MARINE OCCURRENCE REPORT

DOWNFLOODING AND SINKING

OF THE FISHING VESSEL "CAPE ASPY"
OFF THE SOUTH-WEST COAST
OF NOVA SCOTIA
30 JANUARY 1993

REPORT NUMBER M93M4004

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Synopsis

The "CAPE ASPY" departed Lunenburg, Nova Scotia, on 30 January 1993, bound for the Georges Bank fishing grounds. Approximately 14 hours later, while still en route, the vessel sank in rough weather conditions, in 120 fathoms, in position 42°28.6'N, 65°y58.2'W, with the loss of five lives.

The Board determined that the "CAPE ASPY" proceeded to sea in rough weather conditions with many weathertight/ watertight openings to the hull either in the open or in the closed but unsecured condition. The combined effects of rough weather, sea spray ice accretion, free surface effect of shipped seas retained on deck, in conjunction with the vessel's low transverse stability and the downflooding to the hull, caused the "CAPE ASPY" to lose all reserve buoyancy and sink.

11 May 1994

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 Particulars of the Vessel

"CAPE ASPY"	
Official Number	320507
Port of Registry	Halifax, Nova Scotia
Flag	Canadian
Type	Scallop trawler (dragger)
Gross Tons[1]	323
Length (registered)	35.39 m
Breadth	7.47 m
Draught (on departure)	F[2]: 2.8 m A: 4.2 m
Built	1963, Lauzon, Quebec
Propulsion	One Deutz diesel engine, 650 BHP, driving one fixed-pitch propeller, 10 knots
Owners	National Sea Products Ltd. Halifax, Nova Scotia
Operating Managers	Scotia Trawler Equipment Ltd. Lunenburg, Nova Scotia

1.1.1 Description of the Vessel

The "CAPE ASPY" was built, registered and rigged for side trawling in 1963, but, in 1977, she was converted into a scallop trawler (dragger). The hull was subdivided by six transverse watertight bulkheads. (For layout see photograph (Appendix A) and Outline General Arrangement (Appendix B).)

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

2 See Glossary for all abbreviations and acronyms.

3 All times are AST (Coordinated Universal Time (UTC) minus four hours) unless otherwise stated.

1.2 History of the Voyage

The "CAPE ASPY" departed Lunenburg, Nova Scotia (Appendix C), at 0915[3], on Saturday, 30 January 1993, and was expected to arrive at the Georges Bank fishing grounds at 0200 the following day. The temperature at departure was very cold, due mainly to a strong northwesterly wind, but the sea conditions while in the lee of land were relatively calm. The air temperature was minus 6°C and was expected to fall to minus 20°C that evening.

Progress toward the fishing grounds took the vessel in a southwesterly direction at a speed of 10 knots, a course which gradually diverged from the protection of the coast, giving an increase in the roughness of the seas. The speed of the vessel, combined with the wind speed and rougher seas, caused a progressive increase in the sea spray ice accretion and, at 1800, when positioned approximately 25 miles south-east of the southern tip of Nova Scotia, the vessel was exposed to the full force of the weather and was shipping seas. The rate of ice accretion accelerated as the ice surface areas expanded.

At about 1900, the off-duty crew turned in for the night. The on-duty personnel comprised the master in the wheel-house (in charge of navigation), assisted by a stand-by/ look-out man. The chief engineer was attending to the engines.

From about 2000, there was a further increase in wind speed and wave height and by 2300 a starboard list of approximately 8° had developed due to ice accretion. At that time, the vessel was rolling approximately 20° and shipping water on deck. At an undetermined time, the vessel's course was altered to southerly, placing the wind and seas in a direction from further astern. No attempt was made to physically remove the ice.

At approximately 2315, the vessel rolled heavily to starboard, partially

returned to the upright and then rolled further to starboard. The list suddenly increased to about 45° and the vessel appeared to be 'settled by the head'.

At about the same time, all hands were roused. Crew members who donned immersion suits in the galley area observed sea water flooding the starboard shucking house and surging to the level of the galley portholes and also entering the engine-room through the open starboard access door (marked C in Appendix B). Just before the vessel was abandoned, downflooding of the under-deck crew accommodation was witnessed. The continued flooding of the engine-room stopped the main engine and generators and caused the lights to fail. The flooding continued until the vessel sank at about 2330. Winds were northwesterly at 25 to 40 knots, seas were about 5 m on swells of 2 to 3 m, the air temperature was minus 12°C to minus 15°C, the sea temperature was plus 2°C to plus 4°C and there was moderate freezing spray.

A distress signal generated by an Emergency Position Indicating Radio Beacon (EPIRB) alerted Search and Rescue (SAR) authorities, and 11 of the 16 crew members were rescued.

1.2.1 Abandonment of the Vessel

While the crew members, who had been awakened, were donning immersion suits, they noticed that the list was increasing. They proceeded out of the accommodation and up to the wheel-house where they were ordered to proceed to the position of the inflatable liferaft on the port side of the poop deck. Considerable difficulty was experienced in travelling the few metres to the liferaft as the list necessitated walking along the sloping wheel-house side and deck which were ice-encrusted to a depth of some 10 to 15 mm.

Fifteen of the crew members collected at the port liferaft, all but one of them wearing immersion suits. Under the directions of the mate, they kicked the ice from the securing device. Difficulties were experienced in launching the liferaft. The painter was cut at its position on deck and the liferaft started to inflate. As the liferaft was inflating (which took a matter of seconds), a wave washed up the deck and swept the crew and liferaft over the side. Two of the crew members managed to enter the liferaft and they assisted others to board from the sea. The mate and three crew members could not reach the liferaft, and the strong winds caused it to drift away. Reportedly, the master did not manage to leave the wheel-house and was last seen attempting to don an immersion suit. The other missing person had been seen not to be wearing an immersion suit.

