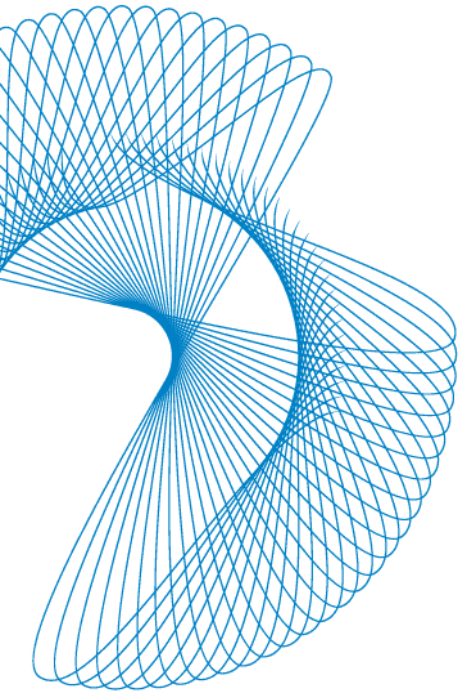
MARITIME NEW ZEALAND



Accident Report

Fatality from an Unnamed Vessel

24 October 2009

Maritime New Zealand

Maritime New Zealand (MNZ) is a Crown entity appointed under Section 429 of the Maritime Transport Act 1994, with the responsibility to promote maritime safety, security and the protection of the marine environment.

Section 431 of the Maritime Transport Act sets out MNZ's functions. One of those functions is to investigate and review maritime transport accidents and incidents.

This accident report is published in 2011 by:

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ENVBOP	Environment Bay of Plenty
EPIRB	emergency position-indicating radio beacon
HELP	Heat Escape Lessening Posture
hp	horsepower
kW	kilowatt
MNZ	Maritime New Zealand
NPBSF	National Pleasure Boat Safety Forum
NRBSS	National Recreational Boating Safety Strategy
PFD	personal flotation device
PLB	personal locator beacon
rpm	revolutions per minute
SAR	search and rescue
SSB	single sideband
VHF	very high frequency

Executive summary

At approximately 1500 hours on 24 October 2009, a recreational fisherman departed the shore of Lake Rotoma to go fishing for trout in a 12 foot (3.7 metre) aluminium dinghy.

At approximately 1910 hours, a member of the public alerted local police that his unmanned vessel was going around in circles on the lake.

The vessel was bought ashore with no sign of the fisherman.

A search of the lake by police divers the following day found the fisherman's body on the lake bed.

The investigation found that the fisherman is likely to have fallen overboard while his vessel was operating at speed and it struck him as it circled, rendering him unconscious and causing him to drown.

As a result of this investigation, Maritime New Zealand (MNZ) has made a series of safety recommendations concerning the attachment of engine shut-off lanyards, the wearing of lifejackets, the use of propeller guards, and communications.

Information on lifejackets and cold water immersion survival is also provided.

Figure 1 Vessel post recovery

Factual information

1. The information in this report comes from a variety of sources, including:

   - witness statements
   - Environment Bay of Plenty (ENVBOP)
   - New Zealand Police.

2. On 24 October 2009, the fisherman departed the shore at approximately 1500 hours to fish on Lake Rotoma. He was assisted by a family member to launch his vessel and was seen by local residents fishing between Otangiwai and Anaputa Points.

3. At 1901 hours, a member of the public approached local police, advising that the fisherman's unmanned vessel was going in circles on the lake.

4. A number of local vessels went to the scene, approximately 150 metres from shore, but were unable to find any sign of the fisherman.

5. His vessel eventually ran ashore after another vessel was able to come alongside and nudge it in the direction of the shore.

6. At 2011 hours, a rescue helicopter arrived on the scene, but after a visual and spotlight search it failed to locate the fisherman.

7. On 25 October at 1400 hours, police dive squad members commenced a search of the lake bed.

8. At 1800 hours, the fisherman's body was located and recovered from the lake bed.

9. A post-mortem examination concluded that the fisherman had suffered head injuries consistent with a high-impact collision, probably as a result of being hit by his vessel's propeller, and had drowned.

Comment and analysis

The vessel

10. The vessel was a 12 foot aluminium Fyran powered by a 15hp (11.2kW) Yamaha outboard motor. This length of vessel and motor is a common combination for small open power craft in New Zealand. The manufacturers state that a 15hp motor is the maximum power rating for a 12 foot vessel.

11. The Yamaha motor was equipped with a shut-off switch that can stop the motor when in operation. A lanyard (short piece of line) extends from the engine shut-off switch on the tiller to a clip designed to be attached to the operator's body. When the operator falls overboard or away from the motor, the lanyard tightens and pulls out the ignition shut-off switch, cutting the motor off and causing the vessel to stop.

12. To enable the Yamaha motor to maintain constant revs while underway a throttle control wing nut on the tiller can be tightened. As a consequence when the tiller is released the motor will continue to operate at set revs with no-one in control. In situations where control of the tiller is lost, even momentarily, small vessels can alter course suddenly causing persons on board to lose their balance and fall overboard. With no-one in control and the throttle controls at set revs most small vessels will turn in a tight circle in the manner described by witnesses.

13. Information provided to MNZ did not establish if the throttle control on the Yamaha motor was set at high revs when recovered however the observations of witnesses would suggest it was.

14. When tested at speed a Fyran 12 foot vessel with a 15hp Yamaha motor on set revs was found to turn suddenly to starboard when the tiller handle was released. In rougher conditions, vessels have been known to steer an erratic course due to the influence of waves on the hull.

