMS requires that logbook entries be made when a vessel's position is confirmed at a specific location.

The crew manual indicates that crew members must also take an active role as lookouts to ensure the safe passage of the vessel. When there is adequate visibility, a lookout can help spot navigational hazards such as debris in the water and other vessel traffic in the vicinity. They can also assist in spotting navigation aids such as buoys and shoreline features. The crew manual notes that at least one member must be designated as a lookout.

In this occurrence, the lookouts' ability to see was affected by darkness, the absence of lit aids to navigation, minimal ambient light, limited sightlines from inside the vessel, and the time required for their vision to adapt after the searchlights were used.

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[23] Transport Canada, CRC c. 1416, *Collision Regulations*, Schedule 1, *International Regulations for Preventing Collision at Sea, 1972, with Canadian Modifications,* Rules 5 and 6, at https://laws-lois.justice.gc.ca/eng/regulations/c.r.c.,_c._1416/ (last accessed on 07 May 2020).

1.12.3.3 Safe speed

Safe speed involves consideration of various factors, including the vessel's current and future location, the geography of the area, weather conditions, visibility, vessel characteristics, nearby traffic, proximity to shore, experience level of the crew, potential for wake damage, and debris in the water. Determining a safe speed relies on the operator's assessment of these factors and judgment of the associated risks. The speed selected should also allow time for effective action to avoid hazards. In some areas, speed is guided by imposed speed limits.[24]

Several RCMSAR documents provide guidance and warnings regarding safe speed. The SMS reminds navigators to proceed at a safe speed in accordance with prevailing conditions and circumstances and to obey the *Collision Regulations*, specifically Rule 6.[25] The policy manual states that the preferred maximum speed for all RCMSAR vessels is 35 knots. The crew manual notes that

- the most important thing to remember when transiting in darkness is to slow down due to lack of visibility;
- excessive speed can degrade crew safety and SAR effectiveness and must be avoided; and
- the chart plotter and radar were not designed for use at high speeds and give the impression that they are displaying information that is more current and accurate than it really is.

The crew manual also refers to situations in which members were thrown from vessels due to high speed collisions. An article within the crew manual, entitled "High Speed Doom," cautions that the speed that SAR vessels are capable of achieving has increased over time and, as a result, there is a tendency to proceed at faster speeds that may not be safe.

At the time of the occurrence, the vessel was travelling at approximately 27 knots (14 m/s).

1.12.3.4 Navigational equipment

1.12.3.4.1 Functionality

The primary electronic navigational equipment used to monitor the *Spirit of Sooke*'s movement and location was the radar and chart plotter. The radar had a variable range marker feature and navigational alarms. The chart plotter was capable of storing waypoints,

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24 Speed limits may be prescribed by harbour authorities, provincial requirements, MCTS, or by an organization's SOPs.

25 Transport Canada, CRC c. 1416, *Collision Regulations*, Schedule 1, *International Regulations for Preventing Collision at Sea, 1972, with Canadian Modifications,* at https://laws-lois.justice.gc.ca/eng/regulations/c.r.c.,_c._1416/ (last accessed on 07 May 2020). Rule 6 states that vessels shall proceed at a safe speed at all times so that proper and effective action can be taken to avoid a collision and so that the vessel can be stopped within a distance appropriate to the prevailing circumstances and conditions.

routes, and tracks and also had navigational alarms. The plotter was capable of displaying the vessel's projected course line but this feature was not enabled.

The crew manual and SMS indicate that crew members must be familiar with all aspects of the navigational equipment, including their capabilities and limitations. Use of the various functions is at the discretion of the navigator. The crew manual notes that a navigator must never rely solely on a single source of information. It also indicates that navigators must be able to navigate without the use of electronic navigational aids. The SMS recommends that pertinent waypoints be entered in the vessel's logbook when the vessel is underway.

It is a navigational best practice for mariners to fully use their navigational equipment and to apply certain functions depending on the situation, such as plotting the vessel's intended route on the chart plotter and verifying the vessel's position against it. The investigation identified that, in this occurrence and at other RCMSAR stations, navigational alarms, routes, waypoints, or course lines were not routinely used because operators find that they clutter the plotter display. These functions were also not used during training exercises.

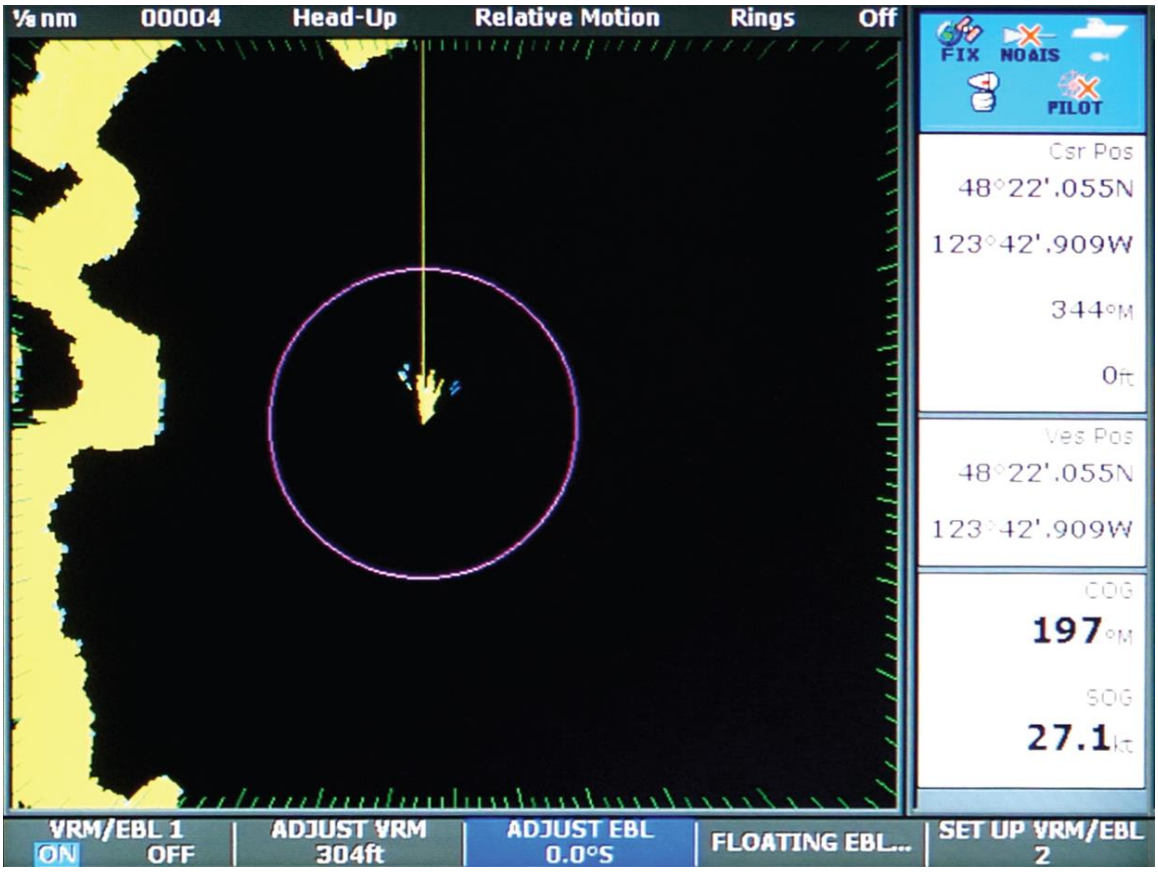
The logbook entries for the occurrence voyage only included the departure time, the crew on board, the arrival time at the fuel dock, and the amount of fuel taken.