1.3 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	3	-	-	3
Missing	2	-	-	2
Serious	-	-	-	-
Minor/ None	11	-	-	11
Total	16	-	-	16

Ten of the crew members were rescued from the liferaft after three hours and one other was rescued from the cold waters some five hours after the vessel sank. The bodies of three crew members were retrieved from the sea some six hours later, and two other crew members remain missing and are presumed drowned.

1.4 Vessel and Personnel Certification

The "CAPE ASPY" was certificated, equipped and manned in accordance with existing regulations.

1.4.1 Personnel History

The master had held his position on the "CAPE ASPY" for seven years in addition to having commanded similar vessels in the past. Of the rest of the crew, most had served on the "CAPE ASPY" for periods of five to six years; all had previous similar experience on other vessels.

1.5 Weather Forecasts and Decision to Sail

Due to adverse weather forecasts, the vessel's planned departure for Friday, 29 January 1993, had been postponed awaiting improvements in the forecasts. The Saturday early morning forecasts were typical for the time of the year off the Nova Scotia coast, giving varied prognoses, but indicating that conditions would improve over the short term. Northwesterly gales would diminish to light winds overnight but freezing spray warnings were still in effect. The 1700 forecast indicated freezing spray warnings would end overnight, with the air temperature rising to minus 5°C by Sunday afternoon. The outlook for Monday was for strong to gale force northeasterlies.

The master took into consideration these weather forecasts together with his own experience and, having made a contingency plan to call at a port of refuge should it become necessary, he was in favour of making the trip. Under the union agreement, to prevent the crew's weekends at home being pre-empted, weekend sailings could only occur with the full consent of the crew. Thus, a meeting with the crew was arranged at which the master expressed his opinion that, as far as the weather was concerned, the trip could be made. None of the crew members demurred. The master thus decided to make the trip on the morning of 30 January.

Many other similar fishing vessels, which were in the general area, successfully negotiated the weather.

1.6 Freezing Spray and Vessel Icing

Most often, ice formation results from deposits of water droplets on the vessel's structure. These droplets come from spray driven off wave crests and from ship-generated spray which freeze on the vessel whenever the air temperature is minus 2.2°C or below in conjunction with wind speeds of 17 knots or more (J.G. Holburn, R.A. Dick, E.W. Thompson). An increase in wind or a decrease in temperature or both causes ice formation to increase. In this instance, the low temperatures and the wind chill factor facilitated ice formation on the superstructure. (See Appendix D.)

Actual icing potential is a characteristic of each vessel and depends on a number of factors including the size, design, load condition and sea-keeping ability of the vessel and her speed and direction relative to the wind. Intense ice

formation occurs when the vessel is heading into the wind and sea while proceeding at maximum speed. In beam and quartering winds, ice accumulates more rapidly on the windward side, thus causing the vessel to list. This can be extremely dangerous if accumulation is allowed to continue.

1.6.1 Ice Accretion and Stability

The additional top weight due to ice accretion on the superstructure, masts and rigging caused a reduction in initial stability and the vessel to roll more readily and to a greater degree, increasing the amount of sea water shipped on deck. Due to the relative wind blowing on the starboard beam during the initial part of the ice accretion period, the ice build-up was unsymmetrical and resulted in a list of some 8° to starboard shortly before the vessel's loss.

The subsequent immersion of the deck edge, together with the ice on deck, reduced the effectiveness of the freeing ports in the bulwarks in freeing water as the ice moved with the water among the many deck fittings.

1.6.2 De-icing

Ice can be physically knocked off the superstructure using ice mallets or any suitable implement while the vessel is at sea. Tools with which this task could have been accomplished were carried on board. This method of de-icing small vessels such as the "CAPE ASPY" at night and in poor weather is dangerous and fishermen have been lost/ injured while carrying out such tasks. De-icing was not attempted on this trip.

1.7 Departure Condition

One week had been spent in port during which time some minor servicing and repair work had been carried out. The vessel's trim and stability was similar to that at the start of many previous fishing trips, giving no cause for concern. The "CAPE ASPY" was upright with a full amount of diesel fuel oil, (potable) water and stores as well as the usual amount of catch preservation ice stowed and secured in the forward part of the fish hold. After departure, the mooring ropes were stowed in the net store (forward store hold) and all loose items on deck were checked and found secured.

As was the general practice on board this vessel, a number of accesses to the interior of the hull were either secured in the open position or closed but not secured.

The location and description of these accesses is shown in Appendix B:

(A) Weathertight access hatch to forepeak.
(B) Weathertight access hatch to forward net store.
(C) Weathertight door to starboard side of engine-room.
(D) Weathertight door between port shucking house and accommodation alleyway.
(E) Weathertight door between starboard side shucking house and processing room.
(F) Weathertight door between processing room and accommodation area.
(G) Weathertight escape hatch from crew accommodation to processing room.
(H) Weathertight hatch to forward end of fish hold.
(J) Weathertight hatch to after end of fish hold.
(K) Weathertight door to forecastle store.
(L) Gastight internal door to port side of engine-room.
(M) Non-weathertight wooden screen door to port side of forecastle.
(N) Non-weathertight wooden screen door to starboard side of forecastle.

(O) Non-weathertight door to port shucking house.
(P) Non-weathertight door to starboard shucking house.
(R) Weathertight escape hatch from processing room to poop deck.

