

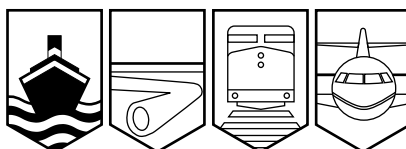
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

MARINE INVESTIGATION REPORT

M99C0027



GROUNDING

**PRODUCT CARRIER “SUNNY BLOSSOM”
ENTERING THE CORNWALL CHANNEL,
ST. LAWRENCE SEAWAY
16 JULY 1999**

Canada

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

Marine Investigation Report

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St. Lawrence Seaway
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Report Number M99C0027

Summary

The “SUNNY BLOSSOM” was upbound towards Cornwall in daylight and in clear weather. An apprentice pilot had the conduct of the vessel and a pilot was also in the wheel-house. Upstream of buoy DCB and to the south of the Cornwall channel, the vessel ran aground. Two days later, assisted by two tugs, the vessel was refloated and brought to the quay at Cornwall. The grounding caused neither damage to the vessel nor pollution.

Ce rapport est également disponible en français.

Other Factual Information

“SUNNY BLOSSOM”	
Port of registry	Nassau
Flag	Bahamas
Official number	715942
Type	Product Carrier
Gross tons ¹	11 598
Length	160.8 m
Draught	Forward: 7.88 m Aft: 7.65 m
Built	1986, Minami-Nippon Usuki, Japan.
Propulsion	Mitsui B&W diesel, 5146 kW, driving a fixed-pitch propeller
Number of crew	23
Registered owner	Yellow Fin Shipping Co. Ltd., Gibraltar
Ship manager	Laurin Maritime (America) Inc., Houston, Texas, USA
Cargo	14 365 tonnes of caustic soda

Description of the Vessel

The “SUNNY BLOSSOM”, an ocean-going vessel with accommodation and machinery space aft, has been calling at Canadian and United States ports on the Atlantic coast and in the Great Lakes for several years. The vessel is crewed, equipped and certificated as required by current regulations. In addition to having the required navigational equipment, the vessel was recently fitted with an electronic chart system but it was not yet operational.

Personnel

The master and the officer of the watch (OOW) were certificated to the standard required for a vessel of the size of the “SUNNY BLOSSOM” and for the type of voyage being made.

The pilot is the holder of a pilotage licence from the Great Lakes Pilotage Authority (GLPA), issued in 1976. He also possesses a Certificate of Competency as Master, Local Voyage (formerly Inland Waters).

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

The apprentice pilot is the holder of a Certificate of Competency as mate, intermediate voyages, issued in 1994. In October 1998 the apprentice pilot commenced an apprenticeship with the GLPA.

History of the Voyage

At 0908 eastern daylight time,² on 11 July 1999, the “SUNNY BLOSSOM” sailed from Saint John, New Brunswick, with a cargo of 14 365 tonnes of caustic soda for discharge at Cornwall, Ontario. The draughts on sailing were 7.5 m forward and 7.98 m aft.

After an uneventful voyage up the St. Lawrence River, the vessel entered the first lock in the St. Lawrence Seaway at St. Lambert, Quebec, where, at 0120 on July 16, a change of pilots took place. The pilot who boarded was familiar with the “SUNNY BLOSSOM”, and had piloted the vessel on several occasions. Although the draughts were recorded by Seaway personnel at St. Lambert lock as 7.92 m forward and 7.65 m aft, the pilot did not request them nor was he informed of them at this time.

On passage upbound from the lock at St. Lambert, while passing the Mercier Bridge, the pilot reported to Seaway Beauharnois by very high frequency (VHF) radio. Shortly afterwards, Seaway Beauharnois informed the pilot that a relief, who had been expected to board at Beauharnois lock No. 4 at about 0800, would not be available until 1600. At the same time, the pilot was informed that an apprentice pilot would board at Beauharnois lock No. 4. As he had the right to do according to current practice, the pilot decided on the spot to continue with the conduct of the vessel from lock No. 4 to Cornwall and informed Seaway Beauharnois of his decision.