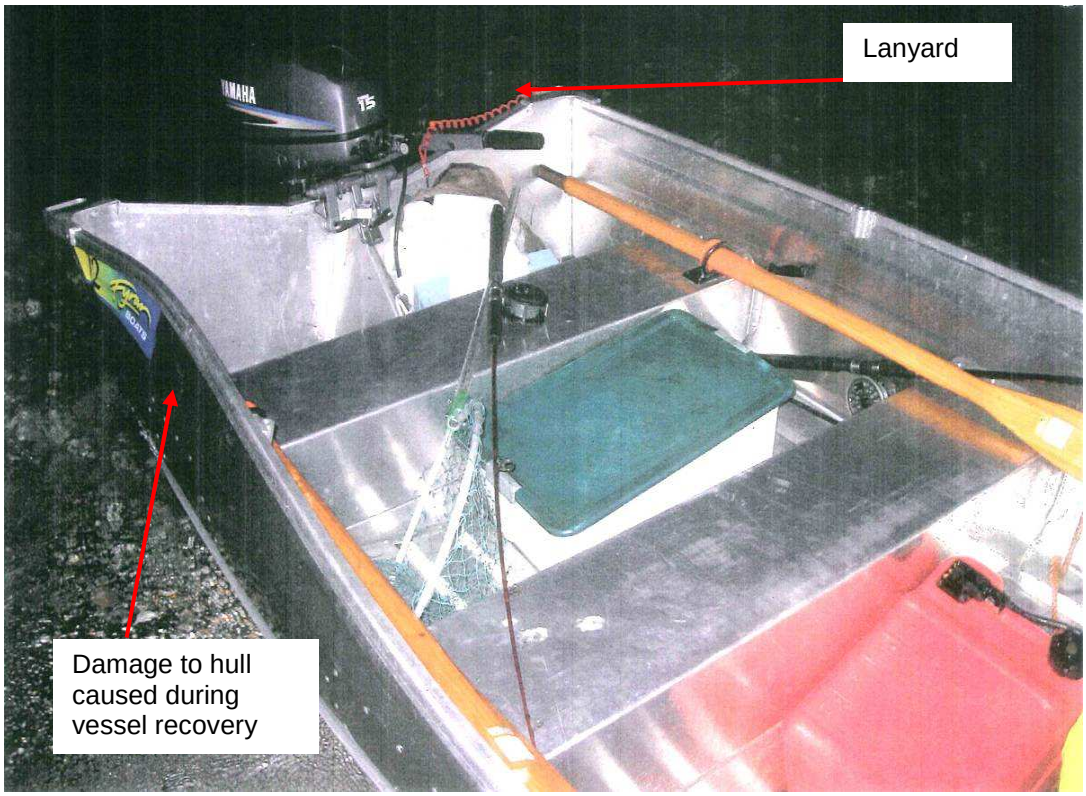

Figure 2 Fisherman's vessel after being beached

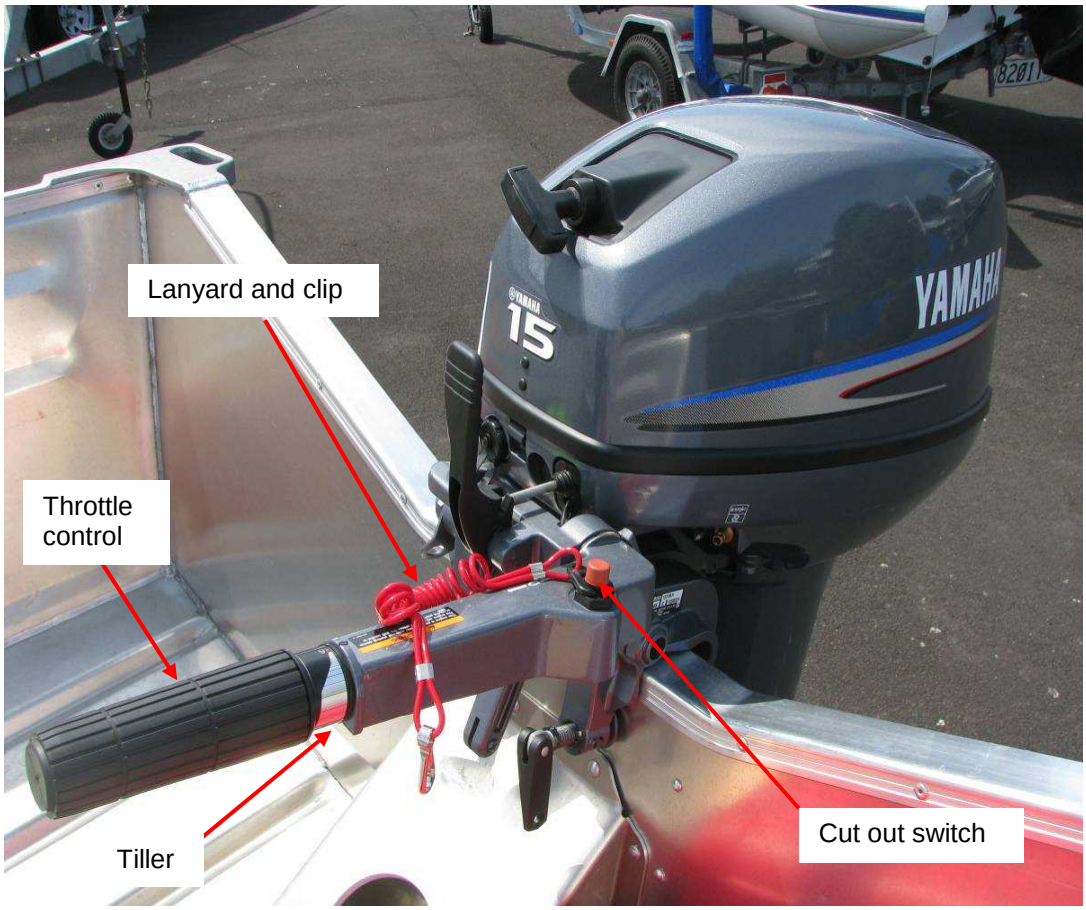

Figure 3 Similar vessel and motor showing lanyard arrangement

Figure 4 Similar vessel and motor showing throttle control wing nut

15. The motor manual advises operators on the appropriate use of the emergency stop switch as follows:

> *Engine shut-off cord (lanyard) and clip*
>
> *The clip must be attached to the engine shut-off switch for the engine to run. The cord should be attached to a secure place on the operator's clothing, or arm or leg. Should the operator fall overboard or leave the helm, the cord will pull out the clip, stopping ignition in the engine. This will prevent the boat from running away under power. Warning! Attach the engine shut-off switch to your clothing, arm or leg while operating. Do not attach the cord to clothing that could tear loose.*

16. The following equipment was found on board:

- 1 x yellow PFD with a collar head support
- 2 x fishing rods
- 1 x oar
- 1 x fish bin
- 1 x fuel tank.

One cap and one oar were found in the water by rescue craft.

17. The fisherman had a cellphone, but left it in his vehicle on the shore. It is believed he had no other means of communication on board.

The fisherman

18. A family member described the fisherman as an experienced boater. He had recently purchased his vessel and used it on three previous occasions. He was more experienced with larger recreational craft.

