The **Chilling Truth** about **Cold Water**

What you know about cold-water shock could save your life.

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Illustration by Sir John Tenniel from *Alice in Wonderland*

It can happen quickly: a slip on a slick deck; a lean too far without a handhold; a momentary loss of balance; and suddenly the sea has wrapped its frigid fingers around another victim. At any time of year most BC coastal waters are shockingly cold, and a light-hearted outing on a sunny day can suddenly become a fight for survival.

Clearly, an overboard boater on a solo trip, or one whose fall went unobserved, is in very serious trouble indeed. But the statistics tell us that even if help is close to hand, a fall into cold water can be fatal. Witnesses often report…"I don't understand how it happened. He went down so fast and never came up again." Here's how it can happen and what you can do about it.

Cold water carries heat away from the body 25 times faster than air of the same temperature and as a result, the body core immediately begins to lose heat to the outside environment. At first, the body tries to generate more heat by shivering, but this is not enough to offset the loss of heat to the water. Within 20 to 30 minutes, depending on water temperature, body core temperature drops to below 35° C (95° F) cognitive functioning and judgement become affected. This cooling, if not checked, leads to disorientation, unconsciousness and eventually death.

An individual's response to cold water will vary depending on a number of factors including clothing, amount of body fat and activity, but the steady decline in core temperature will continue until after the person is removed from the water. Many books and web sites contain graphs based on expected survival times without protective clothing in various temperatures of water.

Survival Times in Cold Water Without Protective Clothing

Water Temperature Degrees C	Degrees F	Loss of Dexterity with no protective clothing	Exhaustion or Unconsciousness	Expected Time of Survival
0.3	32.5	Under 2 min.	Under 15 min.	Under 15 to 45 min.
0.3 to 4.5	32.5 - 40	Under 3 min.	15 to 30 min.	30 to 90 min.
4.5 to 10	40 - 50	Under 5 min.	30 to 60 min.	1 to 3 hrs.
10 to 15.5	50 - 60	10 to 15 min.	1 to 2 hrs.	1 to 6 hrs.
15.5 to 21	60 - 70	30 to 40 min.	2 to 7 hrs.	2 to 40 hrs.
21 to 26.5	70 - 80	1 to 2 hrs.	2 to 12 hrs.	3 hrs. to indefinite
Over 26.5	Over 80	2 to 12 hrs.	Indefinite	Indefinite

from *Local Knowledge—A Skipper's Reference* (Fine Edge, 2005) by Kevin Monahan

These tables are useful in predicting maximum survival times. However, we have all heard of anomalous cases of long-term survival in cold water—far beyond the expected limits proposed by the table. The table simply shows an average of expected survival times, assuming a victim doesn't succumb to other forces in the meantime.

For more than two decades, public safety programs that focused on mechanisms for reducing heat loss in cold water were second only to those that promoted the wearing of life jackets or personal flotation devices. Boaters were advised they could extend survival time by elevating a portion of the body out of the water onto floating wreckage. Every square inch of body surface removed from the water will incrementally extend the cooling time, even though the air may be cold and a wind blowing. Alternatively heat loss can be reduced by adopting the H.E.L.P. (heat escape lessening posture) position, or by huddling close to others to reduce heat loss. While these strategies are very useful, they don't take into account all factors.

By the 1990's the statistics collected by the US Coast Guard and the Canadian Red Cross, amongst others, were telling a story that was no longer possible to ignore. It turned out that in spite of the attention paid to hypothermia over past decades, drowning continued to be a major cause of death.

We had been more correct than we realized, several decades ago. Most victims of cold water immersion actually die of drowning, not hypothermia—and many drowning victims were very close to safety when they died. For instance, the Canadian Safe Boating Council / SmartRisk Study showed that between 1991 and 2000, 41% of those who drowned while boating were within 10 meters of shore at the time. An additional 22% were within 10 to 15 meters of shore. A British study from 1977 showed that 55% of open water drownings occurred within 3 meters of safety!!! And two thirds of drowning victims were strong swimmers.

Clearly some mechanism was at work that prevented these victims from being able to help themselves. The mechanisms are physiological and neurological shock brought on by sudden immersion in cold water, and the functional disability caused by the cooling of the muscles of the limbs—not the body core.