During the transit towards Côte St. Catherine lock, the pilot noted that steering the vessel was more difficult than usual and remarked on this to the master. The pilot was informed at this time by the master that the vessel was trimmed 10 cm by the head. The pilot did not request that the trim by the head be reduced.

At about 0800 the “SUNNY BLOSSOM” left Beauharnois lock No. 4. The apprentice pilot had boarded at the lock. The apprentice pilot informed the pilot that, according to the lockmaster, the vessel’s draughts were 7.88 m forward and 7.65 m aft. The trim by the head was now confirmed as 23 cm. The pilot handed over the conduct of the vessel to the apprentice pilot, at the same time giving the warning that the vessel was not steering well—probably due to the trim by the head.

This was not the apprentice pilot’s first experience on the “SUNNY BLOSSOM”; the apprentice pilot had piloted the vessel on four previous occasions, twice upbound and twice downbound, the last trips being from Cornwall on June 10 and June 11.

² All times are eastern daylight time (coordinated universal time minus four hours).

Upbound to Cornwall, the vessel's conduct was shared, in turns, by the pilot and the apprentice pilot. When the apprentice pilot had the conduct of the vessel, the pilot remained in the wheel-house.

At about 1115 the master informed those on the bridge that, to correct the trim by the head, the afterpeak had been ballasted. An entry in the vessel's log book was made to the effect that 100 tonnes of ballast had been taken on in the afterpeak. However, the pilots did not notice any difference in the vessel's manoeuvrability.

At about 1140 the vessel was approaching buoy D82. The apprentice pilot resumed the conduct of the vessel for the Cornwall channel and to bring the vessel alongside. The maximum permitted speed over the ground in these waters is 8.5 knots.³ The vessel's speed was kept between 8 and 8.5 knots by varying the engine telegraph between "half ahead" and "full ahead." The current against the ship was about two knots and parallel to the channel. Visibility was good and there was a light wind from the south-southwest.

On the bridge at this time were the master, the OOW, the helmsman, the pilot and the apprentice pilot. The OOW carried out the pilots' engine telegraph orders. He also charted the vessel's position about every six minutes when his services were not required at the telegraph. The pilot was on the port side of the wheel-house and was looking forward. The apprentice pilot was standing amidships near the window and the gyro-compass repeater. The helmsman was at his post and carrying out helm orders. According to the pilot and the apprentice pilot, the helmsman did not always repeat the helm orders given to him before carrying them out and, when he did so, did not speak up loudly. Although the helmsman had been at the steering position for more than three hours, none of the officers had seen fit to ensure a correct response to orders.

About 1150 the master left the bridge to quickly eat something before the vessel started docking manoeuvres. At this time the vessel was steering 241°(G) on Cornwall Island leading marks. The gyro error was about 1° high. The apprentice pilot called Seaway Eisenhower by VHF radio to inform them that the vessel would soon be leaving the main channel and to give the vessel's estimated time of arrival at the quay in Cornwall.

Around 1152 the vessel was about 2.8 cables downstream of buoy DCB, the mid-channel buoy between the main and Cornwall channels. The apprentice pilot ordered 10 degrees of starboard helm. The order was carried out by the helmsman and, shortly after, the vessel started to alter course to starboard. The apprentice pilot then ordered the helm to midships to reduce the rate at which the vessel was swinging to starboard. The helmsman carried out the order.

At about 1154, as the vessel's heading was nearing 255°(G), the vessel's bow was abeam of buoy DCB, which was some 60 m to port. At this time the apprentice pilot ordered the helmsman to increase the amount of helm.

³ The vessel's speed is expressed in knots over the ground unless otherwise indicated.

There are differing versions of the helm orders that were given at this juncture. In one version, an order of starboard 10 degrees was reportedly given to complete the starboard turn to come to a heading of 265°(G) in the Cornwall channel. In the other, the helm order was port 10 degrees, followed shortly thereafter by an order of port 20 degrees.

The helmsman put the wheel 10 degrees to port followed by 20 degrees to port.