On departure and at the time of the sinking, the following was the status of accesses:

- weathertight accesses A, B, C, D and E, non-weathertight doors M and N, and door L were secured open;
- weathertight accesses, hatches and doors G, H, J and K were closed but not secured;
- weathertight escape hatch R was closed but its securing status was unknown;
- non-weathertight doors O and P were open, and
- weathertight door F was open on departure, however, it was closed and secured at about 1850 when shipped water was found to be entering the accommodation from the starboard processing room.

1.8 *Vessel Stability*

1.8.1 Regulatory Stability Approvals

The "CAPE ASPY", as built, was registered as a side-fishing trawler in 1963, and appropriate trim and stability data were duly approved by the Ship Safety Branch of the Canadian Coast Guard (CCG) on 08 October 1963.

On completion of conversion to a scallop trawler (dragger), the vessel was subjected to an inclining experiment and the related Trim and Stability Booklet was subsequently submitted in accordance with regulatory requirements. Approval, based on this data meeting the minimum criteria detailed in the CCG *Stability, Subdivision, and Load Line Standards, Stability Standard, STAB. 4*, was given on 28 November 1978.

Compliance with STAB. 4 (Appendix E) ensures that large fishing vessels maintain what is generally recognized as adequate intact transverse stability throughout a range of standard loading configurations for normal and winter operations. In winter, when a vessel's stability can be detrimentally affected by the weight of freezing spray (ice) on the upperworks, masts and rigging, approval is based on the vessel's stability exceeding minimum criteria with an assumed regulatory prescribed weight of ice accretion. In the case of the "CAPE ASPY", the regulatory prescribed additional weight amounted to some 32 tonnes.

The criteria of STAB. 4 are related to intact transverse stability and, consequently, are dependent on the watertight integrity of the hull being maintained, together with the proper closure of openings on the weather deck such as doors, hatches, ventilators, air pipes, etc.

1.8.2 Post-casualty Stability Examination Conclusions

A post-casualty analysis[4] of the vessel's stability at the time of the accident yielded the following conclusions:

4 The Stability Report is available upon request.

- On departure, the vessel's transverse stability characteristics met all but one of the normal ice-free criteria of STAB. 4 in that the maximum righting lever GZ was some nine per cent less than the minimum requirement.

- The addition of the regulatory prescribed weight of ice accretion to the departure loading condition showed the vessel's transverse stability to have been markedly below all but one of the applicable STAB. 4 criteria.

- Due to the location of the non-watertight fish hold sole, which had been raised at the time of conversion to a scallop trawler, the actual centre of gravity of the 25.4 tonnes of catch preservation ice on board on departure was some 1.22 m higher than that indicated in the approved Trim and Stability Booklet.

- On departure and throughout the trip, the weathertight door to the starboard side processing room (marked E in Appendix B) was secured in the open position; consequently, significant reserve intact buoyancy contributing to the vessel's righting ability was lost.

- The calculations showed the heeling moment necessary to cause the list of 7 to 8° was achieved when some 21 tonnes of ice accretion had accumulated predominantly on the starboard side, and that the vessel then retained approximately 10 per cent of the positive dynamic stability she possessed before any ice accretion occurred. It should be noted that, with a total of 21 tonnes of ice accretion distributed 25 per cent to port and 75 per cent to starboard, the corresponding thicknesses of ice on the port side of the poop deck and wheel-house side coincide with those observed by several survivors just prior to the abandonment.

- Upon the vessel listing, openings furthest outboard on the starboard side would have been the first subjected to intermittent immersion and so would have allowed the initial entry of water into the hull. Because of the starboard list, the initial downflooding into the compartments below the weather deck would have gravitated to starboard, further increasing the angle of heel and accelerating the rate of downflooding.

- When the vessel heeled approximately 45°, downflooding by way of several of the open or unsecured doors and hatches would have become general and, subsequently, would have progressed until all reserve buoyancy was lost and the vessel sank.

1.9 Navigation and Propulsion Equipment

The mechanical propulsion and the electronic navigation equipment, with the exception of one of the two radars, were in good working condition.

1.10 Radio Communications

The vessel was equipped with a single side band (long range) radiotelephone (SSB R/ T) and a very high frequency radiotelephone (VHF R/ T), and both were switched on and tuned to their respective calling and distress frequencies. Both had functioned satisfactorily when last used prior to the sinking; the SSB R/ T during the previous trip and the VHF R/ T at 1000 that morning while in communication with the office at Lunenburg. Between 2315 and 2330, three 'MAYDAY' messages were

transmitted on the SSB R/ T, but none were received by either shore-based or ship-board radio stations. At least two vessels were well within range, one at 12.5 miles and the other at 25 miles as was the Coast Guard Radio Station at Yarmouth, some 80 miles away. Time constraints prevented the use of the VHF R/ T and no consideration was given to the activation of any of the three EPIRBs carried on board.

1.11 Life-saving Equipment

The vessel's life-saving equipment included 18 immersion suits, a dory and two inflatable liferafts. The two 20-person liferafts on board were positioned one on either side of the poop deck. There is no regulatory requirement for a liferaft to be equipped with a radio. However, the "CAPE ASPY" was required to carry two Class II EPIRBs, strategically positioned for easy access in an emergency, so that one EPIRB could be placed in each of the first two survival craft launched.

1.11.1 Difficulty in Launching Liferaft

The liferafts were stowed in metal cradles on either side of the poop deck some 30 cm inboard of a 1 m-high shipside rail. They were secured in the cradles by means of nylon webbing secured to the deck by quick-release (senhouse) slips. They were not fitted, nor were they required to be fitted, with hydrostatic release systems (HRS). Thus, the starboard liferaft, which had become immersed in the sea due to the list, could not be reached and sank with the vessel.