As a community we had been fixated on hypothermia as a cause of death. Search and Rescue crews found the most common injury found in survivors of cold-water immersion was hypothermia; recovered bodies showed a significant core temperature drop, consistent with the idea of hypothermia. Exposure to cold water was clearly the cause of death; it was assumed that hypothermia was the mechanism. Consequently, any cold, wet dead body was assumed to have died of hypothermia; even if the victim had died after less than 20 minutes; and even though it is impossible for a victim to become hypothermic in less than 20 to 30 minutes immersion in cold water. Even in ice water, it takes more than 20 minutes to cool the body core below 35º C (95° F).

In fact, it takes a long time to die of hypothermia. Reports from Titanic survivors describe the cries of victims, who were wearing cork life vests, lasting for more than one hour, even in the frigid -0.5º C (31º F) waters of the Labrador Current.

Now, in the early years of the twenty-first century, scientists have finally developed an understanding of the physiological processes that result from cold water immersion. Pioneering research by Drs Michael Tipton and Frank Golden in the United Kingdom, and by Canadians Drs Chris Brooks and Gordon Giesbrecht (among others) has painted a very clear picture.

Cold Shock

- On falling into cold water, cold receptors in the skin cause immediate physiological responses, the first of which is a “gasp” reflex. If this happens when your head is under water, you are in deep trouble.
- Next, you begin to hyperventilate, within seconds, your heart begins to race, and your blood pressure spikes. Hyperventilation may make it difficult to get air into your lungs, leading to panic and further hyperventilation.
- These symptoms can trigger cardiac arrest in susceptible individuals. Even healthy individuals will have difficulty keeping their airways above water without a flotation aid while undergoing these major physiological stresses.
- The effects of cold shock normally peak within the first minute and stabilize very soon thereafter.

Cold Incapacity

- After a few minutes, the muscles of your limbs are affected. Neuromuscular activity slows and body fluids literally congeal in the muscles.
- You feel the effects first in your hands and fingers. Then the deeper tissues in your arms and legs cease to operate properly. It becomes more and more difficult to perform any tasks requiring manual dexterity, such as using flares or other survival equipment.
- Survivors have reported that after a few minutes it was impossible to open a package of flares or to tie a knot in a line.
- After ten minutes immersion in very cold water, your arms and legs will no longer respond to your will. Even experienced swimmers have difficulty co-ordinating breathing and swimming strokes; short swims may be impossible.
- In heavy weather you have difficulty keeping your face out of the spray and you may not be able to avoid inhaling water.
- You will certainly have difficulty keeping your airway above the water without the assistance of a flotation aid.

During these two periods, the major risk of death is from drowning, caused by the body’s reaction to cold water. Any water less than 15^{o} C (59^{o} F) will trigger these physical reactions, though the colder the water, the more severe the response. Some experts suggest that if you are in water that is warm enough not to trigger these physiological reactions, then your biggest problem will be shark attack instead.

Hypothermia

- After 20 to 30 minutes your body core temperature will drop to 35°C (95° F.) Even in ice water hypothermia does not set in until after 20 to 30 minutes, depending on the amount and type of clothing.
- After hypothermia begins, depending on water temperature, your own body fat index, size and a number of other factors, you have about another half-hour of useful consciousness left.

During this last period, it is still likely victims will die from drowning, unable too keep their airways above water as they slip into disorientation and unconsciousness. The only victims who actually die of hypothermia are those who have managed to keep their airways above water, even after unconsciousness, by securing themselves to floating wreckage or through the use of self-righting lifejackets.

Simply knowing the mechanism of death may be useful to some scientists, but for the average boater, it is clearly not enough. For this information to be valuable, it must help boaters with strategies to extend survival time in cold water. Until recently, this new understanding of the dynamics of cold water immersion was useful in reinforcing the traditional safety message – "***Wear your lifejacket***" – by explaining ***why*** one should wear a lifejacket. "***You might not be able to save yourself if you are not already wearing a lifejacket when you enter the water***." But the only strategy for extending survival time considered only the effects of hypothermia and not the effects of cold shock or functional disability.

Prevention

- ***Wear personal flotation whenever you are in a small boat, or on deck on a larger boat, especially in heavy weather.***
- ***If you must abandon ship, make every effort to do so dry. Avoid getting wet if at all possible. If you have an immersion suit, put it on while on board the vessel.***
- ***Your goal must be to live long enough to actually risk dying of hypothermia.***

One – Ten – One

Enter Dr. Gordon Giesbrecht, a thermophysiologist at the University of Manitoba, who has developed the **1-10-1** concept (1 minute—10 minutes—1 hour), an easily remembered strategy for managing sudden cold water immersion. The time scales are approximate and are dependent on many factors, but the essential strategy remains valid for all temperatures less than 15º C (59º F).