During this time the attention of the apprentice pilot was concentrated on the vessel's foremast, to discern its movement against the background (which would indicate a change of course). The apprentice pilot was not looking at the rudder angle indicator and did not notice the direction in which the helmsman put the wheel. The pilot, from his position on the port side of the wheel-house, made no comment either on the orders given by the apprentice pilot or on the way they were carried out by the helmsman.

With the helm now 20 degrees to port, the vessel started swinging to port.

From this moment the differing versions of the events again coincide. As soon as the apprentice pilot became aware of the swing to port, the apprentice pilot looked at the rudder angle indicator and saw that the rudder was to port. One member of the bridge team recalls seeing 10 degrees to port at this time; however, the three other members of the bridge team recollect seeing 20 degrees to port. After an exclamation of surprise in the French language, the apprentice pilot immediately ordered the helm to midships and then ordered the helmsman to put the wheel "hard to starboard." The helmsman carried out these orders, but given the momentum of the vessel's port swing, the vessel continued to swing to port.

Alerted by the order "hard to starboard," the pilot came to the assistance of the apprentice pilot, who asked him if the engines should be put "full astern." The pilot concurred and the order was given. The OOW put the engine telegraph to "full astern." The apprentice pilot then asked the OOW to telephone the engine-room to ask for "emergency full astern." The OOW complied with this order and, shortly after, the main engine was turning "full astern." At about 1155 the vessel ran aground on a 4.8 m shoal on the southern edge of the Cornwall channel, one cable upstream of buoy DCB.⁴ The vessel's heading was 249°(G) and the vessel had a slight starboard list of about half a degree. The master, who had just returned to the bridge, stopped the main engine.

On July 18, assisted by two tugs, the "SUNNY BLOSSOM" was refloated and brought alongside the quay at Cornwall. There was neither damage to the vessel nor pollution as a result of the grounding.

Work/Rest Schedule

On July 13 the pilot had worked between 1030 and 1635 piloting a vessel from Beauharnois to St. Lambert. On July 14 he had started work at 1800 and finished a little over six hours later at 0020 on July 15, piloting a vessel from St. Lambert to Beauharnois. At 0118 on July 16 the pilot started his third assignment in four days.

⁴ See position No. 3, Sketch 1 and Appendix A.

The pilot had 22 hours of sleep in the 72 hours preceding the occurrence, and 3 hours of sleep in the 24 hours preceding the occurrence.

On July 13 and 14 the apprentice pilot had no ship assignments. On July 15 the assignment was from 0540 to 1030. Three sleep periods taken in the 72 hours preceding the grounding were each at least 8 hours long.

Analysis

Handling and Trim

Having left the St. Lambert lock, the pilot noted that the vessel was difficult to steer, but not to the extent of asking the master to correct the trim by the head. The “SUNNY BLOSSOM”, on leaving No. 4 lock at Beauharnois had a trim by the head of 23 cm. In general, vessels with a slight trim by the head do not experience an appreciable falling off in their steering characteristics. As trim by the head increases, the vessel’s steering characteristics are adversely affected.

A trim by the head of 23 cm is not, in principle, unacceptable for a vessel such as the “SUNNY BLOSSOM”, with a length of 161 m. That this was the case is borne out by the vessel’s successful passage, at this trim, of the South Shore and Beauharnois Canals, where good steering is of primary importance. The fact that the pilots continued on, before and after knowing the true trim, is tacit evidence that this trim is not unacceptable, at least not to the pilots. After a comment on this negative trim by lock personnel at Beauharnois No. 4, however, the master decided to try to correct the trim before arrival at Cornwall.

