MARINE OCCURRENCE REPORT

SWAMPING AND CAPSIZING

FISHERIES RESEARCH VESSEL “MARSOUIN”
RIVIÈRE-DU-LOUP, QUEBEC
09 JUNE 1997

REPORT NUMBER M97L0050

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Summary

On the morning of 09 June 1997, while manoeuvring astern before berthing at a marina pontoon, the "MARSOUIN", with three persons on board, shipped seas over the stern, which caused the vessel to heel to starboard and then capsize. The vessel remained afloat after capsizing and all three persons surfaced, held on to the overturned hull, and were soon rescued uninjured.

Ce rapport est également disponible en français.

Other Factual Information

	"MARSOUIN"
Port of Registry	Rimouski, Quebec
Flag	Canada
Licence Number	14D1517
Type	Fisheries research vessel
Gross Tons	Less than 5 tons
Length	6.3 m
Draught	0.74 m
Built	1985
Propulsion	Two 70-HP outboard motors
Crew	2
Passengers	1
Registered Owners	Ministry of Fisheries and Oceans Institut Maurice-Lamontagne Mont-Joli, Quebec

The "MARSOUIN" is a small research vessel employed in various marine biology research projects conducted by scientists at the Institut Maurice-Lamontagne (IML). The vessel is of fibreglass (glass-reinforced plastic) construction, and a watertight well deck extends from the after end of the wheel-house to the stern, beneath which permanent foamed-in-place buoyancy is fitted.

The vessel was tied up starboard side to a pontoon inside the marina at Rivière-du-Loup, while a mechanic carried out repairs to the port side outboard motor. Some wave crests occasionally shipped over the transom and were pumped overboard by the intermittent use of an electrically powered bilge pump located at the after end of the well deck. The orientation of the pontoon was such that it was aligned with the marina entrance, and the stern of the vessel was exposed to the prevailing winds and waves. Before the vessel's departure, winds of 10 to 15 knots were observed to be generally from the northwest, which generated waves with small white caps in the exposed waters of the St. Lawrence River, outside the marina. Where the water became shallower, near the entrance to the marina, the waves were reportedly shorter and steep-sided, and estimated to be approximately one metre high and rolling directly into the marina entrance.

Once the motor was repaired, the vessel headed toward the entrance of the marina to test the engines under way. As the vessel was proceeding to the more exposed marina entrance, short, steep, one-metre-high waves were encountered, and some spray was shipped over the gunwales. The pump activated automatically as the vessel was turned to resume its former berth. During the return, it was decided to berth port-side-to on the more sheltered side of the pontoon, and during the subsequent manoeuvres, the motors were put into reverse.

As the vessel gathered stern way, the transom became buried in a following sea causing both motors to stall and water to be shipped over the transom. Several attempts to restart the motors from the conning position in the wheel-house were unsuccessful, and as the vessel trimmed by the stern, the well deck was soon swamped by two more waves. At about 1115, the vessel capsized to starboard.

The vessel capsized so rapidly that it remained afloat in the inverted position supported by air trapped in the forecastle and the wheel-house and also by the built-in buoyancy under the well deck. The mechanic and deck-hand, who were on the well deck at the time of the capsizing, were immersed but soon surfaced and held onto the inverted hull. However, the operator experienced some difficulty in exiting the enclosed wheel-house, as she was impeded by various loosely stowed items that floated out of the forecastle, and because the doorway was partially obstructed by the mechanic as he also was abandoning the vessel from the port side of the well deck.

The capsizing was witnessed from the shore, and a small boat was launched quickly from a tour boat berthed nearby. Within five minutes, all three victims were retrieved from the water and returned to shore without any apparent signs of injuries. The "MARSOUIN", its gear and research equipment were subsequently recovered.

The life-saving appliances on board the "MARSOUIN" were in excess of the regulatory requirements for small vessels of this size. No personal flotation device (PFD) was worn by anyone on board despite the strong winds and rough seas observed before departure. The rapidity of the capsizing precluded the donning of any of the life-saving equipment stowed in the forecastle. The stowage arrangements of the lifebuoy and inflatable liferaft were such that they could not float free, and both remained secured on the wheel-house top throughout the capsizing and subsequent recovery operations.