1.12.3.4.2 Display modes

The radar and chart plotter displays at the navigation station and the communications station could be configured so that they operated either independently or in a slave mode. When configured to operate independently, the individuals at both stations could adjust the display settings without affecting the other's display. When configured to operate in slave mode, the radar display at the communications station was simply a replica of the display at the navigation station. The SMS states that when the navigational equipment is in slave mode, the member at the second station should not change the display without permission from the navigator. At the time of the occurrence, the radar display was configured in slave mode, which was the typical configuration for this equipment at Station 37.

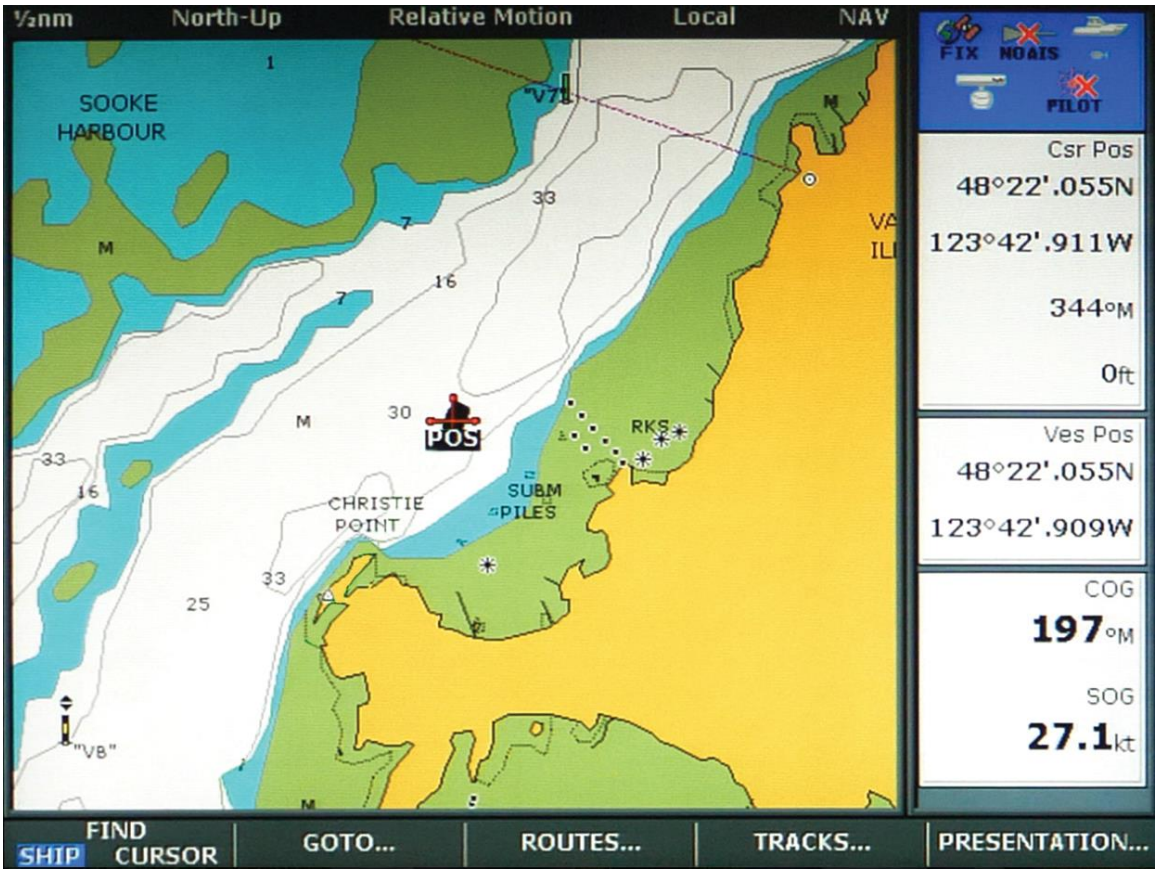
The radar and plotter displays could also be set to different orientations. RCMSAR directs vessels to operate with the radar in head-up mode, which means that the display is oriented so that the vessel is always moving towards the top of the display and the geographical features are oriented around the vessel's direction (Figure 6).

Figure 6. Radar display in head-up mode. The purple ring is a 0.05 NM variable range marker. (Source: TSB screenshots of RCMSAR/CCG simulation videos)



By contrast, RCMSAR directs vessels to operate with the plotter in north-up mode, which means the display is oriented so that north is always located at the top of the display, regardless of the vessel's direction (Figure 7).

Figure 7. Chart plotter display in north-up mode. The vessel icon indicates the direction that the vessel is travelling. (Source: TSB screenshots of RCMSAR/CCG simulation videos)



1.12.3.4.3 Ranges

The range determines the scale and level of detail on the radar and chart plotter displays. It is indicated in the upper left-hand corner of both displays.

On the occurrence voyage, the coxswain followed the instructions in the crew manual for determining an appropriate radar range. The instructions state that, for manoeuvring close to targets, the range is usually reduced to the smallest range that will show the area of interest. The crew manual notes that a good rule of thumb is to keep objects of interest in the outer third of the display. The crew manual also states that the radar should not remain on a set range; instead, the range should be increased to give advance warning and detection of long-range targets and reduced to a smaller scale to monitor targets at close range. The SMS states that the operator should select an appropriate range, observe the display carefully and plot effectively, and ensure that the ranges are changed often enough that targets are detected as early as possible.

After the occurrence, the radar range was found to be 0.125 NM and the plotter range was 0.5 NM.

1.12.4 Searchlights

The vessel has 2 searchlights located on the roof of the cabin, one directly above the navigation station and the other directly above the helm station. The searchlights provide

visibility up to a distance of approximately 80 m. However, at night, they create glare on the cabin windows, which reduces long-range visibility and can affect the crew's night vision for a period following their use, depending on the intensity of the glare.[26] The use of searchlights is left to the discretion of the coxswain. The searchlights are not designed for navigational purposes and can hinder visibility for opposing traffic if used in this manner.

The investigation determined that, given the vessel's speed, if the searchlights had been left on, they would have illuminated Christie Point only about 6 seconds before the vessel made impact. This would not have been sufficient time for the crew to realize what was happening and react to the situation and for the vessel to respond and stop. Furthermore, the crew had not received training in crash stops.

1.12.5 Vessel inspections

At the time of the occurrence, RCMSAR's SMS required pre-departure, weekly, annual, and biennial inspections for station vessels. Individual stations were responsible for addressing deficiencies found during inspections.

Outside of the SMS, RCMSAR had an annual vessel inspection checklist that took precedence over the SMS and removed the need for biennial inspections and audits. The checklist guided station members to look at the following:

- Policy and procedures (adherence to SOPs)
- Organization (incident reporting, annual fitness testing, adequate members)
- Personal protective equipment (use, training, personal flotation devices, helmets)
- Lifesaving equipment (expiry dates on fire extinguishers and emergency position-indicating radiobeacons [EPIRBs], SAR equipment)
- Navigational equipment (radar, plotter, global positioning system, charts, lights)
- Engine space and mechanical systems (fire suppression system)

The annual vessel inspection checklist was last updated in April 2018 as a result of guidance from the readiness framework, which underscored the need to ensure that vessels were inspected in accordance with the checklists and that deficiencies were addressed in a timely manner. The framework introduced the use of a safety audit team to conduct annual safety audits on all stations using the checklist as guidance.

Before the occurrence, Station 37 was last inspected on 28 January 2019 while the *Spirit of Sooke* was alongside the dock. The inspection identified the following deficiencies on the *Spirit of Sooke*:

- All of the *Spirit of Sooke*'s fire extinguishers had expired.
- The fire suppression system required immediate servicing.
- The EPIRB's battery and hydrostatic release unit had expired in 2017.

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26 K.H.E. Kroemer, *Fitting the Human: Introduction to Ergonomics/Human Factors Engineering*, 7th edition (CRC Press, 2017), p. 99.

- One VHF radio did not have a marine mobile service identity number.

Additionally, the inspection noted that the station was in need of more coxswains and had 7 to 8 new members.