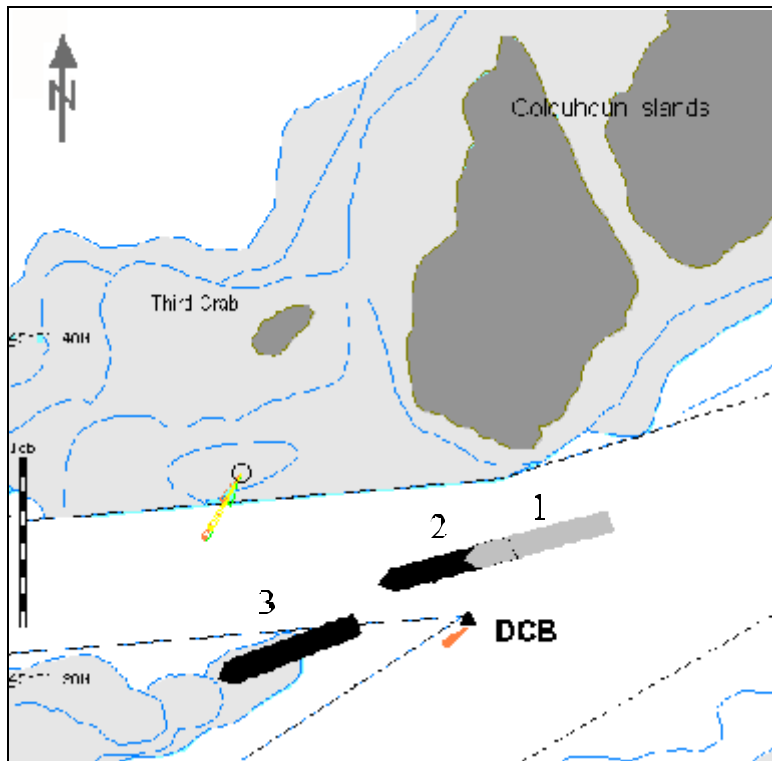
At about 1115 the afterpeak was ballasted with 100 tonnes of water to correct the trim by the head. Calculations made using the vessel’s stability data show that this amount of ballast would cause a change in trim aft of 26.8 cm. In consequence, the new trim would be 3.8 cm by the stern. For a vessel of the dimensions of the “SUNNY BLOSSOM”, however, transiting a shallow channel, it is possible that the fore part of the vessel was subject to the effect of squat. The squat has been calculated to have been about 90 cm. Under these circumstances, it is possible that steering the vessel was more difficult than it would have been in open sea, but this squat was not unusual for the “SUNNY BLOSSOM” at this location. Given the existing conditions of helm (20 degrees to port), engine (full ahead), and vessel position at the time the error was discovered, it is unlikely that the trim or the effect of squat contributed to the grounding.

Pilotage Techniques

During a watch at sea, the person having the conduct of a vessel should employ certain fundamental techniques to assure a safe passage. This is even more critical when a vessel is in restricted waters. When more than one person is involved in the conduct of a vessel, e.g. when a helmsman is at the wheel, an OOW is maintaining a record of the vessel’s position and a pilot has the conduct of the vessel, these techniques must be mastered to avoid errors of communication, understanding and execution of orders.

One of the practices widely adopted by pilots and OOWs is to have the helmsman repeat the order given—both on its receipt and upon its execution. The pilot or OOW then confirms, by repeating the order, that it has been carried out. This practice creates a “closed circuit” of repetition and confirmation of orders given by the pilot or OOW to the helmsman.

Another practice is for the person having the conduct of the vessel to look at the rudder angle indicator after giving a helm order. In doing so, they can be assured that the order has been understood and carried out. This is of great importance when the vessel is in restricted waters or in areas where traffic is heavy. Neither the pilot nor the apprentice pilot was looking at the rudder angle indicator during the last alteration of course entering the Cornwall channel.



Sketch 1

Notwithstanding the differences of opinion on why the helm was put to port, all those on the bridge agreed that the vessel went aground as a result of the helm being put over to port instead of to starboard, and that this occurred at a critical time during the course alteration. Between the time that the helm was put to port, about 1154, and the movement of the vessel to port, some time elapsed.⁵ It is estimated that the “SUNNY BLOSSOM” would have taken about 25 seconds to start its swing to port from the time that the initial helm order was given. At 8 knots, the distance covered would have been about 103 m. From the position at 1154, the

⁵ See Sketch No. 1, position 1.