The liferaft on the port side was released by the crew. However, due to the list, the liferaft was effectively placed under the rail and this, together with its weight of about 170 kg and the motion of the vessel, made the liferaft very difficult to launch. Consequently, it was inflated on board and, as the inflation process commenced, the liferaft was washed clear of the vessel almost intantaneously.

1.11.2 Emergency Position Indicating Radio Beacon (EPIRB)

The vessel was equipped with three 406 MHz EPIRBs, one of which was a Class I (float-free) EPIRB and the other two, which were fitted to the bulkheads in the wheel-house, were Class II EPIRBs. All three beacons were battery-powered and, while the Class I EPIRB can be activated manually or will activate

5 HRS is one of the approved release mechanisms that meet the regulatory requirements.

automatically when immersed in (fresh or salt) water, the Class II EPIRBs can only be activated manually. The latter were not removed during abandonment, and none of the survivors thought to take them. However, as the Class I EPIRB was fitted with a HRS[5], it floated free when the vessel sank and activated automatically, transmitting a 'MAYDAY' message. The message was received at the Mission Control Centre at 2350, 30 January 1993, and relayed to the Rescue Coordination Centre (RCC) Halifax, thereby initiating official SAR response.

The accident demonstrates the crucial role of a float-free EPIRB in saving lives.

1.12 Search and Rescue (SAR)

Once alerted, RCC tasked various CCG and commercial vessels together with SAR aircraft. An aircraft homed onto the EPIRB at 0241, and by 0318 had sighted the liferaft. Surface vessels were then directed to the scene, and at 0342 rescued ten persons from the liferaft.

At 0500, another vessel sighted and rescued a survivor floating in the water in an immersion suit. Three bodies were recovered at 0530, 0900 and 1015, respectively. The search continued for another 30 hours, it was then placed on reduced status, and the case was handed over to the Royal Canadian Mounted Police (RCMP) as a missing persons case.

1.13 Operational Safety and Training

1.13.1 Company Standing Orders

Included in the Company Standing Orders issued to the master were the procedures for securing vessels for sea. They included a requirement that all openings to the sea be closed before sailing and that security rounds be carried out while at sea to ensure the openings remained closed. However, there was no regime in place within the organization to ensure compliance with these orders.

1.13.2 Ship Safety Bulletins

The parent company, National Sea Products Ltd., received Ship Safety Bulletins from the CCG but Scotia Trawler Equipment Ltd., the operators, did not receive them from either source.

A number of these bulletins refer specifically to the dangers of vessels proceeding to sea without first ensuring that weathertight openings to the hull are properly secured.

1.13.3 Marine Emergency Duties (MED) Training and Crew Safety

Responsibility was delegated by the company to the master, chief engineer and mate of each vessel for training the crews in safety aspects and drills, including abandon ship procedures. There is no regulatory requirement, nor is it a company policy, for uncertificated crew to undertake MED training. Only crew members who held Certificates of Competency had undergone MED training as a prerequisite to obtaining certificates. Six of the seven crew members who had MED training played a role in the inflating and eventual launching of the liferaft.

1.13.4 Boat Drills

It had been the practice to hold boat drills on board the vessel at intervals of not more than one month. During these drills, abandon ship procedures, comprising the donning of immersion suits and mustering at the liferaft stations, had been carried out. All but one of the crew members, who had recently joined the vessel, had been well trained in the shipboard abandon ship procedures. Hands-on training respecting the launching, inflating and boarding of liferafts from the sea and essential survival techniques is generally offered at appropriate marine training establishments.

1.13.5 Survival

None of the crew members who boarded the liferaft knew of the position or use of the knife provided in the liferaft to cut the painter. However, the painter had been cut by the crew before the liferaft was washed over the side.

After crew members boarded the liferaft, the sea anchor was deployed and the paddle was used in an attempt to hold the liferaft against the wind and seas; however, the paddle proved ineffective and broke. Shortly thereafter, one of the liferaft's distress flares was activated and the rest were deployed when rescue aircraft arrived on scene. The liferaft canopy was sealed to conserve body heat. Fresh water rations were used to alleviate the thirst associated with swallowing sea water.

The person who survived some five hours in the water attributed his survival to the protection afforded by his immersion suit, together with his efforts to stay awake and alert by occasionally forcing his body to the upright, which required concentration and effort. When rescued, he was suffering from mild hypothermia. (For survival time, see Appendix F.)

1.13.6 Immersion Suits - Colour Degradation

Those immersion suits which had been immersed in sea water for five hours or

more had lost the greater part of their high visibility characteristics; they showed signs of colour degradation and had blackened.

1.13.7 Operational Practices - Weathertight Openings

The "CAPE ASPY" had made some 225 trips since she was converted into a scallop trawler. During the trawling operations, which required slow speed and access to various compartments, the practice was to leave the access doors and hatches open. Such practices continued even when the vessel was proceeding at full speed to and from fishing grounds. No survivor could recall when the weathertight doors and hatches had last been closed.

1.13.8 Ice Accretion Hazard - Appreciation by the Crew

All of the survivors believed the sudden increase in the list was due to the ice accretion causing a sudden massive loss of stability, and that it was not associated with the practice of keeping weathertight accesses open.

1.14 Operating Pressures

Under a recently adopted system of harvesting, the Department of Fisheries and Oceans had allocated a catch quota to the company. The quota was shared equally between the vessels in this fleet thus eliminating internal fleet competition.

The scallop fishery is well managed. The price of scallop varies based on market conditions and is low in the early part of the year, increasing in spring and reaching a maximum toward the latter part of the year.