Following the inspection and before the occurrence, the EPIRB battery and hydrostatic release unit had been replaced and the fire extinguishers had been serviced. The fire suppression system, which had been identified as requiring immediate servicing, had not been serviced and its operational status was unknown at the time of the occurrence.

1.13 Incident and accident reporting

The TSB's requirements, set out in the *Transportation Safety Board Regulations,* state that

> [t]he operator of the ship, other than a pleasure craft, whether or not they are the owner, the master, the ship's pilot, any crew member of the ship and the harbour master, that have direct knowledge of a marine occurrence must report […] to the Board […].[27]

This requirement is intended to ensure that the TSB is made aware of shipping accidents so that a safety investigation can be pursued, if warranted, in accordance with the TSB's mandate to advance transportation safety.

Although TC treats community-owned vessels as pleasure craft, the TSB's mandatory reporting requirements still apply, and marine occurrences involving these vessels must be reported to the TSB.

TC has similar reporting requirements under the *Shipping Casualties Reporting Regulations*, which state that if

> a ship, or a vessel being towed by a ship, is involved in a shipping casualty, an accident or a dangerous occurrence, the master, any certified officer, operator, member of the crew, pilot or person responsible for the ship, or the vessel being towed, shall report the incident without delay […].[28]

Depending on the severity of the occurrence, TC may investigate for regulatory compliance and/or causal and contributory factors. [29]

CCG also has guidelines that require RCMSAR to immediately advise the Minister of Fisheries and Oceans Canada in writing of any accidents involving its vessels or members,

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27 Transportation Safety Board, SOR 2014/37, *Transportation Safety Board Regulations* (last amended 23 November 2018), section 3, subsection 1, at https://laws-lois.justice.gc.ca/eng/regulations/SOR-2014-37/ (last accessed 07 May 2020).

28 Transport Canada, SOR 85-514, *Shipping Casualties Reporting Regulations* (last amended 01 July 2007), section 4, subsection 1, at https://laws.justice.gc.ca/eng/regulations/SOR-85-514/page-1.html (last accessed 07 May 2020).

29 Subsection 14(3) of the *Canadian Transportation Accident Investigation and Safety Board Act* stipulates that the Board has exclusive jurisdiction that precludes any department from commencing an investigation into a transportation occurrence or continuing one, for the purpose of making findings as to its causes and contributing factors if that transportation occurrence is being or has been investigated by the Board under this Act.

so that the minister can work with RCMSAR to ensure that corrective action is taken to prevent reccurrence.

RCMSAR has a policy on accident reporting and investigation that defines hazardous occurrences as all incidents, accidents, and near-misses that are required to be reported by regulations applicable to the class and type of vessel. RCMSAR also has emergency procedures in the SMS that state a coxswain must contact the Joint Rescue Coordination Centre and one management team member to provide a report in a situation involving the actual or potential loss of life or significant injury to crew, significant damage or total loss of a vessel, or incidents of pollution.

Further, the SMS indicates that, following an accident, an investigation report must be completed and submitted to the station leader. If the accident is considered serious, the station leader conducts an investigation and produces a report. The SMS requires this report to be submitted to the safety officer and the STB chairperson.

The *Spirit of Sooke* grounding was initially reported to TC and the TSB by MCTS in Victoria. RCMSAR later completed the required written report at the request of the TSB.

1.13.1 Lessons-learned reports

Between 2012 and 2018, RCMSAR posted on its internal website "lessons-learned" reports on 9 incidents[30] for station leaders to discuss with their members. These incidents included groundings, collisions, an instance of bottom contact, and an instance in which a crew member fell overboard.

Some of the lessons learned identified in one or more of these occurrences were as follows:

- RCMSAR vessels should always meet the crewing standards for their vessel type.
- RCMSAR vessels should have a crew complement that adequately contributes to all aspects of navigation, communication, helming, and leadership and allows roles to be specific to the crew, not shared or performed simultaneously, if possible.
- Coxswains should be aware of and evaluate competencies and experience of crew based on the mission for which they are being tasked.
- Crew must maintain situational awareness and ensure the plotter is ranged correctly for the vessel's proximity to the shoreline.
- RCMSAR members must strive to maintain constant verbal communication and continuous alertness during operations.
- All crew should be briefed on the intended route before departing so that everyone understands where the vessel is supposed to be going and can speak up if they are concerned about deviations from the plan, as this helps with situational awareness.
- The GAR model risk calculation worksheet must be used properly to evaluate both short- and long-term risks, in order to ensure the safety of the crew and the vessel.

30 Of these 9 incidents, 7 should have been reported to the TSB. Reportable marine transportation occurrences are defined in subsection 3(1) of the *Transportation Safety Board Regulations*.

- RCMSAR members should be familiar with its policies.
- All members must be cognizant of the fundamental safe practices of navigation including safe speed, proper lookout, and the correct plotter range for the vessel's proximity to land.
- RCMSAR vessels should transit at speeds that are appropriate given the conditions and the experience of the crew.
- The multi-function displays must, at all times, be set to the appropriate ranges and display sizes to allow for safe and effective navigation in the prevailing environmental conditions.

1.14 Canadian Coast Guard Auxiliary

Outside BC, the CCGA continues to provides volunteer SAR services to the remaining regions across Canada. The CCGA has approximately 3100 members and access to approximately 900 vessels.[31] Most CCGA volunteers use their own vessels, unlike at RCMSAR, and are usually experienced recreational boaters (Quebec and Ontario) and commercial fish harvesters[32] (New Brunswick, Nova Scotia, PEI, and Newfoundland and Labrador). CCGA also has 27 community-based dedicated response vessels crewed by volunteers.

In 2008, the CCG and CCGA-National jointly established national guidelines to provide coordination and standardization of the 5 CCGA regions,[33] as well as policy and operational direction. The guidelines set out the oversight requirements for the CCGA that existed at that time. Under the guidelines, the board of directors of the CCGA-National was responsible for overseeing the regions for fundraising, management of insurance programs, marketing, policy, administration, and adherence to safe work practices and national training standards.

In 2012, RCMSAR, along with the regional CCGA presidents, voted to downsize the CCGA-National. The CCGA-National budget was reduced by 80%, and the funds were divided up among the CCGA regions, as were CCGA-National's responsibilities under the national guidelines. CCG supported the decision with the understanding that CCGA regions would continue to meet the requirements of the contribution agreement.

Until 2012, the CCG had a department with a manager and staff to manage the CCGA-National, the contribution agreement, the national guidelines, and a national insurance policy. In 2012, when a agency restructuring action plan was put in place by the federal government, these functions were redistributed among CCG staff.

CCG indicates that it continues to play an active role with RCMSAR and the CCGAs. The CCG encourages members to participate in CCG-led training and exercises in order to hone the

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31 Canadian Coast Guard Auxiliary, "CCGA Statistics (Operations)", at https://ccga-gcac.ca/library/?action=category&lcid=85 (last accessed 13 February 2020).

32 Fishing vessel master certificates require at least 365 days of sea service.

33 At that time, the 5 CCGA regions were BC, Ontario, Quebec, the Maritimes, and Newfoundland and Labrador.

skills required for SAR operations. CCG Western SAR participates in quarterly meetings with RCMSAR and has a CCG member on the STB.