The fishing trip

19. The fisherman was experienced at fishing on Lake Rotoma. The family member who helped him launch the vessel was expecting him to fish for some hours on the lake before returning for dinner.

20. The precise time the fisherman fell out of the vessel cannot be determined, as there were no witnesses. There are numerous scenarios for what may have occurred for him to be in the water. One witness observed that trolling rods were reeled in and that the equipment on board was arranged to suggest he had completed fishing and was returning to the shore.

Environment

21. Lake Rotoma is located between Rotorua and Whakatane on State Highway 30. It is 103 square kilometres in size and can reach depths of 73 metres. It is a popular fishing lake.

22. Locals described the wind on the day as light, with a slightly stronger breeze developing during the rescue attempt. Air temperatures were cold, with frosts at night.

23. According to data received from ENVBOP, the water temperature was close to 10.5℃.

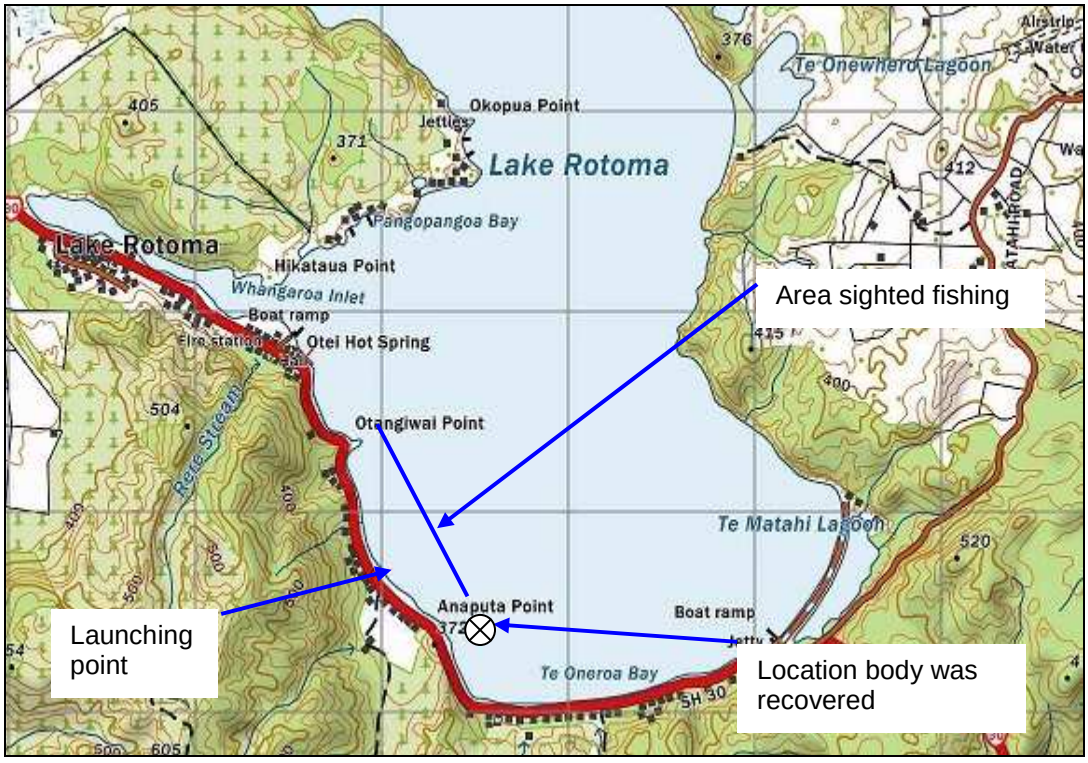

Figure 5 Lake Rotoma

Lifejackets/buoyancy aids

24. The fisherman's body was found fully clothed in heavy polar fleece clothing that included a jacket. He was also wearing gumboots. He was not wearing the lifejacket the family member said he was wearing when he left the shore. The family member believes he removed the lifejacket at some point to put on the jacket, and failed to put the lifejacket back on again.