Reportedly, no pressure had been placed by the operators upon the master or crew to go to sea under conditions that may not have satisfied them, or that they may have believed to be more dangerous than during the normal course of fishing. The master had approached senior management on the Friday morning and expressed his concerns over the weather forecasts, stating his intention to sail when the forecasts improved, which met with their concurrence. Shore management internal correspondence indicated that the "CAPE ASPY" would not sail on Friday, but probably would do so on Saturday or Monday. The note also provides the appropriate catch landing dates.

1.15 Factors Affecting Decision Making

The work at sea takes place in a very specific, sometimes hostile, environment e.g. vessel icing and motion which vary in strength with meteorological conditions.

Generally, variable and continuously changing factors result in complex decision-making processes that involve the safety of the vessel and crew. These decisions are often made in the face of grave adversities and in a limited time frame. Some of the factors influencing decision making associated with impending dangers include:

- The (individual's) tendency to search for alternative interpretations of warning messages that will neutralize the threat conveyed (Ikeda, 1982).

- Any vagueness in warning allows for interpretation of the situation in a non-threatening fashion (Perry et al., 1981).

- The initial tendency to interpret new data in terms of the known and the familiar (Quaranteilli, 1980).

- The perceived risk by decision makers bears a stronger positive relationship to warning response (Perry and Greene, 1983).

2.0 Analysis

2.1 Stability and Sinking Sequence

The vessel's intact transverse stability, which was inherently lower than designed or approved due to the position of the sole in the converted fish hold, was further lowered with the reduction in the righting ability caused by the loss of the reserve buoyancy of the starboard processing room.

Had the ice accretion been symmetrical and the vessel remained upright, her transverse stability characteristics would have been lower than the STAB. 4 criteria when approximately 65 per cent of the regulatory ice accretion was incurred. However, because there was more ice accretion on the starboard side, the resulting heel made the vessel more vulnerable to the shipping of seas and caused a further reduction of the already lowered transverse stability.

Because of the vessel's motion in the rough seas, the surging of the shipped water caused the intermittent immersion of open or unsecured openings on the weather deck and, due to the existing heel, those on the starboard side were the most susceptible to downflooding.

The starboard side air pipe to the forward net store (marked Q in Appendix B) was the furthest outboard and, therefore, the most likely initial source of downflooding. The watertight sole of the net store extended the full width of the hull, and the downflooding, after initially gravitating to starboard, was free to flow across the under-deck compartment in response to the vessel's rolling. This free surface effect quickly eliminated the vessel's already reduced transverse stability and resulted in the sudden large angle of heel reported by the survivors.

Since the vessel suddenly listed about 45° to starboard and appeared to be 'settled by the head', this would indicate that sea water had entered the forward part of the hull and downflooding had commenced.

When the vessel heeled approximately 45°, downflooding by way of several of the open or unsecured doors and hatches became general and subsequently progressed until all reserve buoyancy was lost and the vessel sank.

2.2 Appreciation of Factors Affecting Stability

2.2.1 Operational Practices Aboard the "CAPE ASPY"

While the "CAPE ASPY" had made many trips with the access doors and hatches in the open position, harsher weather conditions, such as those experienced during the last trip, show how vulnerable a vessel becomes when such unsafe practices are allowed to continue. Good seamanship practice dictates that all watertight/ weathertight doors/ accesses/ hatches be kept open only while in use and that they be secured shut at all other times while at sea.

2.2.2 Ice Accretion and Removal

Local Nova Scotia experience has shown that ice accretion occurs principally in the vicinity of the coast, rapidly decreasing as vessels move closer to the warmer waters and milder weather associated with the Gulf Stream and Georges Bank. In fact, there is no known record of ice accretion being a problem to fishing while on Georges Bank. It is not unusual for fishing vessels to accrete ice during trips from and to Lunenburg in the winter months and to allow the changing weather conditions to solve the problem, but, in this case, the accretion was reportedly heavier than usual.

2.2.3 Passage Planning

Following departure, as the track of the vessel gradually diverged from the coast, the protection afforded by the lee of the land gradually decreased over a period of some nine hours. During this time, the vessel would have accreted some ice on her upperworks. Considering that the vessel was proceeding to sea in unfavourable weather conditions with freezing spray warnings and with the wind on her starboard beam, good seamanship practice would have been to proceed as close to shore as was safe and practicable to minimize the initial rate of ice accretion. The vessel was some 25 miles off the coast and exposed to severe weather.

2.2.4 Ice Accretion and the Ingress of Sea Water

Contrary to the survivors' belief (section 1.13.8), ice accretion produces a gradual, albeit accelerating, loss of stability. The characteristics of the reported sudden list are consistent with an uncontrolled ingress of water to the hull.

There was awareness of the dangers of ice accretion, hence the course alteration to reduce the rate of ice accretion. Because the vessel proceeded to sea in adverse weather conditions with watertight/ weathertight openings not securely shut, there was an apparent lack of appreciation of the dangers associated with a possible ingress of sea water through those openings.

2.3 Operational Safety Issues

In the absence of acknowledgement of any of the 'MAYDAY' messages transmitted by the "CAPE ASPY" on the SSB R/ T, it could have been advantageous to have attempted calls on the VHF R/ T channel 16 as well. Whether the 'MAYDAY' messages were acknowledged or not, it could have been useful to have activated at least one of the three EPIRBS before abandoning the vessel. Furthermore, despite having easy access to the Class II EPIRBs, the crew did not take any of the EPIRBs required to be taken into the survival craft.

The benefits of the MED course and of practising abandon ship procedures on board are reflected by the fact that most of the crew successfully abandoned the vessel within 15 minutes, in difficult conditions.