1.14.1 Contribution agreement

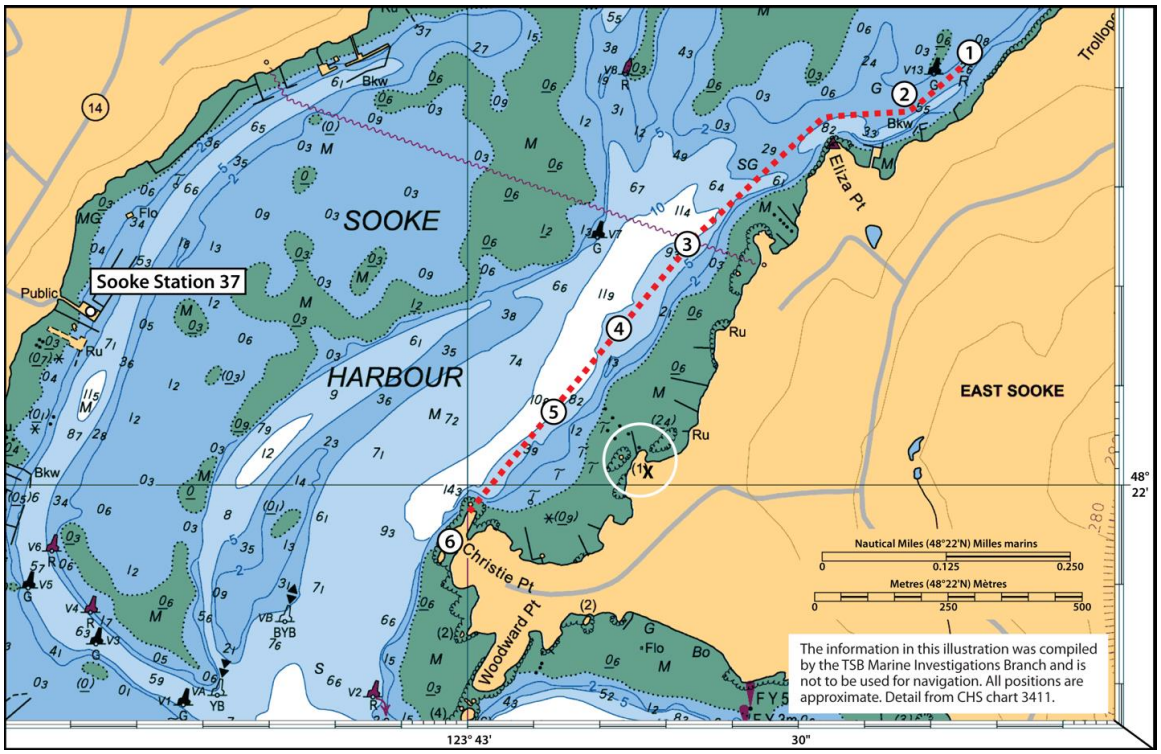
RCMSAR and the CCGA organizations receive funding through a contribution agreement with the Minister of Fisheries and Oceans. Financial assistance is provided by the CCG for costs associated with carrying out authorized activities related to maritime SAR preparedness, operations (response), and other maritime activities in direct support of CCG's mandate. In return, the contribution agreement requires RCMSAR and all CCGA organizations to provide performance indicators (such as number of members, vessels and incident responses), as well as annual business plans, a plan for recruitment and retention of members, and financial statements, among other things.

1.15 Post-occurrence voyage simulations

Following this occurrence, the RCMSAR used its vessel simulator to conduct a series of simulations in an attempt to recreate the occurrence voyage and identify a timeline of the events leading up to the grounding. This was accomplished by putting together the last known position of the vessel, indicated by the vessel's AIS signal, with information collected by RCMSAR.

Examination of the vessel's radar showed that the radar range setting was at 0.125 NM and the display was in head-up mode when the vessel ran aground. The vessel speed and the radar ranges were varied throughout the various simulations for comparison purposes. A simulated vessel track depicts the 1.5 minutes leading up to the grounding, based on a vessel speed of approximately 27 knots (Figure 8).

Figure 8. Simulated vessel track leading up to occurrence (Source: Canadian Hydrographic Service with TSB annotations).



Position	Event
1	Last AIS signal sent before grounding at 2131:53; vessel speed is 14.2 knots
2	Coxswain asks the crew member to select speed and course to return to base
3	Vessel speed reaches approximately 27 knots
4	Vessel is 0.25 NM from Christie Point, and coxswain indicates course is good
5	Vessel is 0.125 NM from Christie Point, and vessel speed is about 27 knots; northernmost tip of Christie Point appears on the radar display
6	Vessel grounds on Christie Point at approximately 2133:30

Figures 9 and 10 show screenshots of the radar display from simulations of the vessel at different positions, with the radar range set at 0.125 NM. RCMSAR noted that the small point of land before Christie Point (marked with an X on Figure 9) appears similar in shape to Christie Point (marked as Position 6 on Figure 10).

Figure 9. Vessel at 0.25 NM from Christie Point; coxswain indicates course is good (Source: TSB screenshots of RCMSAR simulation videos; annotations by TSB)

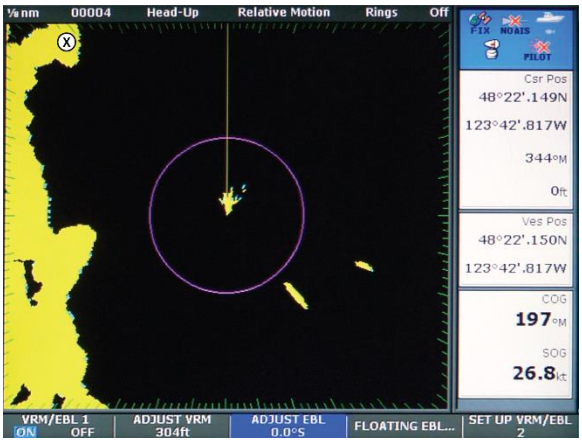


Figure 10. Vessel at 0.125 NM from Christie Point (Source: TSB screenshots of RCMSAR simulation videos; annotations by TSB)

Christie Point would have appeared on the radar display when the vessel was 0.125 NM away from it. When a vessel's speed is 27 knots, it will travel 0.125 NM in approximately 16 seconds.

1.16 Post-occurrence TSB ride-along

As part of the investigation into this occurrence, the TSB went on a ride-along on an RCMSAR vessel identical to the *Spirit of Sooke*. The ride-along took place in daylight, in good weather and sea conditions. The following observations were made:

- The radar scanner took approximately 2.5 seconds to complete a full sweep and update the display.
- A sound-level meter indicated that the noise level in the cabin was 85 decibels when the vessel was travelling at 27 knots; at this level, communication between the members seated at the navigation and helm stations was not clearly audible from the rear seats.
- When the vessel was planing, forward visibility was hindered because the vessel's bow was raised.
- The coxswain was positioned at the forward lookout station throughout the voyage and was monitoring the actions of the members at the navigation and helm stations from this location.
- The radar and plotter at the communications station were configured independently of the navigation station, and the member at the communications station was constantly monitoring the navigation of the vessel and cross-checking its position using different radar and plotter settings from those used by the navigator.
- Closed-loop communication was practised throughout the ride-along.
- None of the members wore helmets, headsets, or harnesses, nor were they required to do so.

1.17 Human performance

1.17.1 Interpretation of cues and construction of mindset

People generally interpret cues from their external environments to develop a mindset and then act largely on the basis of this mindset.[34] For example, when at sea, once a navigator sets the vessel's course toward home, the navigator may interpret information from the environment and navigational equipment as confirmation that the vessel is proceeding in that direction. Information to the contrary usually has to be very compelling for the navigator to recognize a misinterpretation of the situation. Further, once compelling evidence arises, the navigator may not recognize a misinterpretation immediately. Instead, a period of confusion may ensue, during which the navigator mentally sifts through past and present information in order to verify the accuracy of the existing mindset and shift that mindset if warranted.

1.17.2 Premature exit from a task

Once the main goal of a task is achieved, people have a natural tendency to relax their attention on remaining steps associated with finishing the task. In some cases, they may not even complete the remaining steps.[35] This tendency can pose risks when the remaining steps, following the achievement of the main goal, are critical to safety.