On recovery, both outboard-motor control levers in the wheel-house were found to be in the fully forward drive position with the ignition/starting switch at "ON". The outboard motor installation is such that the outlets of the exhaust gas back-pressure relief valves are approximately 125 mm above the trimmed waterline when the vessel is at rest, and significantly more in the trough created in the wake of the transom when the vessel is moving ahead. However, deep immersion or prolonged submersion of the outlets when the vessel is going astern or is overtaken by following seas, can effectively prevent exhaust gas back-pressure relief and cause the motors to stall.

As a vessel of less than 15 gross registered tons, the "MARSOUIN" was not required to submit stability data or be inspected for safety purposes by the Transport Canada Marine Safety. The vessel was licensed as required on 24 April 1985, prior to commencement of service with IML.

None of the crew held any formal marine qualifications for small vessels nor were they required to by regulation. In the spring of 1997 the operator and deck-hand had attended a 10-day small boat safety course. The operator took charge of the "MARSOUIN" in May 1997, having six summers' previous experience in various capacities on this and other small boats at IML.

As there are no original design and stability data available, the review of the vessel's stability characteristics was based on the results of post-casualty inclining experiments, rolling period tests and hull measurements. The results showed the fully loaded displacement on departure to have been some 2552 kg, including a total deadweight of 982 kg. The deadweight comprised the three persons on board, 122 kg of fuel in the vessel's

built-in tanks and 113 kg of extra fuel oil in five portable tanks. Also, there was a research seawater storage tank and gear totalling 150 kg, spare personal flotation devices (PFDs) and accumulated redundant equipment amounting to 374 kg, all of which were unsecured.

Other weights, such as the inflatable liferaft, navigation equipment, steel mast, rigging and other fittings, are estimated to have been approximately 228 kg which, in conjunction with the deadweight on board at the time of the capsizing, show an operational displacement of approximately 1210 kg more than the original lightship weight. The reduction of the mean freeboard, due specifically to extra fuel and accumulated spare gear, is estimated to have been approximately 5 cm.

Review of the reported loaded departure condition shows the vessel had relatively high initial intact transverse stability, with a metacentric height of 0.88 m, a mean draught of 0.36 m and a static trim by the stern of 1.4 cm. The configuration of the transom and the height of the forward end of the motor well conform with the recommendation of the *Construction Standards for Small Vessels* (TP 1332) and, on departure, the vessel had an effective static after freeboard of approximately 0.32 m.

Analysis

On departure, the "MARSOUIN" maintained satisfactory intact transverse stability characteristics; however, the weight of additional fittings together with the unmonitored accumulation of working material reduced the mean freeboard and caused a slight trim which lowered the freeboard at the stern. Review of all the factors contributing to the lowered freeboard characteristics shows that the biology research gear, and related mast and rigging, accounted for about 20 per cent of the total reduction, and the remaining portion was due to the weight of the additional fuel, outfit, spares and supplementary equipment.

The primary means of access to, and escape from, the wheel-house is by way of an athwartships sliding door located in the after bulkhead, which slides to starboard when in the open position. When the vessel capsized to starboard, the door remained open and the escape route remained available. However, had the vessel capsized to port, it is highly likely that the unsecured door would have slid to port into the closed position and either retarded or prevented the operator's escape from the enclosed wheel-house.

When the vessel was recovered, both outboard-motor control levers were found to be in the fully forward position and the ignition/starting switch was at "ON". According to the operating procedure, the motors can be started electrically only when their combined throttle and drive levers are in the vertical, "NEUTRAL" position. Initial hasty attempts to restart both outboard motors were unsuccessful. Subsequent attempts, when the second and third waves were shipped, became futile because the vessel's pronounced after trim resulted in the prolonged and deep submersion of both motors' exhaust gas back-pressure relief valve outlets.

All small vessels of open construction employed in exposed or relatively rough waters are operated at some risk, being particularly vulnerable to swamping by taking seas over the gunwale. Prudent operation with regard to loading, freeboard, speed and orientation relative to the prevailing seas is essential for safety.