However, as neither of the two Class II EPIRBs were taken into the liferaft and one crew member did not manage to don an immersion suit or abandon the vessel properly, the need for additional training is apparent.

2.4 Launching of Inflatable Liferaft on Deck

Because the list of the vessel effectively placed the port liferaft below the port side railing, difficulties were experienced in launching the liferaft and it was therefore inflated at its position on deck. This procedure was unsafe inasmuch as it left the liferaft vulnerable to possible damage and/ or to becoming entangled in the vessel's rigging, etc. However, given the unusual circumstances and the inaccessibility of the other liferaft, there was

no alternative but to inflate the liferaft at its position on deck.

2.5 *Monitoring of Company Orders*

Since there were no records to indicate adherence to company orders respecting the closing of weathertight/ watertight doors, etc., and since none of the crew members could recall when they had last seen them closed, it would appear that the instructions were not followed.

2.6 *Effect of Icing on Radio Performance*

Experience has shown that ice accretion on a radio antenna can significantly diminish transmission capabilities. The extent to which the antenna on the "CAPE ASPY" was ice accreted is not known. However, as none of the three 'MAYDAY' messages were received by the two vessels or the shore-based radio station which were well within normal radio range, it is possible that ice accretion played a significant part in a reduction of the transmission power.

2.7 *Crew Decision Making*

Various factors were involved in the decision to fish. It was determined that, as the scallop fishery was well managed and as the price of scallops was at a seasonal low in January, there likely was no fishery-related economic pressure to take additional risks on this trip.

Over the years, fishing has been transformed from an occupation based on traditional knowledge and skill to one based on management skills and entrepreneurial abilities. Fishing, in general, is a high-risk occupation and the traditional attitude of the fishermen is to accept the risks involved[6]. Thus, threats posed by the hostile environment are often downplayed in the initial stages and during the decision-making process, and are responded to only when danger arrives, in some cases, with tragic consequences.

Because fishing is physically demanding, the crew set practices to facilitate operations. These practices, when continued, form habits, and the resultant changes in attitude and perception can inadvertently compromise safety. In this instance, weathertight/ watertight accesses were left open at sea for easy access which permitted downflooding to occur and progress until the vessel sank.

6 Study by the Coast Guard Working Group on Fishing Vessel Safety.

3.0 Conclusions

3.1 Findings

1. The vessel proceeded at full service speed toward the fishing grounds in adverse weather conditions with some weathertight accesses to the hull secured in the open position and others closed but not secured.

2. On departure, the vessel's transverse stability characteristics met all but one of the normal ice-free criteria.

3. The addition of the regulatory prescribed weight of ice accretion to the departure loading condition shows the vessel's transverse stability to have been markedly below all but one of the applicable STAB. 4 criteria.

4. Due to the location of the fish hold sole, the actual centre of gravity of the catch preservation ice on board on departure was some 1.22 m higher than that indicated in the approved Trim and Stability Booklet.

5. Because the weathertight door to the starboard processing room had been left in the open position, significant reserve intact buoyancy, which would have contributed to the vessel's righting ability, was lost.

6. The starboard side air pipe to the forward net store, being the furthest outboard, was the most likely initial source of downflooding in the listed condition.

7. The ice accretion was predominantly to starboard and caused a list of some 8° which led to the shipping and retention of sea water on the weather deck.

8. When the vessel heeled some 45°, downflooding by way of several of the open or unsecured doors and hatches became general, and subsequently progressed until all reserve buoyancy was lost and the vessel sank.

9. There was no attempt to physically remove the sea spray ice in order to reduce the list.

10. Distress messages were not transmitted by all of the available means; they were transmitted on the SSB R/ T distress frequency and were not received by any shipboard or shore-based radio station, probably due to ice accretion on the "CAPE ASPY" antenna.

11. The only indication of the distress was provided by the vessel's Class I EPIRB which floated free and activated automatically after the vessel sank.

12. The location of the liferafts aboard the vessel did not take into account the launching difficulties that could possibly be encountered when abandoning ship in adverse weather conditions or with a severe list.

13. Neither of the two liferafts was fitted with a HRS, and the starboard liferaft, which had become immersed in the sea due to the list, could not be reached and sank with the vessel.

14. Some survivors in the water did not gain the safety of the liferaft as it drifted away from them.

15. The immersion suits lost the brilliance of their orange colouring after they were immersed in sea water for some five hours.

16. The vessel operators did not receive Ship Safety Bulletins from either the parent company or the CCG.

17. There was no system in place to monitor the Company's Standing Orders to ensure that weathertight accesses to the hull were closed and secured while at sea.

3.2 Causes

The "CAPE ASPY" proceeded to sea in rough weather conditions with many weathertight/ watertight openings to the hull either in the open or in the closed but unsecured condition. The combined effects of rough weather, sea spray ice accretion, free surface effect of shipped seas retained on deck, in conjunction with the vessel's low transverse stability and the downflooding to the hull, caused the "CAPE ASPY" to lose all reserve buoyancy and sink.

4.0 Safety Action

4.1 Action Taken

4.1.1 Interim Recommendations

Since 1975, failure to secure openings on decks and below decks has contributed to the loss of at least 17 other Canadian vessels and 23 lives.

In 1992, as a result of the investigation into the sinking of the Canadian fishing vessel "NORTHERN OSPREY", the Board made a recommendation concerning the openings in bulkheads and associated watertight integrity on fishing vessels (M92-04). The Department of Transport then issued a Ship Safety Bulletin (No. 16/ 92) reminding mariners of the importance of keeping watertight fittings closed at all times.