25. People operating boats in environments with inherent risks should be equipped and prepared to ensure their safety. This accident highlights the need to wear a lifejacket or PFD at all times. This is especially so when operating in environments with inherent risks, such as a small craft on a cold lake. Some examples of inherent and environmental risks include operating:

- alone
- in small craft
- in remote locations
- at high speed
- on cold waters
- crossing bars
- in rough conditions

26. Discussion and advice about the various types of lifejacket, buoyancy aid and PFD can also be found in the *Safe Boating: An Essential Guide* publication. Appendix 2 of this report reproduces MNZ's website information about lifejackets and provides additional commentary on this topic.

Propeller strike

27. The autopsy report recorded the fisherman's cause of death as consistent with drowning. The facial injury is described as "a traumatic force sufficient to produce loss of consciousness with resultant drowning".

28. The danger to people in the water from propellers is well known to most mariners. Serious injuries and fatalities have occurred in New Zealand and overseas. A typical three-blade propeller running at 3,200 rpm can inflict 160 impacts in one second. Victims suffer multiple deep open wounds, parallel lacerations that can result in permanent scarring, severe blood loss, amputation or death.

29. There are a number of documented accidents where victims have fallen from power vessels and suffered severe injury from propellers after vessels have turned towards their position and struck them.

30. In such cases where the throttle remains open, many vessels will make a series of tight circles. This poses a grave risk of propeller strike to people in the water in the track of such vessels.

31. Propeller (prop) guards provide protection against injury from propellers. They are commonly used in situations where vessels are used in proximity to people in the water or alongside other vessels – for example, sailing clubs where support vessels come alongside capsized vessels with people in the water. Different varieties, made of plastic and metal, are available on the market. Some encase the entire aft lower unit that houses the propeller. One prop guard on the New Zealand market for a 15hp Yamaha retails for $199.00. Most prop guards have an adverse effect on performance, but this is offset by the protection provided from the propeller.

Cold water immersion

32. The period spent in the water prior to impact with the boat cannot be established and may have been relatively short. Water temperature may not have been a factor. The fisherman may have been struck and rendered unconscious soon after falling overboard.

33. When operating on waters where the danger of cold water immersion is present, it is highly recommended that every recreational boater should be adequately prepared for an emergency situation. When boating in cold water, where slowing the onset of hypothermia is crucial to survival, this should include:

- wearing lifejackets or PFDs suitable for the environment
- wearing several layers of warm clothing with a watertight outer layer
- carrying several suitable means of quickly and effectively communicating distress
- training, practice and experience with the essential safety equipment prior to entering the water
- avoiding entering the water if at all possible.

34. Appendix 3 contains general information about the effects of unplanned immersion in cold water.

Ability to communicate distress

35. The fisherman is not believed to have had any means of communicating distress on his person. This is not considered good practice, as the greater the number of means of communication carried, the greater the chance of contacting someone and being rescued in an emergency. However, it should be noted that the circumstances surrounding this accident suggest the fisherman may not have been in a position to communicate, even if he had equipment to do so. In heavy clothing and possibly with a circling vessel, his focus may have been on attempting to keep afloat and avoiding the vessel.

36. Discussion and advice on communications equipment can be found in the MNZ publication *Safe Boating: An Essential Guide*. This is produced by MNZ, Coastguard and Water Safety New Zealand and is available free from www.maritimenz.govt.nz. Appendix 1 of this report reproduces MNZ's website information about means of communication and provides additional commentary on this topic.

37. In cases where people suddenly find themselves in the water, any effective means of communication should be carried on a person, not left in the boat. A hand-held VHF radio or personal locator beacon (PLB) carried on a lifejacket significantly increases the chance of survival.

38. While cellphones, preferably stored in a waterproof bag, have allowed mariners to effectively communicate distress on many occasions, limitations such as coverage and signal availability make them a back-up option rather than a primary means of communication.

Conclusions

39. While the precise circumstances leading to the fisherman falling overboard and sustaining injuries cannot be determined, it is likely he lost control of the tiller while travelling at speed. If control was lost even momentarily, the dinghy may have altered course suddenly, causing him to lose his balance and fall overboard.

40. With no-one in control and the throttle set for the vessel to operate at speed, the thrust of the propeller would have caused the motor to hold a hard-over position. This would have caused the vessel to turn in tight circles, as observed by witnesses.

41. The vessel is likely to have begun turning in circles immediately after the fisherman fell overboard.

42. In heavy clothing, the fisherman would have had extreme difficulty in keeping clear of his vessel as it circled towards him.

43. After being stuck on the side of the face by the propeller and possibly rendered unconscious, the fisherman drowned.

44. Had the fisherman been wearing a lifejacket, he would have remained on the surface. Had he remained conscious after impact, it is possible he may have survived until rescued, despite his severe injuries.

45. A primary cause of this accident was the failure of the fisherman to attach the shut-off lanyard to his body. Had he done so, the vessel would have stopped immediately he fell overboard. He could then have used his vessel to support himself in the water and await rescue or, possibly, re-board the vessel.