One Minute

- Once you fall into cold water, you will hyperventilate for **one minute**. Take the time to get control of your breath and keep your head clear of the water.
- Don't panic. It helps to know that your breathing will settle down. Take stock of your surroundings and plan your next steps.

Ten Minutes

- Next you will have approximately **ten minutes** of reasonable mobility and dexterity. Take advantage of this time to perform the tasks that will extend your survival. But don't try to swim any long distances. You are unlikely to survive the experience.
- Remember, even though you will have some dexterity, you may not be capable of complex tasks. Experienced boaters have reported they were unable to don an immersion suit in cold water. Instead they simply became exhausted in trying.
- If possible, reduce heat loss by climbing partly onto wreckage. Even if you lack the strength to pull yourself completely clear of the water, any amount of your body removed from the water will proportionately extend your survival time.
- If you do not have a self-righting PFD, secure yourself so that your airway will be kept clear of the water when you lose consciousness. Try not to depend on your own grip to keep your airway clear. Winter sports enthusiasts who fall through ice are advised to let their arms freeze to the ice surface in order to keep their heads out of the water when they lose consciousness.

One Hour

- Finally, you will have **one hour** of useful consciousness.

- After **ten minutes** you will probably not have the dexterity or strength to carry out any further tasks. If you have not been able to self-rescue in this time, adopt a heat lessening posture to reduce your cooling rate.
- If you attempt to swim, you will not be able to do so efficiently—and the movement will cool you down more rapidly.
- If you are wearing a self-righting lifejacket or if you have been able to secure your airway clear of the water, you may be able to survive long enough to actually risk dying of hypothermia. Certainly you will have extended the window of opportunity in which you can be rescued.

Just because the statistics suggest that most people who succumb to cold water actually drown in the early stages of immersion, it doesn't mean that most people who fall into cold water die in a few minutes. This is clearly not true. It isn't possible to evaluate the actual risk of falling into cold water, because those who are recovered quickly never report the experience. So it isn't possible to predict the percentage risk of death after falling into cold water. But if you are not wearing flotation, and not rescued or self-rescued in the first 15 to 20 minutes, the consequences will be very serious indeed.

Extreme Cases of Survival

If cold-water effects can claim lives so quickly, then how does one explain certain well-publicized incidents in which people have survived for extremely long periods? In July 1993, Bob Lord fell overboard from a BC Ferry, was carried almost 30 miles by the 3-knot current, and managed to survive until he was found near Orcas Island, over 8 hours later. In July 2005, a 40-year old woman fell overboard from a sailboat near the mouth of the Fraser River and drifted for 7 hours until she was recovered near Valdes Island. She attributed her survival to the presence of a seal, which kept her company during her entire ordeal and buoyed her spirits if not her body.

Surface Water Temperatures

Summer surface temperature in the languid waters of Georgia Strait often rises to 15ºC or higher for a few weeks in late summer—along shallow beaches, the temperature may even rise above 20ºC. Because of restricted circulation, the waters of Desolation Sound and Jervis Inlet are the warmest on the BC coast.

Typical Surface Water Temperature ºC / ºF		
	Summer	**Winter**
Georgia Strait	14-16ºC / 57-61ºF	10-11ºC / 50-52ºF
Race Rocks	10-11ºC / 50-52ºF	7-8ºC / 44.5-46.5ºF
Johnstone Strait	9-10ºC / 48-50ºF	7-8ºC / 44.5-46.5ºF
Desolation Sound	16-18ºC / 61-64ºF	10-11ºC / 50-52ºF

In Johnstone and Juan de Fuca Straits and the channels that connect them to Georgia Strait, where turbulence brings cold water to the surface there is very little difference between summer and winter surface temperature.

These cases are both anomalies. Scientific models fail to predict survival in these situations. However, we can identify some of the factors that may have lead to the greatly extended survival times.

- Though hypothermic when recovered, both managed to remain conscious throughout their entire ordeals.

- Both cases occurred in July, when water temperatures in the southern Georgia Strait can locally rise above 15ºC, and may be additionally heated by warm Fraser River outflow, which reaches its maximum in June and July. As shown in the table, above 15ºC survival times rapidly increase.
- Finally, both refused to give up. A survival mentality is often the most significant factor.

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By the same author **Cold Water and Personal Floatation**

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