For example, consider vessel maintenance that involves replacing an engine part. The main goal is achieved when the new part is installed. However, there are remaining steps required to return the vessel to service. Some of these steps include reconnecting parts that were disconnected to allow access to the engine, checking the functionality of the new part, reinstalling safety items such as cotter pins or lock nuts, conducting critical inspections, and completing sign-out procedures. These remaining steps may be avoided, done hastily, or forgotten altogether. This is especially the case if the person completing these steps does not understand or accept their importance and/or if the person completing the task is not reminded of these steps.[36]

1.18 Organizational and management factors

Factors at the organizational and management levels of an operation can contribute to unsafe conditions, can negatively impact human performance, and can inhibit the proactive identification and mitigation of risk. Gaps in organizational risk management, oversight, and hazard reporting are examples of organizational and management factors that can affect safety. All organizations must strike a balance between safety and operational goals.[37]

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34 S. Dekker, *The Field Guide to Human Error Investigations* (Ashgate Publishing, 2002), pp. 110–113.

35 A. Hobbs and J. Reason, *Managing Maintenance Error: A Practical Guide* (Ashgate Publishing, 2003), p. 46.

36 Ibid., p. 130.

37 J. Reason, *Managing the Risks of Organizational Accidents* (Ashgate Publishing, 1997), pp. 107–124.

1.18.1 Practical drift

Procedures dictate the specific steps that an individual should take to accomplish a task, and practices reflect the way that work is done in day-to-day operations. For inexperienced workers, following established procedures can help compensate for a lack of skill and knowledge. For experienced workers, who may complete tasks from memory, following procedures can help slow down the execution of the task and remind the worker of all the steps needed to complete the task.

Practical drift[38] is a term used to describe a situation in which practices drift away from operational guidance and procedures, and those practices then become routine. In an ideal world, practices and procedures would be identical. However, practical drift can occur for a number of reasons. If procedures do not accommodate the actual conditions facing the worker or organization, workers may modify steps of the procedure to complete the task. If departing from procedures results in immediate and tangible rewards with no obvious negative consequences, these modified steps may become entrenched practices.

Practical drift often occurs incrementally over time and can cause a degradation of safety, usually without workers realizing it. Furthermore, practical drift may be reinforced because other goals are achieved as a result—operations or production continue, money is saved, efficiency is achieved, or organizational goals are met.

1.19 TSB Watchlist

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

Safety management is a Watchlist 2020 issue. Although RCMSAR had a voluntary SMS in place and was taking steps to manage safety through various processes, the investigation identified gaps in the effectiveness of its safety management related to operational reviews, hazard identification and risk mitigation, and document control.

ACTIONS REQUIRED

Safety management will remain on the Watchlist for the marine transportation sector until:

- TC implements regulations requiring *all* commercial operators to have formal safety management processes; and
- Transportation operators that do have an SMS demonstrate to TC that it is working—that hazards are being identified and effective risk-mitigation measures are being implemented.

38 S. Dekker, *Drift into Failure: From Hunting Broken Components to Understanding Complex Systems*. (Ashgate Publishing, 2011), p. 110.

1.20 Previous occurrences

In 2012, the TSB investigated another occurrence involving an RCMSAR vessel. The *Lewis-McPhee* capsized, with 4 crew members on board, during training exercises in Sechelt Rapids, BC, resulting in 2 deaths.[39] Among other things, the report looked at RCMSAR's medical and fitness standards to ensure fitness for duty and organizational oversight of vessel maintenance.

1.21 TSB laboratory reports

The TSB completed the following laboratory report in support of this investigation:

- LP057/2019 – Data recovery – Chart recorders

The radar and chart plotter displays from the navigation station and the communications station were recovered from the *Spirit of Sooke* and sent to the TSB Engineering Laboratory to extract data relevant to the occurrence. However, when the units were powered up, it was found that no waypoints, routes, or tracks had been saved on any of the units.

39 TSB Marine Investigation Report M12W0070.

2.0 ANALYSIS

The investigation determined that the *Spirit of Sooke* ran aground on Christie Point as a result of a combination of factors, including the speed of the vessel, ineffective cross-checking of the vessel's position, and the likely misinterpretation of the radar display. The investigation looked at the organizational and management factors that contributed to risk in Royal Canadian Marine Search and Rescue (RCMSAR) operations. These included safety issues related to operational risk assessments, safe speed, external oversight, fitness for duty, incident and accident reporting, and overall management of safety.

2.1 Factors leading to the grounding and serious injuries

In this occurrence, the crew embarked on a trip to conduct navigation and communications training and included refuelling the vessel, which was the main goal. The crew departed without a plotted route to monitor and cross-check the vessel's position. During the training exercise, crew 1 and crew 2 practised closed-loop communications as they navigated the vessel to the fuel dock. After departing the fuel dock, during the return voyage to Sooke Station 37, the crew relaxed their adherence to operational guidance for navigation, resulting in helm orders that were informal and communication that was not closed-loop. The return trip was therefore conducted in a less formal manner, which is consistent with a natural tendency to relax attention on remaining steps once the main goal has been completed. The coxswain took on all the navigational responsibilities, and the 2 new crew were assigned as lookouts, based on their experience levels. The roles were assigned to the crew in such a manner that there was no experienced crew member available to actively monitor the vessel's position and detect navigation errors.

On the return voyage, the searchlights were initially on, allowing the crew to navigate visually. During this time, the vessel was travelling at a slower speed, and the crew verbally acknowledged passing certain shoreline features and navigational buoys. The searchlights were turned off just after the vessel passed buoy V13.

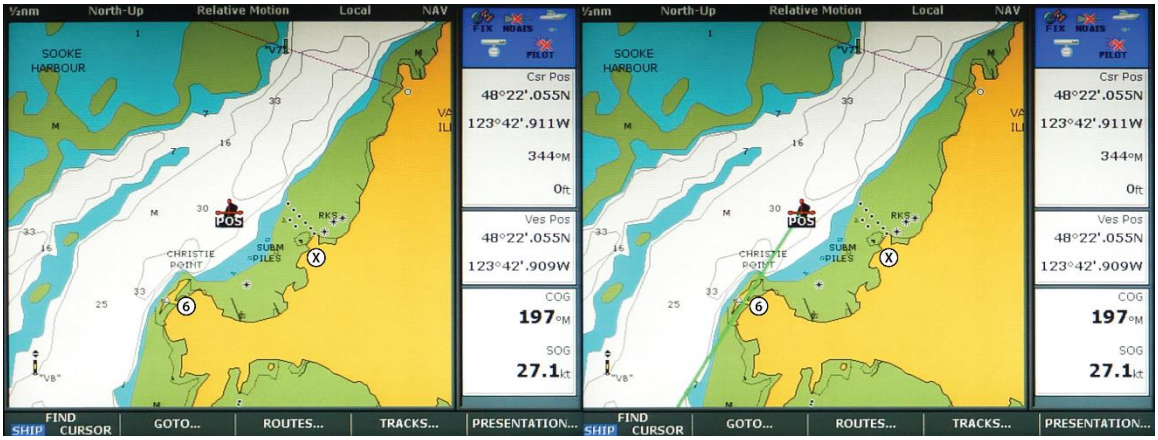
When the vessel rounded Eliza Point, neither the chart plotter nor the radar were on a range setting that showed the coastal features leading to and including Christie Point on the displays. The lookout was unable to see Christie Point because of the darkness and various other factors.

It was the coxswain's understanding that he was operating the radar at a range of 0.25 nautical miles (NM), but the radar was likely inadvertently left set to 0.125 NM. This may have also contributed to the misinterpretation of the radar screen because, on a 0.25 NM range setting, Christie Point would have come into view on the radar screen sooner than it did on a 0.125 NM range setting. As the vessel approached Christie Point, the coxswain's interpretation of the radar screen was that the vessel was on a good course to clear it, which suggests that the coxswain may have misinterpreted the unnamed point as being Christie Point.

The coxswain consulted the chart plotter to cross-check the vessel's position. However, the plotter's usefulness was impeded because the course line, which projects the vessel's course into the future, was not enabled (Figure 11), and the orientation of the plotter differed from that of the radar. Because a plotted route and effective cross-checking of the vessel's position were not done, the likelihood of detecting that the vessel's course was not clear of Christie Point was reduced. Figure 12 shows what the chart plotter would display with the vessel's course line enabled.