Recommendations

46. It is recommended that:

    a) all people operating outboard motors should ensure that engine shut-off lanyards are attached to their body before operation

    b) sole operators of smaller craft should always wear a lifejacket

    c) operators and owners of outboard motors should consider the added safety benefit of fitting outboard motors with prop guards.

47. It is recommended that MNZ, working through the National Pleasure Boat Safety Forum (NPBSF):

    a) continues to foster, in line with the National Recreational Boating Safety Strategy (NRBSS), the carriage of effective emergency equipment by way of:

        i) a national safety awareness campaign, and

        ii) consideration of the introduction of legislation making the carriage of communications equipment in recreational craft compulsory in support the NPBSF's current recommendation.

    b) continues to promote throughout the recreational boating community:

        i) the safe use of lifejackets and PFDs

        ii) the correct methods for in-water survival techniques

        iii) the effects of hypothermia and the steps that can be taken to reduce its onset

        iv) the need to be prepared for any emergency situation and the value of assessing the associated risks and implementing contingency plans to mitigate such risks

        v) the need to carry several forms of communication.

48. This accident report should be placed on the MNZ website.

Appendix 1: Communications equipment

Published on the MNZ website at www.maritimenz.govt.nz/Recreational-Boating/Communications-equipment/Communications-equipment.asp, as at Thursday, 19 November 2009.

Communications equipment is an essential part of safe boating – because if you can't contact someone to say you're in trouble, nobody can rescue you.

You should carry at least two of the following at all times, so you can get help in the event of an emergency:

- hand-held VHF radio (channel 16) – a hand-held waterproof radio will allow you to speak to anyone in the area who could help (as well as to rescue authorities) – hand-held VHF radios are recommended because, in the event of a capsize, a radio attached to the boat will not be accessible
- cellphone (call 111) – remember to keep it on you and keep it dry! The problem with a cellphone (compared with a VHF radio) is that you can only ring one person at a time, and the phone will only work when dry
- red hand-held flares – use red ones to signal for help
- EPIRBs – emergency position-indicating radio beacons or EPIRBs are for maritime use and are designed to float in water. For more about 406MHz distress beacons, visit the beacons website at www.beacons.org.nz.

In addition, don't forget some low-tech ways to help get attention:

- sound signals – use a horn or anything that makes noise
- torch – move or flash on and off or even signal SOS
- red flag
- arms – raising and lowering your arms is a recognised international distress signal.

More information and free resources

Email: publications@maritimenz.govt.nz with your details, to request any of the following:

- a cellphone bag – a ziplock bag to keep your cellphone dry
- *Radio Handbook* – all about VHF and SSB radios
- *Safe Boating: An Essential Guide* – booklet covering how to be safe on the water (seas, rivers or lakes)
- *Safe Boating in New Zealand* DVD – choose the topics you want to view – includes information on communications equipment (two hours long)
- tips about boating safety – a sticker with a quick summary of safe boating tips.

To learn more about safe boating, check out the courses on the Coastguard Boating Education website, including information about its marine VHF radio course.

Appendix 2: Lifejackets

Part 1: Lifejackets

Published on the MNZ website at www.maritimenz.govt.nz/Recreational-Boating/Lifejackets/Lifejackets.asp, as at Thursday, 19 November 2009.

You must carry a correctly sized, serviceable lifejacket (also known as a personal flotation device or PFD) for each person on board a pleasure boat in New Zealand. This is a legal requirement, and this rule applies to all boats, including tenders and larger craft.

Lifejackets must meet New Zealand Standard 5823: 2005 – specification for buoyancy aids and marine safety harnesses and lines, or another national standard accepted by MNZ. They must be stored so that they are immediately available in case of a sudden emergency or capsize.

It is the skipper's legal responsibility to ensure that lifejackets are worn in situations of heightened risk, such as when crossing a bar, in rough water and during an emergency, and by non-swimmers.

Most drownings in boating accidents involve craft under 6 metres. All those on board boats under 6 metres should wear a lifejacket, unless the skipper has assessed that this is not necessary, due to the low risk at the time.

Most accidents occur suddenly with no warning. There may be no time to grab a lifejacket unless it is close at hand, and it is extremely difficult or impossible to put on lifejackets securely in the water. Children should wear lifejackets at all times in boats under 6 metres.

Some local authorities in New Zealand now require life jackets to be worn at all times by people in vessels of 6 metres or less.

The right type of lifejacket

It is important to have the right type of lifejacket. Consider the type of boating you do, the distance from shore you intend to go and the kind of conditions you are likely to encounter. Your lifejacket retailer should be able to help you choose the type most suited to your needs.

Lifejackets provide more than flotation. They allow a person in the water to keep still and conserve energy, which will help to delay the onset of hypothermia. They also provide protection from injury in collisions, or when running aground.

Storage and maintenance

Store your lifejacket away from the sunlight. Ensure it is dry and clean and away from chemicals. Check your lifejacket before reuse and make sure it is still the correct size (especially for children). Inflatable lifejackets need to be checked and serviced regularly.

More information

For more information about lifejackets, you can:

- go to the section Types of lifejackets and PFDs
- talk to your supplier, or contact Water Safety New Zealand or Coastguard for some expert advice
- contact the MNZ recreational boating team, Water Safety New Zealand Inc or Coastguard.

Part 2: Types of lifejacket and PFD

Published on the MNZ website at www.maritimenz.govt.nz/Recreational-Boating/Lifejackets/Types-of-lifejacket-and-PFD.asp, as at Thursday, 19 November 2009.