Review of the vessel's stability at the time of the occurrence shows that the weight, trimming and free-surface effects of the water initially shipped and retained on the well deck reduced the after freeboard and virtually

eliminated the vessel's initial transverse stability. While the vessel was in this highly vulnerable condition, the shipping of two or more relatively high waves caused the vessel to settle markedly, trim even more by the stern, lose all righting ability and capsize.

The Ship Division of IML specifically addresses boat maintenance and repair, providing manuals and introductory guidance for the functioning of on-board equipment, but only limited on-the-water instruction to the various crews before departure. Consequently, the practical boat-handling abilities of the marine biologists and summer students who operate the small boats for the most part, are gained largely from on-the-job experience and augmented in some instances by on-shore instruction from the Institut maritime du Québec (Rimouski).

The scheduling, assignment and matching of equipment with particular vessels by the Technical Committee composed of senior marine biology research managers is focussed primarily on the conduct and timely completion of the research projects. The absence of specific knowledge of marine practices, or the guidance of accurately recorded technical data addressing the current status and physical limitations of IML's rather small boats, can lead to the mismatching of some vessels and their assigned tasks.

No formal standing orders addressing vessel operational trim, loading or stability limitations are provided for the instruction and guidance of the small boat crews at IML, nor are there any formal emergency instructions regarding the reporting responsibilities of the operators in the event of a vessel or crew-related accident. Senior shore personnel of the Ship Division and the Technical Committee of IML were unaware of the existence of accident reporting regulations, and the capsizing was reported belatedly by the operator, following some inquiries to the Canadian Coast Guard (CCG) and Transport Canada Marine Safety.

Findings

1. IML did not provide the operator with standing orders or formal instructions addressing the loading, freeboard, trim or weather-related operational limitations of the vessel.

2. There was no formal monitoring system or assessment by a suitably qualified person of the loading, operational limitations, trim and stability of this small vessel, which was operated by uncertified personnel engaged in marine biology research projects.

3. The cumulative effect of additional navigation equipment, deck and rigging fittings, extra fuel tanks, biology research equipment and spare gear reduced the as-designed freeboard and made the vessel more vulnerable to shipping seas over the gunwale and transom.

4. The well deck was swamped when the vessel was manoeuvred astern into following seas that were three times the height of the effective transom freeboard.

5. Intact transverse stability was satisfactory on departure; however, the vessel capsized when stability was lost because of the weight and free-surface effects of water shipped and retained on the well deck.

6. The outboard motors stalled when their exhaust gas back-pressure relief valve outlets became deeply submerged as the vessel went astern into steep following seas.

7. Prolonged submersion of the exhaust gas back- pressure relief valve outlets precluded restarting the outboard motors, while the vessel was partially swamped and heavily trimmed by the stern.

8. Despite the relatively rough weather conditions observed before departure, no one on board wore a PFD, and because the lifebuoy and inflatable liferaft were secured to the wheel-house top, they could not float free after the capsizing.

9. Shore IML management personnel were unaware of the existence of accident reporting regulations, and the occurrence was belatedly reported by the operator as a result of inquiries to the CCG and the Marine Safety Branch of Transport Canada.

Causes and Contributing Factors

The “MARSOUIN” was swamped while going astern into following seas, lost transverse stability and capsized because of the weight and free-surface effects of the water shipped and retained on the well deck. The weight of an accumulation of additional equipment, fuel oil, deck fittings and spare gear reduced the vessel’s effective freeboard, making it more vulnerable to shipping seas over the gunwale and transom.

Safety Action

In order to improve the safety of small vessel users, Fisheries and Oceans has implemented a series of actions to correct the observed deficiencies:

- Implementation of a more severe monitoring system for small vessel users, including the presence of a coxwain in certain areas of operation.

- In collaboration with the Institut maritime du Québec (Rimouski), development of an academic and hands-on training for small vessel users.

- Establishment of a sub-committee on occupational safety and health for small vessels to receive complaints and comments; and

- Implementation of an awareness and information program for users of small vessels.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 23 March 1999.

Appendix A - Outline General Arrangement

Appendix B - Sketch of Occurrence Area