Figure 11. Chart plotter with vessel's course line not enabled (Source: TSB screenshots of RCMSAR simulation videos; annotations by TSB)

Figure 12. Chart plotter with vessel's course line enabled (Source: TSB screenshot of RCMSAR simulation videos; annotations by TSB)



When Christie Point became visible on the radar display, it likely did not conform to the coxswain's understanding of the vessel's position and probably caused momentary confusion. Given the speed of the vessel and the time required for the radar and the chart plotter displays to update, the vessel was even closer to Christie Point than indicated by the navigational equipment. Once the impending grounding was detected, there was insufficient time to respond, given the vessel's high speed.

The sudden reduction in speed upon impact, combined with the vessel launching into the air and landing stern-first, resulted in the crew members being thrown around the cabin in a violent manner. All of the crew members sustained serious injuries, in part because they were not wearing harnesses or helmets when the vessel grounded. One of the crew members' injuries were serious enough to require evacuation by air ambulance.

2.2 Operational risk assessment

Effective operational risk management is important in all organizations, but especially in organizations that rely primarily on volunteers with limited marine experience to carry out safety-critical tasks. Risk assessments are standard pre-departure measures in many safety-critical operations and can proactively identify hazards and help manage risks, increasing awareness and safety.

Before departure, the coxswain led the crew through a risk assessment using the risk calculation worksheet poster at Station 37. The poster available to the crew was a simplified

version. Two other more comprehensive versions of the risk calculation worksheet were in the RCMSAR search and rescue (SAR) management system. The simplified version did not include prompts to consider some of the hazards that were underlying factors in this and other RCMSAR incidents and accidents. Some of these prompts included time of day, the vessel's proximity to navigational hazards such as the shoreline, the crew complement, and the crew's fitness for duty (aside from fatigue). None of the 3 versions of the risk calculation worksheet included a prompt about speed, despite warnings elsewhere in RCMSAR guidance about the effects of high speeds on the accuracy of electronic navigational equipment.

As a result, the crew was not prompted to explore common hazards and their risks on the occurrence trip. Some risks that were not identified and mitigated included

- the effect of darkness on the lookouts' ability to see obstructions to navigation,
- lack of an experienced crew member to monitor navigation, and
- reduced time to react while travelling at high speeds in a narrow channel.

Clear and comprehensive guidance and training for risk assessment is important at RCMSAR because members are volunteers who may not have the experience necessary to anticipate hazards that they may encounter. The risk calculation worksheet involves all members, regardless of experience level, and weights their assessment of operational risk equally. However, inexperienced members may have little background on which to base their risk scores and may be influenced to follow experienced members in deciding on scores.

Crew are generally focused on carrying out a mission or training exercise when they complete the risk calculation worksheet, which is not conducive to assigning a score higher than green (low risk), as this could delay the voyage. Once a green score is obtained, members may be less likely to continuously identify hazards throughout the voyage because of a sense that the entire voyage has already been determined to be safe. As a result, new hazards that may arise on the return trip may not be identified.

The investigation determined that in January 2019, just prior to the occurrence, RCMSAR had started reviewing risk calculation worksheet scores. Prior to January 2019, the scores were not reviewed to ensure that the assessments were accurately carried out, which limited the organization's ability to manage risk and identify differences in risk assessments across crews and stations.

If risk assessment guidance does not prompt consideration of hazards and/or the risk assessment process is not monitored to ensure consistent application, there is a risk that hazards will go unidentified and/or risks will be assessed inaccurately.

2.3 Safe speed

Selecting speed requires a navigator to perceive and constantly assess a number of variables (visibility, capability of electronic navigational equipment, experience level of the

crew, proximity to navigational hazards) and understand their implications on navigational safety.

At the time of the occurrence, the speed of the vessel was generally consistent with normal station practice for the prevailing conditions. However, the speed of 27 knots limited the time available to respond to navigational hazards and contributed to the severity of the injuries. In addition, at this speed, the information displayed on the radar and chart plotter lagged behind the vessel's actual position. Inappropriate radar and chart plotter range settings in use at the time meant the lag was more pronounced, creating an unsafe condition during nighttime navigation, which is based primarily on electronic navigational equipment. Excessive speed has been found by RCMSAR to be a contributing factor in several previous accidents.

Over the years, the speeds at which SAR vessels are capable of travelling have increased as a result of technological advancements in vessel design. The Canadian Coast Guard Auxiliary (CCGA) crew manual had identified safety concerns about these increased speed capabilities and the selection of safe speed as early as 2002. Despite this, coxwains have discretion in selecting safe speed, with limited guidance on what constitutes safe speed in various conditions. In this case, the coxswain had minimal marine experience aside from RCMSAR training and mission sea time. Leaving safe speed selection solely to the judgment of crew without adequate guidance may therefore have safety implications, given that awareness of safe speed tends to develop over time with experience at sea in different situations and conditions.

If organizational guidance is not sufficiently detailed to assist crews in determining safe speed and account for the experience of the crew, there is a risk that the speed selected may not be appropriate for prevailing conditions.

2.4 Fitness for duty

Ensuring that mariners are fit for duty is an important aspect of safety in marine operations. An unfit mariner on a vessel poses risks to their own personal safety, to that of other crew and passengers on board, and to the safe operation of the vessel.

RCMSAR's bylaws require all operational members to be fit and able to perform the activities for their role at RCMSAR. Although members are not required to undergo a marine medical examination, RCMSAR has various screening steps and policies to assess and manage volunteer suitability and fitness:

- an annual fitness test;
- applicants' self-assessment of whether participation in any SAR activity would be hazardous to their health due to medical conditions, disabilities, or diseases;
- an alcohol and drug policy; and
- requirements for members to undergo criminal record checks and disclose criminal convictions.

The investigation determined that the coxswain had been prohibited from driving a motor vehicle due to a Criminal Code conviction. The prohibition began in July 2014 and was still in effect at the time of the occurrence. RCMSAR policy requires members to undergo a one-time criminal record check and disclose subsequent criminal convictions. The coxswain had not disclosed his conviction, and RCMSAR did not have any other process in place to check if members have Criminal Code convictions after the initial check. As a result, RCMSAR was unaware of the coxswain's conviction.

Within the first 6 months, new members must complete a fitness test focused on operational tasks. The investigation also revealed that one crew member had been a member for 2 months and had not yet completed the annual fitness test.

If an organization's process for determining volunteers' continued suitability and fitness for duty is inadequate, there is a risk that they will not be qualified or fit to perform their required duties.

2.5 Occurrence reporting

When a marine incident or accident occurs, it is important that all necessary internal and external authorities be notified. Not only does occurrence reporting initiate an appropriate emergency response, but it also facilitates other safety-related activities, including occurrence investigations and statistical data-gathering to track accident trends and patterns.

RCMSAR requires members to report internally accidents, incidents, hazardous occurrences, near-misses, or incidents of pollution. The Canadian Coast Guard (CCG) requires RCMSAR to report marine accidents. The TSB requires RCMSAR vessels to report marine occurrences, since their operations are not pleasure in nature. Transport Canada (TC) requires commercial vessels and, under certain circumstances, pleasure craft as well, to report marine occurrences.

The total number of occurrences that RCMSAR has had in past years could not be determined because RCMSAR does not have data that are consolidated and readily available, nor are these occurrences reported externally. However, between 2012 and 2018, RCMSAR posted 9 "lessons-learned" reports related to occurrences on its internal website. All but 2 of the occurrences were reportable[40] to the TSB by regulation, but none had been reported to the TSB.

The investigation identified that RCMSAR's lack of occurrence reporting to TSB may have resulted from ambiguity created by TC's policy for community-owned, CCGA-operated vessels. This policy states that all such vessels (including RCMSAR vessels) are to be treated as pleasure craft, and the TSB does not require pleasure craft to report marine occurrences.