Many different types of lifejacket or personal flotation device (PFD) are available. It is essential that you choose the correct type for your boating activities.

The following summarises the different types:

Type 401 – open waters lifejacket

Type 402 – inshore waters PFD

Type 403 – buoyancy vest

Type 404 – buoyancy aid wetsuit

Type 405 – buoyancy garment

Type 406 – specialist lifejacket

Inflatable lifejackets

Rescue buoy

Your lifejacket retailer should be able to help you choose the right PFD.

Type 401 – open waters lifejacket

These are designed to keep the wearer vertical in the water, and to hold a person's mouth and nose uppermost if they are unconscious. The two versions available are inflatable, or with semi-rigid foam flotation.

The ones with foam flotation are rated as having a minimum buoyancy rating of 100 newtons (adult size). These jackets are cumbersome and uncomfortable. They are not suited to continuous wearing on a pleasure craft, but because they are designed to hold an unconscious person's head and face clear of the water, they are best suited for emergencies such as abandoning a vessel.

The inflatable 401 lifejackets must provide 150 newtons of buoyancy, and are fitted with either a water activated inflation switch or a manual pull cord to inflate. They can also be inflated using a mouthpiece.

These jackets are also designed to keep a person's head and face clear of the water, and are comfortable and convenient to wear. They can be fitted with a safety harness.

Type 402 – inshore waters PFD

These provide at least 71 newtons of buoyancy and must have a buoyant collar to support the wearer's head. They are quite comfortable to wear continuously while boating, and are the most common PFDs found on recreational craft.

However, while they must not allow the wearer to tilt forward of vertical, they are not designed to keep an unconscious person's head and face above water. This type of PFD must be marked “May not be suitable for all conditions”. The effectiveness of this PFD is considerably reduced in rough or breaking seas or surf. The PFD will give support in the water for an extended period.

This type of PFD normally relies on plastic clips and adjustable straps to secure it. These straps must be fastened securely and there is some tendency for this type of PFD to ride up on the wearer. A crotch strap is advised if the wearer may be using the PFD in rough water.

Type 403 – buoyancy vest

No collar is fitted to a buoyancy vest and it has a lower buoyancy rating than a lifejacket. It is designed for use in aquatic sports, such as dinghy sailing.

This particular type of PFD (adult size) must have at least 53 newtons of buoyancy. While wearing this type of PFD will not provide the same level of support or safety provided by other models, it is necessary for specialist type sports to have the most appropriate PFD for their purpose.

Type 404 – buoyancy aid wetsuit
A wetsuit with added buoyancy in specific areas. These are very expensive and suitable for some sporting activities.

Type 405 – buoyancy garment

This standard is the same as type 403, but is not required to have reflective tape or be brightly coloured.

They are often used in specialist sporting events, but where lack of bright colours may compromise safety a type 403 PFD should be used.

Type 406 – specialist lifejacket

This lifejacket is designed for white-water rafting or jetboating, and has a minimum buoyancy rating of 100 newtons (the same as type 401).

Inflatable lifejackets

Inflatable lifejackets are becoming increasingly popular with boaties, as they are more comfortable than other lifejackets. They are very light to wear and less restrictive. They also have considerably more flotation than foam lifejackets, and therefore exceed buoyancy requirements.

These lifejackets come in manual and automatic variations. Manual inflatables require the wearer to pull a tab to inflate the lifejacket, and automatic lifejackets inflate as soon as they are immersed in water. A ‘bumbag’ style inflatable lifejacket is also available.

While inflatable lifejackets have many advantages, they do require regular servicing and users should check them frequently to ensure the gas canister is properly screwed in and has not rusted.

Rescue buoy

This is one of two buoyancy aids that are not PFDs set by NZ Standard 5823:2001.

A rescue buoy is a semi-rigid buoyancy aid designed to be thrown to a person in the water to provide buoyancy while awaiting rescue. Commonly shaped as a ring or horseshoe, it can be held onto or placed around the chest.

Crotch straps

Crotch straps are recommended for lifejackets when they may be used in situations other than very calm water. Even when tightly secured, lifejackets have a tendency to ride up on the wearer if there is any wave action. Crotch straps are mandatory for all children-sized lifejackets.

Appendix 3: Cold water immersion

Part 1: Surviving cold water immersion

Adapted from Golden, F and Tipton, M, Essentials of Sea Survival*, 2002, ISBN-10: 0-7360-0215-4 Human Kinetics.*

Each year, 140,000 water-related deaths occur worldwide and in the United Kingdom, 55 percent of the annual open-water immersion deaths occur within 3 metres of a safe refuge. Significant international research has been undertaken to establish why some people survive cold water immersion when others do not.

First, there appears to be a general lack of understanding by seafarers of the nature of the various threats and the reaction of the body (physiological responses) to them. Second, in a survival situation, safety equipment is often not readily to hand, is difficult to operate in adverse conditions, or is impossible to use correctly without specific training. Survivors are often left to their own devices to adapt to the situation as best they can.

Predicting survival times in immersion victims is not a precise science. No magic mathematical formula can determine exactly how long someone will survive or how long a rescue search should continue. Therefore, search and rescue (SAR) coordinators must make some tough decisions based on the best information available and a number of assumptions. Search times typically extend beyond that which a person can reasonably be expected to survive in the circumstances. A rule of thumb is for search times to be at least three to six times the predicted survival times.