As a result of the "CAPE ASPY" accident and of the sinking of the Canadian fishing vessel "NADINE" in the Gulf of St. Lawrence in 1990, the Board issued three interim marine safety recommendations which addressed safety deficiencies with respect to watertight integrity, the distribution of safety information, and the installation of liferafts for fishing vessels. Specifically, the Board recommended that the Department of Transport:

> Develop and implement measures to ensure that owners, operators and masters of vessels under its jurisdiction have effective training and procedures for securing all exterior and interior openings sufficient to preserve the watertight integrity of the hull;
> (M93-01, issued March 1993)
>
> Evaluate the effectiveness of its distribution practices for all marine safety information aimed at fishing masters and fishermen; and
> (M93-02, issued March 1993)
>
> Ensure that liferafts on all federally approved or inspected vessels are stowed in such a manner as to permit easy manual launching under distress and any environmental conditions likely to be encountered by that vessel.
> (M93-03, issued March 1993)

In response to these recommendations, the Minister of Transport advised that the Canadian Coast Guard (CCG) intended to intensify the examination of masters, mates and engineers on matters related to watertight integrity and to re-issue Ship Safety Bulletins Nos. 1/ 83 and 4/ 87. With respect to the effectiveness of the distribution of Ship Safety Bulletins, the CCG issued a Special Edition of the Bulletin (No. 2/ 93) to reach several thousand fishing vessel owners, listing the titles of all Ship Safety Bulletins published since 1977. Finally, the Transportation Development Centre (TDC) is funding a research and development project to consider methods of improving the stowage of liferafts on board fishing vessels.

4.1.2 Scotia Trawler Equipment Ltd.

Following the sinking of the "CAPE ASPY", Scotia Trawler Equipment Ltd. conducted a thorough re-evaluation of its practices and procedures, looking for ways to improve

the level of safety on its vessels. As a result of discussions with crew members, rescuers, government authorities and safety experts, Scotia Trawler has taken the following measures:

a) conducted life-saving training sessions, Marine Emergency Duties (MED) level A-1, for most of its crew members;

b) distributed CCG Marine Advisories and Ship Safety Bulletins to the masters and mates of its fleet;

c) replaced wooden dories by fibreglass lifeboats on board each vessel of its fleet;

d) investigated and installed automatic hydrostatic release systems and repositioned the liferafts to facilitate launching;

e) recommended improvements in the colour and lighting systems of immersion suits to make them more detectable in daylight and at night;

f) improved training on the proper use of immersion suits and various shipboard exercises such as man overboard, boat and fire drills; and

g) provided company masters and mates with additional instruction on factors affecting vessel stability.

4.1.3 Stowage of Liferafts

Every year, fishermen's lives are endangered due to limitations in current liferaft stowage arrangements found on many small fishing vessels and work boats. These liferafts are required to be fitted with a float-free arrangement. The most commonly used stowage systems are deep chocks and hydrostatically released lashings. Both these methods have design flaws that cause operational problems. Liferafts in deep chocks cannot be lashed and are susceptible to being washed overboard in heavy weather. Hydrostatic releases have been known to activate prematurely when waves are shipped on deck.

For these reasons, TDC was requested to conduct a study on the stowage and launching of liferafts on fishing vessels. It has awarded a contract for the development of the design and operational criteria leading to the specification and prototype design of a liferaft stowage and deployment system for use on tugs and fishing vessels. The development of a low-maintenance, cost-effective, safe and efficient system for the stowage and deployment of small liferafts is the objective.

Finally, the CCG provided recommended guidelines for the stowage and installation of throw-over type inflatable liferafts for ease of launching under icing conditions (Ship Safety Bulletin No. 9/ 93).

4.1.4 Use of EPIRBs on Fishing Vessels

On the "NADINE" (TSB #M90L3034), the Class I Emergency Position Indicating Radio Beacon (EPIRB) released automatically. Since it was not armed during installation, no distress signal could be transmitted. In May 1991, the TSB brought to the CCG's attention the inadequacy of set-up procedures and operational practices for EPIRBs. Subsequently, the CCG issued a Notice to Shipping and a Ship Safety Bulletin (No. 1/ 91) advising of the importance for all Class I float-free EPIRBs to be set for automatic operation as soon as they are installed on a vessel. On the "CAPE ASPY", the Class I EPIRB released automatically and a distress signal alerted the Search and Rescue (SAR) Coordination Centre resulting in 11 of the 16 crew members being saved.

4.2 Action Required

4.2.1 MED Training for Fishermen

Between 1986 and 1991, over 30 Canadian fishing vessels were recorded as being lost due to capsizing, foundering or sinking. Having to abandon their vessels, over 70 fishermen died in this same period. The decision to abandon a vessel at sea is often made under intense pressure in a very short time. The more familiar crew members are with their vessel's survival gear and its use, the better they will be able to respond to the emergency.

Although the "CAPE ASPY" was equipped with one Class I and two Class II EPIRBs, due to time constraints, none was activated and none of the survivors took one into the liferaft.

On the "CAPE ASPY", 14 of the 15 crew members were wearing immersion suits. The master was last seen attempting to don an immersion suit. The other missing person had been seen not to be wearing an immersion suit. The donning of immersion suits during emergency drills conducted during MED training and practice several times a season can reduce the time required to find and don the equipment in a real emergency.

At present, uncertificated crew members are not required to receive such training. Currently, on fishing vessels of between 100 and 400 gross registered tons (GRT), only the master is required to have certification. However, approximately 98 per cent of Canadian commercial fishing vessels are less than 100 GRT, and the majority of them are manned by uncertificated crews.