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40 Reportable marine transportation occurrences are defined in subsection 3(1) of the *Transportation Safety Board Regulations* (last amended 23 November 2018), at https://laws-lois.justice.gc.ca/eng/regulations/SOR-2014-37/ (last accessed 07 May 2020).

Although TC treats community-owned vessels as pleasure craft, the TSB's mandatory reporting requirements still apply, and marine occurrences involving these vessels must be reported to the TSB. TC has confirmed that it was not its intent, when treating these vessels as pleasure craft, to imply that they are exempt from the TSB's reporting requirements.

Before this occurrence, RCMSAR operational staff were not aware that the TSB's reporting requirements applied to RCMSAR vessels. The *Spirit of Sooke* grounding was reported to TC and the TSB by Marine Communications and Traffic Services in Victoria. A marine occurrence report was submitted on 24 February 2019 at the TSB's request.

The lack of occurrence reporting to CCG may be related to the redistribution of the responsibilities that originally fell under the CCG department that managed the administrative functions related to the national CCGA guidelines, which include accident reporting requirements. When this department ceased to exist, occurrence reporting appears to have ceased as well. The CCG in the Pacific region has not received any recent occurrence data from RCMSAR.

When occurrences occur, formal and clear reporting requirements are imperative. Furthermore, TC or TSB can conduct their investigations only if occurrences are reported.

If organizations do not report marine occurrences to the appropriate authorities, opportunities to advance transportation safety may be lost.

2.6 External safety oversight

External safety oversight of an organization is performed by an entity outside the organization that is responsible for ensuring that safety-related regulations, standards, operating procedures, and work practices are being implemeneted effectively. For many vessels, this function is fulfilled by TC, although it can also be fulfilled by other federal/provincial regulators or third parties.

The 2004 TC policy that community-owned, CCGA-operated vessels are treated as pleasure craft exempts them from TC's commercial vessel oversight, providing they do not undertake any operations that could be considered non-pleasure in nature, apart from assisting CCG with SAR operations. However, many of the tasks involved in missions are more commercial than pleasure, such as conducting towing operations and transporting or recovering casualties.

The policy was introduced to reduce the financial burden on volunteer SAR operations while maintaining a level of safety appropriate for the operations involved. The policy was required to be reviewed 24 months after its approval and every 3 years thereafter. The investigation determined that the policy has never been formally reviewed. However, there have been substantial changes to volunteer SAR services in Canada since the implementation of the policy. For instance, in 2012, the CCGA-National budget was reduced, the CCG department with oversight duties relating to CCGA operations was eliminated, and the Canadian Coast Guard Auxiliary-Pacific (CCGA-P) became RCMSAR. At this time, RCMSAR began using more community-owned vessels operated by volunteers, and the

profile of the volunteers in the Pacific region changed as a result of the RCMSAR program design. Finally, in 2017, RCMSAR began providing services to Emergency Management BC while also maintaining 24-hour, 7-day availability to CCG. Without regular reviews of the policy, TC has missed opportunities to verify whether volunteer SAR auxiliaries continue to meet the definitions of the policy and maintain an appropriate level of safety for the operations involved.

The CCG is another federal agency with external oversight capabilities for the CCGA. Until 2012, the CCG had a department to manage the CCGA-National, the contribution agreement, and the national guidelines. However, in 2012, the responsibilities of this department were redistributed among CCG staff.

CCGA-National had responsibilities for safety oversight and was ensuring that the CCGAs were adhering to safe work practices and national training standards. However, the CCGA-National budget was reduced by 80%, and the funds were divided up among the CCGA regions, as were CCGA-National's responsibilities under the national guidelines.

Although CCG maintains a close working relationship with CCGAs, it does not provide external safety oversight. One form of external safety oversight is regular, mandatory, and systematic safety audits that compare operational practices with applicable regulations, standards, and procedures to identify any safety gaps. Safety audits should be documented and should result in the planning and implementation of corrective action to address any safety gaps identified. Once the corrective actions have been implemented, their effectiveness should be evaluated as well.

External safety oversight is important to ensure the safety of volunteer SAR members at all times, as volunteers can face missions in harsh environmental conditions and involving tasks that are physically and mentally demanding. However, at present, there is no external body providing safety oversight of RCMSAR.

If external safety oversight of volunteer SAR operations is not adequate, there is a risk that safety gaps will be missed and essential guidance to maintain and improve operational safety will not be provided.

2.7 Safety management

Safety management requires an organization to be cognizant of the hazards involved in is operations and to manage the resultant risks. A safety management system (SMS) can help to ensure that members at all levels of an organization have the knowledge and the tools to manage risk effectively, as well as the necessary information to make sound decisions in all operating conditions, routine and emergency.

In 2016 RCMSAR voluntarily implemented the CCGA-P SMS. The investigation found some gaps in operational reviews, processes for hazard identification and risk mitigation, and documentation control.

2.7.1 Operational reviews

Reviewing and evaluating operational processes is a key element of an SMS that helps organizations ensure compliance with their own policies and procedures, mitigating practical drift. In this occurrence, the investigation found that, on the routine return trip, the crew relaxed their adherence to operational guidance for navigation. This was viewed as normal by the coxswain and helmsmen, but not by the new crew members, who expected guidance to be followed for all on-water activities. The more experienced crew members' perception that the practice was normal suggests that practical drift may have been a factor. Departures from the guidance had become the norm and were reinforced by incident-free voyages, although the margin of safety was, in fact, decreased. The investigation determined that this practical drift with respect to navigation was evident on other RCMSAR voyages as well.

Reviewing and evaluating operational processes is especially important in volunteer organizations, which often face additional challenges with compliance because volunteers have varying motivations, degrees of experience, and commitment, as well as high turnover rates. Because practical drift tends to happen unconsciously over time, it is unlikely to be identified by crew members. A ride-along by an evaluator may be one way to verify the crew's compliance with prescribed guidance. RCMSAR is currently initiating ride-alongs by evaluators for all of its stations.

2.7.2 Hazard identification and risk mitigation

Another key element in an SMS are processes to proactively identify hazards and mitigate risks, at both the operational and organizational levels. RCMSAR does require operational risk assessments before each voyage using the GAR model. However, a review of RCMSAR's SMS did not identify formal organizational-level risk assessments. These are normally focused on the organization's processes to prevent accidents and, if they do happen, to prevent recurrences. Such assessments also help organizations to identify gaps in safety management (such as missing procedures, inconsistent documentation, areas of practical drift, operational hazards) and to anticipate risks when making decisions and implementing new processes.

Organizational risk assessments can be triggered by incidents or accidents, which prompt management to look for underlying factors and take action to mitigate risks. RCMSAR does have a process for creating "lessons-learned" reports following certain incidents and accidents. These lessons-learned reports were posted on RCMSAR's internal website for station leaders to discuss with their members. A review of the 9 lessons-learned reports since 2012 indicate causes, contributing factors, and safety deficiencies similar to those in this occurrence, suggesting that action taken to address the safety deficiencies was ineffective.

While analyzing accidents for lessons learned is important, analyzing identified hazards and near-misses is equally important for effective safety management. Organizations must therefore have a process for reporting and tracking hazards and near-misses. A review of

RCMSAR's SMS did not identify any formal hazard identification and mitigation process. Without a such a process, RCMSAR may be missing an opportunity to learn from hazards and near-misses in its operations.

2.7.3 Document control

Consistent, well-organized, and up-to-date documentation is another key element of safety management. A review of RCMSAR's documents identified a number of issues relating to document control. Among these were the following:

- Guidance information is found in various documents, making it difficult to quickly find all of the relevant guidance on a particular topic (for example, guidance on safe speed is found in the crew manual, the SMS, and lessons-learned reports).
- There are various versions of documents (for example, 3 versions of the risk calculation worksheets, each with different prompts and information).
- Many documents still contain references to CCGA-P and CCGA, making it difficult to identify sections that are relevant to RCMSAR. (For example, the crew manual has many references to CCGA and terminology from CCGA-P.)
- Some documents are referred to by different names, do not contain version dates or records of updates and are not included in the SMS.