103 m covered on a course of 255°(G) would have placed the vessel in an unrecoverable position, given that the rudder was at this time 20 degrees to port with the engine full ahead and a port swing started, and notwithstanding a current setting at 060°(T) at this position.⁶

Bridge Resource Management

Bridge resource management principles advocate that crew members share information to ensure as much as possible that all relevant factors are taken into account in the decision-making process; such principles are a catalyst for other officers to be assertive when faced with a perceived unsafe situation. In this occurrence, the master had drawn the OOW's attention to the fact that, even if the pilot had the conduct of the vessel, the OOW should take command of the ship in circumstances where safety was compromised. Notwithstanding this warning, the OOW was inhibited from asserting himself before the occurrence by at least three obstacles. These were:

- There was a pilot and an apprentice pilot in the wheel-house. The fact that the pilot did not contradict the orders of the apprentice pilot had the effect of an implicit endorsement. The combined weight of their authority was not conducive to a challenge by the OOW.
- The OOW was at the engine telegraph carrying out the pilots' orders and was plotting the vessel's position on the chart about every six minutes, when he was not required at the telegraph. Without the benefit of an electronic chart to continuously follow the vessel's progress in real time, it was extremely difficult, given his responsibilities at the telegraph, to evaluate the appropriateness of the apprentice pilot's orders.
- No information on the pilot's intention, such as wheel-over positions, was exchanged between the pilot and the bridge team. Because of this, it was impossible for the OOW to know with certainty the alter-course (wheel-over) position.

With reference to this third point, an OOW must know the pilot's intentions for the intended voyage. The *Canadian Code of Nautical Procedures and Practices, Operational Guidance for Officers in Charge of a Navigational Watch* specifies that "if the OOW is in any doubt as to the pilot's actions or intentions, he should seek clarification from the pilot; . . . and take whatever action is necessary . . ." ⁷ Without an understanding of intentions, it is difficult to evaluate with certainty the appropriateness of the pilot's actions, or to doubt them.

In October 1995, the Transportation Safety Board recommended that:

⁶ See Sketch No. 1, position 2.

⁷ Adopted from the International Conference on Training and Certification of Seafarers (STCW), Issue of Certificates of Competency and Watchkeeping, Resolution 2 /1995.

The Department of Transport require that pilots, as part of their initial hand-over briefing:

- a. obtain the master's agreement to the intended passage plan; and
- b. invite the bridge team's support by having the officer of the watch plot and monitor the vessel's position at regular intervals and report the position to the pilot with respect to the agreed passage plan.

(M95-08)

Transport Canada indicated acceptance of the intent of the recommendation. Consultation with the pilotage authorities has taken place and the syllabus for bridge resource management training contains passage planning and simulated passage exercises.

Work/Rest Schedule

The time of day at which one sleeps has an effect on the quality of sleep. Nearly every function of the body, including sleep and wakefulness, is regulated following the day/night cycle known as circadian rhythm. Circadian rhythms are influenced by external stimuli, such as sunrise and sunset, but above all by the body's "biological clock." Human performance is better if the subject sleeps at night and is awake during the day. People who are asleep at times when their biological clock tells them that they should be awake have difficulty sleeping, and the sleep they *do* get does not have the same restorative value.⁸

Pilotage requires irregular and unforeseeable hours of work. These factors make pilots vulnerable to sleep debt. The GLPA controls pilot's assignments so that after every assignment a pilot benefits from a period of at least 14 hours before being reassigned. However, this does not mean that the period without assignments is a period of rest or sleep. The GLPA cannot control the quantity or quality of sleep its pilots receive.

The pilot had more than 24 hours off between his previous assignment and the one on the "SUNNY BLOSSOM"; however, because the pilot had slept for only 3 hours in the 24 hours before the grounding, it is likely that he was tired at the time of the occurrence.

The deterioration in performance due to fatigue manifests itself in several ways, *inter alia*: reaction time is slower and reasoning and judgement are less sure, there is a decrease in vigilance, a lack of appropriate reaction to difficulties, nonchalance, and an increased propensity to take risks.⁹

The pilot was on the port side in the wheel-house and was looking forward. He had no knowledge of the actions of the helmsman or of the helm orders given by the apprentice pilot immediately before the occurrence. These facts would lead the Board to believe that he was

⁸ *The CANALERT Guide for Locomotive Engineers and their Families, Living in a 24-Hour World*, Circadian Technologies, Inc., 1996.