In water of 5℃, the survival time for a normally c lothed individual is estimated to be about one hour, with a recommended search time of six hours. The corresponding times for water of 10℃ are two hours and twelve hours. For water at 15℃ it is six and eighteen hours. However, these survival times are highly variable and are influenced by many different factors:

1. **Water temperature**. As the above figures suggest, the colder the water the shorter the survival times.

2. **Conditions**. Choppy water is more difficult for survivors to deal with than calm water, with many people panicking or even drowning from waves splashing over their heads.

3. **Personal factors**. Gender, size, fitness, health, age and shivering response all influence survivability. Statistically, the very young and very old are less likely to survive prolonged immersion in cold water than a mature adult. A fatter person will survive for longer than a skinny person due to the greater subcutaneous fat layer beneath the skin, which helps insulate the body from heat loss. Pre-existing health conditions may be exacerbated by cold water immersion.

4. **Insulation**. Clothing will significantly influence survivability. People dressed in several layers of heat-insulating clothing with a waterproof outer layer will last for longer in cold water than those who are lightly dressed. A popular misconception is that drowning is caused by the weight of saturated clothing ‘dragging people under’. This belief has led to the misguided advice to undress in the water, an action that reduces total insulation.

5. **Posture and exercise**. By limiting the amount of movement undertaken, there will be a corresponding reduction in the amount of heat loss from the body. Drawing the limbs up close to the body, adopting a foetal position and keeping them there is considered to be the ideal posture for prolonged cold water immersion.

6. **Injuries**. Many people who enter the water are injured before they do so, and they are sometimes knocked unconscious. The extent of the injuries will significantly affect survivability.

7. **Personal flotation device (PFD)**. Staying afloat without having to swim or tread water will reduce the amount of movement required by survivors. For those who lose consciousness, wearing a suitable PFD will ensure they remain above the surface of the water and not drown.

8. **Communications**. The sooner the rescue, the greater the chances of survival. But the outside world needs to know an accident has occurred and that can only be via effective planning and communications. Shore-based people should be briefed of the vessel's intentions before departure. A personal locator beacon (PLB), emergency position-indicating radio beacon (EPIRB), VHF radio, flares or even a cellphone in a sealed bag can be used to let others know an emergency situation has occurred.

9. **Ability to operate equipment**. Within a short period of time (often minutes or even seconds) after immersion, it can become extremely difficult to perform even simple tasks. Fingers become numb and 'seize up', so closing a zip, attaching a clasp or even raising a hand and waving can be impossible to achieve. Some survivors speak of the frustration of having safety equipment like a PLB available, but not being able to operate it because their fingers were so numb.

Long-term survival will generally only occur when the survivors are protected from the elements inside a life raft, or they are at least out of the water, reducing the amount of heat loss. Water and food is only an issue when prolonged survival is required before rescue.

While it should not be underestimated, hypothermia is attributed as the cause of death more than it should be. It generally occurs some time after initial immersion and victims are more likely to succumb to their injuries, lose consciousness and/or drown than they are to die of hypothermia.

Approximately 20 percent of rescued survivors die during or shortly after rescue (circumrescue collapse). This results from a collapse of blood pressure, an increase in the work rate of a cold heart when aiding one's own rescue (for example, climbing ladders on a high-sided ship) and/or excessively rapid rewarming (rewarming collapse).

Recommendations

1. Be prepared for the worst. Ensure all the equipment described earlier is aboard and functioning correctly. Regular training by everyone on board will ensure it is used correctly. Trying something for the first time once an emergency exists is not a safe option.

2. Avoid entering the water in the first place. Ensure others on board are capable of performing a speedy and effective man-overboard recovery if required. Only abandon the vessel if necessary and try to do so without entering the water (for example, step into a life raft while remaining dry). If entering the water is unavoidable, try to do so slowly to prevent cold shock and rapid body temperature loss.

3. Wear a PFD. Don't rely on retrieving it in an emergency or having the ability to put it on. Many victims have PFDs aboard their vessels but cannot reach them or they lose the ability to fit them once they enter the water.

4. Wear as much clothing as possible and try to ensure that the outer layer is watertight, protecting as much of the skin as possible from coming rapidly into contact with the water.

5. Stay still in the water and adopt the foetal position.

6. Complete any survival actions that require manual dexterity and strength soon after immersion before it becomes impossible to do so. Don't underestimate the speed with which incapacitation can occur.

7. Upon rescue, victims should be positioned to offset any potential problem in maintaining blood pressure. In a boat, the victim should be laid feet-forward, head-aft, but in a helicopter it is the opposite. Immediate competent medical attention is essential to survival.

8. Where possible, slow rewarming. A rate of 0.5℃ to 1℃ per hour is the safest option.

Part 2: Survive in cold water

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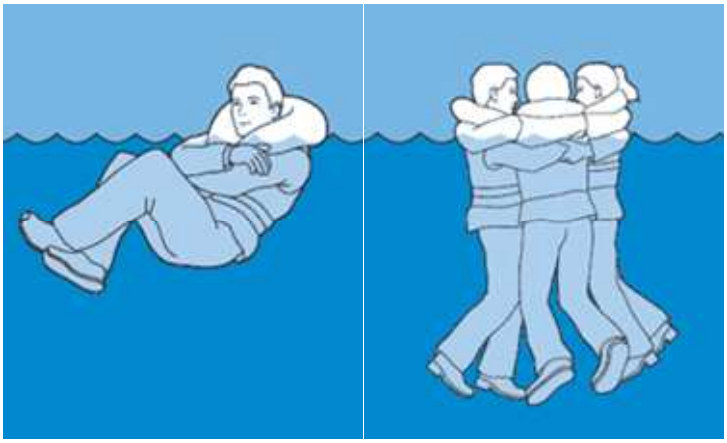
Cold is one of the greatest threats to the lives of everyone on the water. Certain techniques can improve your chance of surviving long enough to be rescued.