Following its investigation into the sinking of the "NADINE", the Board recommended that Transport Canada:

> Take whatever measures are necessary to ensure that the safety intent of the Boat and Fire Drills Regulations is being fulfilled by owners and operators of fishing vessels;
>
> (M94-07, issued May 1994)

> Conduct a formal evaluation of current practices for the stowage of life preservers and immersion suits on fishing vessels with a view to ensuring immediate accessibility; and
>
> (M94-08, issued May 1994)
>
> Encourage all fishing vessel masters/ owners to prepare and maintain appropriate muster lists for each vessel, regardless of the crew size.
>
> (M94-09, issued May 1994)

As a result of its investigation into the sinking of the Canadian fishing vessel "STRAITS PRIDE II" in 1990 (TSB #M90N5017), the Board recommended that:

> The Department of Transport ensure that personnel who regularly crew closed-construction fishing vessels receive formal training in life-saving equipment and survival techniques.
>
> (M92-06, issued March 1993)

It is understood that Transport Canada has completed a proposed amendment to the *Canada Shipping Act* (CSA) that would meet the intent of this recommendation. However, it is not known when this amendment will come into effect.

In light of the Board's previous recommendations relating to MED and the action under way to amend the CSA, the Board has no further action to recommend at this time. However, the lack of knowledge with respect to life-saving equipment and survival techniques continues to reduce fishermen's chances of survival in emergency situations. Therefore, the Board expects that Transport Canada and the industry will urgently take the necessary measures to mitigate the risks inherent in this lack of knowledge.

4.3 Safety Concern

4.3.1 Ice Accretion

Ice accretion on fishing vessels is a perennial hazard for fishermen in Canada. The icing season on Canada's east coast extends from mid-December to late March. Company management and unions recognize the risks involved in winter fishing and they have agreed to impose some restrictions to minimize hazards due to severe ice accretion in the winter months.

When the "CAPE ASPY" foundered in heavy seas, high winds and freezing spray on 30 January 1993, the survivors believed that the sudden increase in the list and the loss of stability were due to ice accretion rather than water ingress. Before the sinking, the course was altered toward warmer waters to reduce the rate of ice accretion. Because de-icing at night and in poor weather conditions is dangerous, it was not attempted.

In the past 10 years, only one other fishing vessel was reported lost due to ice accretion. In December 1990, the fishing vessel "LE BOUT DE LIGNE" sank in the Gulf of St. Lawrence and three lives were lost. The most probable cause of the disappearance of the "LE BOUT DE LIGNE" was that the vessel suddenly capsized and sank in adverse weather conditions due to a loss of transverse stability resulting from the cumulative effects of icing, running before breaking waves in a light load condition and not stowing all the fishing gear at the lowest stowable level (TSB #M90L3033).

The Board is aware that Transport Canada has produced *Guidelines for Fishing Vessels Likely to Encounter Icing Conditions,* in Appendix III of the *Manual for Safety and Health for Fishermen* (TP 1283). Nevertheless, the Board is concerned that fishermen's lives continue to be endangered by ice accretion in winter months. Indeed, economic pressures may induce fishermen to operate in severe icing conditions,

thereby exacerbating the natural risks. Therefore, the Board will continue to monitor and report publicly on marine occurrences involving ice accretion on fishing vessels and the circumstances contributing to such occurrences.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, the Hon. Wilfred R. DuPont and Hugh MacNeil, has authorized the release of this report.

Appendix A - Photograph

The "CAPE ASPY" after conversion to a scallop trawler.

Appendix B - Outline General Arrangement

Appendix C - Sketch of the Area

Appendix D - Wind Chill Factor

Appendix E - Excerpts from STAB.4

Appendix F - Cold Water Survival

Appendix G - Glossary

A	aft
AST	Atlantic standard time
air pipe	A pipe providing ventilation and air pressure relief to tanks or under-deck compartments.
BHP	brake horsepower
C	Celsius
CCG	Canadian Coast Guard
centre of gravity	The point through which a vessel's weight is deemed to act downward.
cm	centimetre(s)
downflooding	The ingress of water into the hull by way of openings at or near the sea surface which become immersed.
EPIRB	Emergency Position Indicating Radio Beacon
F	forward
freeing port	Openings in the bulwark which allow shipped water to drain overboard from the weather deck.
free-surface effect	The reduction of stability due to the movement of unrestricted liquid surfaces.
GZ	Righting lever: The horizontal distance between the line of buoyant upthrust and the downward action of gravity indicative of a vessel's ability to recover from large angles of heel.
heel/ list	The fixed inclination of a vessel from the vertical.
HRS	hydrostatic release system
IMO	International Maritime Organization
intact stability	Stability dependent on the watertight integrity of the hull being maintained.
inclining experiment	A procedure to determine a vessel's lightship weight and centre of gravity.
kg	kilogram(s)
knot	one nautical mile per hour
m	metre(s)
'MAYDAY'	distress message
MED	Marine Emergency Duties
mm	millimetre(s)
MHz	megahertz
N	north
RCC	Rescue Coordination Centre
RCMP	Royal Canadian Mounted Police
reserve buoyancy	Enclosed hull or superstructure volumes which, when immersed, provide buoyancy which is included in the computation of a vessel's intact stability.
R/ T	radiotelephone
SAR	Search and Rescue
SI	International System (of units)
SSB	single side band
stability	The ability or tendency of a vessel to return to the upright.
sole	Bottom - synonymous with floor space.
TDC	Transportation Development Centre

trim	Difference between a vessel's forward and aft draughts.
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VHF	very high frequency
W	west
watertight	Designed to prevent the passage and withstand the pressure of water from either side.
weathertight	Doors and hatches intended to prevent the ingress of water into the intact hull and designed to withstand water pressure from the outboard side.
°	degree(s)
'	minute(s)