⁹ David F. Dinges, *Performance Effects of Fatigue*, Fatigue Symposium Proceeding, November 1995, National Transportation Safety Board and NASA Ames Research Center.

not controlling the quality of the services rendered by the apprentice pilot. Such behaviour is compatible with performance reduced by fatigue.

During the winter of 1998, most of the pilots of the GLPA, including the pilot of the “SUNNY BLOSSOM”, attended a three-hour seminar on sleep and hours worked. Notwithstanding this awareness session, and the fact that the pilot had been piloting since 0120, the pilot decided to continue piloting between Beauharnois and Cornwall. Research has shown that an individual, particularly an individual who is fatigued, does not correctly evaluate his state of wakefulness and performance.¹⁰

Quality Control of Pilotage Services

Having recourse to the services of an apprentice pilot, even an experienced apprentice pilot, was not a reason for the pilot to relax his vigilance. At all times, he was required to assure the quality of the service rendered by the apprentice pilot and the helmsman. In restricted waters, as this occurrence shows, continuous vigilance is necessary to validate the parameters of the operation. This can make the difference between a voyage without incident and one with undesired consequences.

Findings

1. When informed that there would be no relief pilot before 1600, the pilot decided to continue between No. 4 Lock at Beauharnois and Cornwall.
2. Leaving No. 4 Lock at Beauharnois the “SUNNY BLOSSOM” was trimmed 23 cm by the head, but after having ballasted the afterpeak with 100 tonnes of ballast, the vessel’s trim would have been 3.8 cm by the stern. This was probably the vessel’s trim immediately before the grounding.
3. It is unlikely that the trim or the effect of squat contributed to the grounding.
4. At a critical moment in the alteration of course to starboard, the helm was put 10 degrees to port and then 20 degrees to port.
5. At the time of the occurrence, the apprentice pilot had the conduct of the vessel while the pilot was on the port side of the wheel-house.
6. There was no efficient “closed circuit” of repetition and confirmation of helm orders between the person having the conduct of the vessel and the helmsman.

¹⁰ Mark R. Rosekind, et al., *Crew Factors in Flight Operations X: Alertness Management in Flight Operations*, NASA Technical Memorandum DOT/FAA/RD-93/18. NASA Ames Research Center, 1994.

7. At the time of the last alteration of course to enter the Cornwall channel, the apprentice pilot's attention was fixed on the vessel's foremast to detect the alteration.
8. The OOW carried out the main engine telegraph orders as given to him by the pilots. He marked down the vessel's position on the chart about every six minutes, when his services were not required at the telegraph.
9. Given his responsibilities at the telegraph and without the benefit of an electronic chart to continuously follow the vessel's progress in real time, it was extremely difficult for the OOW to evaluate the correctness of the apprentice pilot's orders.
10. No information on the pilot's intentions, such as wheel-over positions, was exchanged between the pilot and the bridge team. As such, the OOW did not know with certainty the course alteration (wheel-over) position and so could not properly evaluate the pilot's actions.
11. Neither the pilot nor the apprentice pilot looked at the rudder angle indicator to confirm that helm orders were being correctly executed while the vessel was leaving the main channel to enter the Cornwall channel.
12. The quality of service provided by the apprentice pilot was not continually verified by the pilot.
13. A little after the start of the vessel's head coming to port, the helm was put hard to starboard and the main engine to full astern.