The aim of the HELP (Heat Escape Lessening Posture, left image) and huddle positions is to keep the warm water close to the body from being replaced by colder surrounding water.

Cold is one of the greatest threats to the lives of everyone on the water. The human body is designed to operate best at about 37℃. Just a couple of deg rees is all it takes to throw that equilibrium off balance, and at 30℃ to 32℃ death is almost assure d.

In waters of 10℃, the average person will be semi- conscious or unconscious within one hour. Death from drowning will often occur within two hours, even with a lifejacket. In waters of 15℃, a person might survive for up to six hours.

The greatest threat from cold is hypothermia. In cold, the body first prioritises the vital organs – the heart, lungs and brain – to enable them to function normally. It reduces warm blood flow to the outer layers of the body and the extremities. Hands and feet feel cold and shivering starts in an involuntary attempt to generate more heat.

As the body's core temperature drops, the vital inner organs also become affected. As the brain cools, consciousness is affected. Without correct treatment, death will follow.

Cold can also kill quickly. The shock of suddenly entering very cold water can cause a large gasp for air and a massive increase in lung and heart effort. This alone can result in muscle spasm, drowning or heart attack.

Many of New Zealand's seas, lakes and rivers are very cold. While the effects of immersion in cold water vary depending on factors such as body fat, strength and attitude, certain techniques can improve your chance of surviving long enough to be rescued.

Here are some of the things you should do to improve your chance of survival:

1. **Wear a lifejacket**. A full lifejacket helps to keep the head and airway clear of the water, even when strength and mental capacity is waning. It will also make adopting heat-loss reducing postures much more stable.

2. **The more clothes you have on, the better**. Do not get undressed to enter the water. If there is time, add more layers. A person wearing two layers of woollen clothing will lose less than a quarter of the heat that a person wearing only a swimsuit will lose. Wear as many layers of wool as possible, covered with a waterproof layer. The wool will trap warmer layers of water closer to the body.

3. **Try not to panic**. Panic can impair breathing and hasten the drowning process. Hyperventilation can occur when a person is unexpectedly immersed in the water. A mistimed breath can result in a laryngospasm, which sometimes results in loss of consciousness.

   A person who does not panic may simply have to cope with hyperventilation, which will eventually subside.

4. **Where possible, get out of the water**. In water, the body loses heat 20 to 30 times faster than it does in air. Even if you feel colder out of the water, try to clamber on top of an overturned boat or any floating wreckage.

5. **If you are forced to stay in the water, adopt the HELP position**. Hold the arms tight against the chest, press the thighs together and raise up the knees to protect the groin.

   This posture will increase survival time by nearly 50 percent. It will be most easy to adopt when wearing a lifejacket.

6. **Groups of three or more should adopt the huddle position**. The sides of the chest and the lower torso are pressed together, arms hugging each other around the lifejackets. Intertwine legs as much as possible and talk to one another. Children succumb to cold much more quickly than adults and should be sandwiched in the middle of the group.

7. **Consider options before swimming to shore**. If you decide to swim for shore, consider that tests show an average person wearing a lifejacket and light clothing could swim about 1.85 kilometres in water of 10℃.

   In one Canadian case, a 20-year-old strong swimmer drowned within five minutes in 10℃ waters. When deciding to swim for it, consider your swimming ability, the weakening effects of the cold and anxiety, and the huge overall heat loss that the swim will cause. If in any doubt, stay with the boat.

How the body reacts to cold

The body must maintain the vital organs in its inner core – the heart, lungs, brain and so on – at a constant temperature of about 37.6℃ to enable them to function normally. At normal temperatures, the heat generated by the body is carried by the blood to all regions of the body. The body automatically regulates its blood flow to control body temperature. Any excess heat is removed by transferring it to the outer layers for dissipation.

As the temperature of the environment falls, the outer layers of the body begin to cool. The body now reduces blood circulation to these outer regions, so that the cooling is not transferred to the important organs in the deeper regions of the body. Hands and feet feel cold because of the reduced blood supply to these areas. Shivering starts as an involuntary muscular attempt to generate more body heat.

With further cooling, the inner core of the body now begins to cool.[1]. This is the beginning of hypothermia. The blood supply to the body's outer regions is further reduced, as the body now takes drastic measures to maintain the temperature of its vital organs. Shivering may now decrease or stop. The organs in the core are now being affected. As the brain cools, there is reduced control and consciousness is affected. Further cooling of the core will cause the organs to stop functioning.

Consciousness is lost. Death will follow unless treatment is immediate and correctly given.

[1] While progressive loss of body heat can result in loss of consciousness and death, many victims perish much sooner when immersed suddenly in cold water. Cold shock can affect some, causing cardiac failure within a few minutes. Increased breathing rates can lead to dizziness, and the muscles cool rapidly. Immersion in cold water can cause such rapid loss of muscular function that in minutes a person loses the strength to board a raft or even operate a flare.
A fit person in these circumstances quickly loses the ability to make even basic movements to help keep themselves afloat. There have been many recorded cases of drowning in less than 10 minutes – long before the body core temperature has started to drop or the person is affected by hypothermia.