The investigation also identified an issue with the tracking of crew training in the SAR management system. After the transition from CCGA-P in 2012, RCMSAR increased the training requirements for crew. Existing members were exempted from having to complete these additional training requirements. However, these additional training requirements still populated on the training profile for existing members, showing that the requirements were incomplete and making it unclear what training had been completed by members.

Ultimately, safety management responsibilities start at the top of an organization. Those at the top are better placed to identify inconsistencies and safety issues that may appear only when looking at operations as a whole, as opposed to individuals like station leaders, who only see what is going on at their own station. For example, the investigation identified that the some stations have the navigational equipment slaved and some have the navigational equipment configured independently. The investigation also identified that some stations have fewer SOPs than others and that there were inconsistency in practices between stations.

At RCMSAR, there are no formal organizational-level risk assessments, and many of the safety management duties fell to the individual station leaders. Station leaders are volunteers whose roles and responsibilities are substantial, with many of them safety-critical and similar to those of shore-side safety personnel in a commercial marine operation. For example, at Station 37, one of the station leader's responsibilities is ensuring the vessel is ready for operation at all times. However, during an external vessel inspection, 2 safety-critical deficiencies related to the fire extinguishers and emergency position-indicating radiobeacons were identified. Because the RCMSAR program uses volunteers to carry out safety-critical tasks, there is a strong need for effective safety management.

If safety management does not include operational reviews, formal processes for hazard identification and risk mitigation, as well as effective documentation control, organizations may experience safety gaps that increase risk in their operations and undermine their efforts to operate safely.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. The crew relaxed their adherence to operational guidance for navigation, resulting in helm orders that were informal and communication that was not closed-loop.

2. There was no experienced crew member available to actively monitor the vessel's position and detect navigation errors.

3. It was the coxswain's understanding that he was operating the radar at a range of 0.25 nautical miles, but the radar was likely inadvertently left set to 0.125 nautical miles, which may have contributed to the misinterpretation of the radar screen.

4. As the vessel approached Christie Point, the coxswain's interpretation of the radar screen was that the vessel was on a good course to clear it, which suggests that the coxswain may have misinterpreted the unnamed point as being Christie Point.

5. Because a plotted route and effective cross-checking of the vessel's position were not done, the likelihood of detecting that the vessel's course was not clear of Christie Point was reduced.

6. Once the impending grounding was detected, there was insufficient time to respond and avoid it, given the vessel's high speed.

7. All of the crew members sustained serious injuries, in part because they were not wearing harnesses or helmets when the vessel grounded.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If risk assessment guidance does not prompt consideration of hazards and/or the risk assessment process is not monitored to ensure consistant application, there is a risk that hazards will go unidentified and/or risks will be assessed inaccuately.

2. If organizational guidance is not sufficiently detailed to assist crews in determining safe speed and account for the experience of the crew, there is a risk that the speed selected may not be appropriate for prevailing conditions.

3. If an organization's process for determining volunteers' continued suitability and fitness for duty is inadequate, there is a risk that they will not be qualified or fit to perform their required duties.

4. If organizations do not report marine occurrences to the appropriate authorities, opportunities to advance transportation safety may be lost.

5. If external safety oversight of volunteer SAR operations is not adequate, there is a risk that safety gaps will be missed and essential guidance to maintain and improve operational safety will not be provided.

6. If safety management does not include operational reviews, formal processes for hazard identification and risk mitigation, as well as effective documentation control, organizations may experience safety gaps that increase risk in their operations and undermine their efforts to operate safely.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. The lookouts' visibility was affected by darkness, no lit aids to navigation, minimal ambient light, limited sightlines from inside the vessel, and the insufficient time for the lookouts' vision to adapt following the use of the searchlights.

2. If the searchlights had been left on, given the vessel's speed, they would have illuminated Christie Point only about 6 seconds before the vessel made impact, which would have provided very little time for corrective action. The searchlights being off at the time of the occurrence was therefore not considered a causal factor.

3. A vessel's self-righting capability is designed to function when the vessel's watertight integrity is maintained and all those on board are restrained in their seats; however, it is not the practice of RCMSAR crew to wear harnesses unless required by prevailing weather conditions.

4. When the vessel is proceeding at high speeds, communication between members seated at the navigation and helm stations is not clearly audible from the rear seats.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Royal Canadian Marine Search and Rescue

Immediately following the occurrence, operations at Station 37 ceased. Royal Canadian Marine Search and Rescue (RCMSAR) has since implemented a return-to-operations plan for Station 37. This included refresher training sessions for coxswains, with regular self-checks and discussions with leaders throughout the process. The training sessions included an evaluation of skills in vessel-simulator scenarios, a review of leadership/decision making, presentations on situational awareness and positive control, and 2 on-the-water training sessions with a focus on navigational communications, emergency procedures, and electronic navigation. All of the coxswains at Station 37 have completed the refresher training.

4.1.2 Transportation Safety Board of Canada

In August 2019, the TSB sent Marine Safety Information Letter 01/20 to RCMSAR to clarify the confusion around whether the TSB's mandatory marine occurrence reporting requirements applied to RCMSAR and Canadian Coast Guard Auxiliary (CCGA) vessels. Although Transport Canada (TC) treats community-owned vessels as pleasure craft, the TSB's mandatory reporting requirements still apply, and marine occurrences involving these vessels must be reported to the TSB. As well, TC requires these vessels to be registered as commercial vessels. TC has confirmed that it was not their intent, when treating these vessels as pleasure craft, to imply that they are exempt from the TSB's reporting requirements.

RCMSAR responded to the letter and indicated that it had reviewed its procedures and had started the process of ensuring that all reportable marine occurrences are reported to the TSB. RCMSAR also implemented a plan to ensure that all its vessels are registered with TC as commercial vessels with TC by the end of 2020.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 16 December 2020. It was officially released on 14 January 2021.

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 – Risk calculation worksheet for calculating risk using the green, amber, red model

Risk Calculation Worksheet

Calculating Risk Using the Green - Amber - Red Model

Assign a risk code of 0 (For no risk) through 10 (For maximum risk) to each of the 6 elements below

Supervision

- Coxswain experience level
- Is Coxswain able to effectively oversee all crew and focus on mission?

Total

Planning

- Is the on-water objective clear?
- Have you had time to effectively plan the evolution or task at hand?

Total

Crew Selection

- How experienced are the crew being used for this event or activity?
- Do crew have the qualifications or certifications for the activity or event?

Total

Crew Fitness

- Are any members tired?
- Are any members fatigued from work, family, lifestyle?
- Are members suffering from lack of quality sleep?

Total

Environment

- Do the environmental conditions pose any increased risk to crew? (e.g - stormy, fog, rain, sea and wind conditions)
- Any possibile exposure to chemicals, smoke, fire, toxicity or possible injuries to crew?

Total

Event / Activity

- Is the event or activity complex?
- Has the crew handled this type of event or activity before?
- Is it a short event or a long event?

Total

TOTAL RISK SCORE:

0-23 Score GREEN ZONE (Proceed)	24-44 Score AMBER ZONE (Caution)	45-60 Score HIGH RISK ZONE (Stop)

If the total risk value falls in the **GREEN ZONE** (0-23), the risk is rated as low. If the total risk value falls in the **AMBER ZONE** (24-44), risk is moderate and you should consider adopting procedures to minimize the risk. If the total value falls in the **RED ZONE** (45-60), you should implement measures to reduce the risk prior to starting the on-water activity or **DO NOT GET UNDERWAY.**

ROYAL CANADIAN MARINE SEARCH & RESCUE

Source: Royal Canadian Marine Search and Rescue