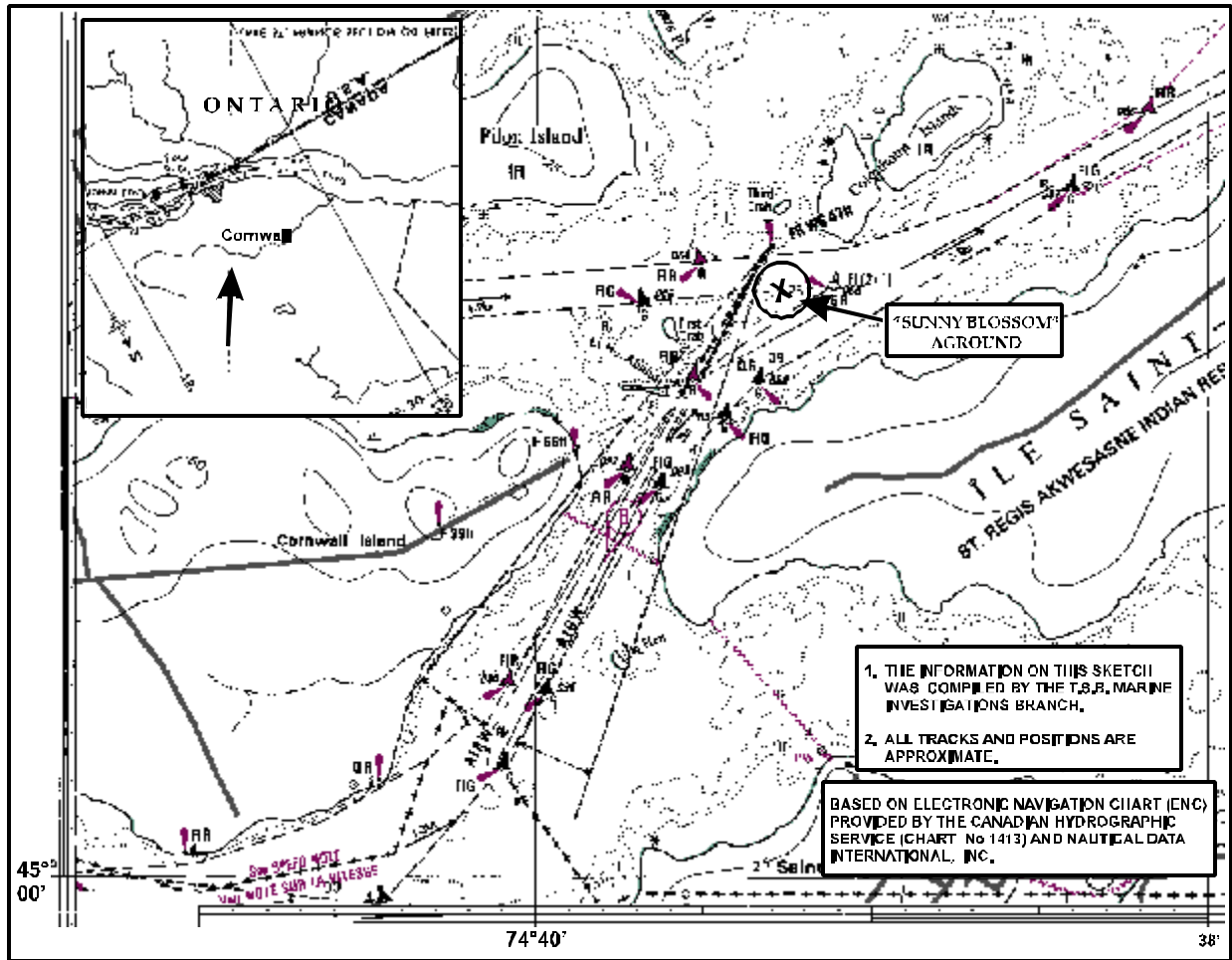
Causes and Contributing Factors

The "SUNNY BLOSSOM" ran aground on the south bank of the Cornwall channel when, at a critical moment of an alteration of course to starboard, the helm was put to port.

Factors contributing to the grounding were: the apprentice pilot did not confirm, by reference to the rudder angle indicator, that helm orders had been carried out, and there was no efficient "closed circuit" of repetition and confirmation of helm orders between the person having the conduct of the vessel and the helmsman; the pilot did not continually verify the quality of service provided by the apprentice pilot; and the multiple responsibilities of the OOW combined with his lack of information on the position at which the vessel was to change course inhibited him from intervening at the critical moment.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 8 August 2000.

Appendix A - Sketch of the Occurrence Area



Appendix B - Photographs



"SUNNY BLOSSOM" AGROUND OUTSIDE THE CORNWALL CHANNEL



BUOY DCB OFF THE PORT QUARTER