

AN AUSTRALIAN GUIDE TO SURFING WITH SHARKS

Written by Madison Stewart with the help of many amazing scientists,
oceanographers and bad ass ocean goers.



Introduction.

I looked on the Australian Surf Life Saving website not too long ago, it contained warnings of jellyfish, rips and skin cancer, but I saw no mention of sharks. As a nation, we seem to have no desire to address the reality of the apex predators we share the oceans with on a daily basis. Until, of course, it is too late. And then we talk about them in the media, perpetuating ideas of fear and terror, to the benefit of no one. In the absence of knowledge, fueled by a reluctance to accept our place below them in the food chain, how can we expect to coexist with what is, in reality, a dangerous animal? No form of shark mitigation will keep us 100% safe on our vast coastline, and no matter how hard we try, we can never rid the oceans of sharks. Shark interactions are an inevitability for many Australians, short of staying out of the water, we cannot choose if we have them or not. We can, however, choose the terms on which those interactions occur. This is my small, and I feel much-needed guide, for the swimmers, surfers and ocean goers of Australia who are on the front line of shark interactions daily. You are in situations more dangerous than people who work and dive with sharks. You deserve to have the information that may help you because when entering the ocean, a responsibility to be educated towards its dangers has failed to be enforced in our communities, and this needs to change. We need to be able to read the factors that increase the risk of a shark attack as well as we read the waves. I truly hope this guide helps you do that, and I hope it sheds some light on the seemingly endless darkness inspired by the Australian media towards sharks and gives you a little more confidence in the water. According to the Australian Shark Attack File, in the last 50 years, there have been a total of 47 unprovoked shark attack fatalities, while The Royal Life Saving Society notes a 10 year average of 292 deaths per year for people drowning in Australia. There were 176 diving-related deaths in Australia between 2002-2009, an average of 23 per year. Fatalities from shark attacks over the last 50 years average just under one per year. This guide is a summary of my understating of sharks and their behaviour, including what I have absorbed from those around me with years of experience and knowledge. As well as the knowledge from a range of scientists, oceanographers, and ocean goers, and should be used at your own discretion.

A handwritten signature in white ink on a blue background. The signature is written in a cursive style and reads "M. Stewart".

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Environmental Factors.

Environmental factors can affect a shark's ability to successfully detect and approach its prey. There are environmental conditions that can often facilitate the success rate of a shark's attack, making certain times and features of the environment favourable to sharks, thus increasing the danger. An 8-year study, focusing on Seal Island in South Africa, recorded the shark attacks on seals in particular, with a focus on their success rates. Attacks and attack attempts varied with changes in depth, natural light, time of day, time of year, wind direction and other factors, proving the effect of the environment on attacks. I once heard someone say there are no dangerous sharks, just dangerous situations, and the same can be true for many wild animals. The reality is that you may avoid all the factors listed below and surf in crystal clear water at a perfect time, on a perfect day and still become subject to a shark attack. Shark behaviour cannot be guaranteed, and taking that risk is something you need to be mentally prepared for before entering the water. In the meantime, the information below is a foundation for your knowledge and awareness.

Bait Balls

Bait balls are a common occurrence along our coastline here in Australia. They occur when small fish swarm in a tightly packed formation, usually as a defence mechanism against predators. One theory for the frequent attacks that occurred in a short span of time in Ballina, could be pinned to a single environmental anomaly that allowed for masses of bait balls. In the year 2000, blue pilchards were devastated by a disease that was introduced into our waters. The species was not expected to bounce back from the collapse, however, the bait balls in Ballina at the time of the frequent shark attacks were made up of the blue pilchard. When a fish species bounces back from a threat like this they return in an unsustainable proportion and take time to dwindle down to a sustainable number depending on predation and availability of food in their environment. So, not only did we have bait balls, but we also had an unusual amount of one particular species, meaning the availability of food could have been responsible for the unusually high number of sharks in the area, which may have ultimately led to the high number of attacks.

Flocks of diving sea birds are a good indicator that there is a bait ball offshore, and it is important to look for this and try to avoid surfing or swimming in any patch of coast where this feeding action may be happening. Putting yourself into a bait ball is putting yourself into a feed frenzy where animals are moving fast and making snap judgments and are ultimately in the area to hunt. In addition to these signs be aware that contrary to popular belief large sharks are not deterred by dolphins. In fact, dolphins and large sharks will often feed on the same fish and in some cases, dolphins are potential food for large sharks.



Rainfall and River Mouths

Rainfalls and river mouths can be dangerous when surfing for a number of reasons. After rainfall, nutrients run into the ocean which attracts fish and other animals to feed. This in turn can attract different species of sharks. Additionally, the visibility of the water after rainfall can greatly decrease, which is ideal for ambush predators like sharks to hunt in. One example of rainfall creating a dangerous situation was an attack in Ballina, where a man was surfing at 6:30 pm near a river mouth after heavy rainfall and was attacked by a Bull shark. The rainfall, visibility and time of day made it a dangerous situation for surfers. Bull sharks are the primary concern with rainfall. Being one of the few species that can travel into freshwater by increasing the level of urea in their system as they mature, research has found that Bull sharks move down into the lower realms of rivers before migrating to the open ocean in their fifth or sixth year. Dr Jonathan Werry, from the Ocean and Coast Research group states, “[Bull sharks will] move into beach areas, they get flushed out [of rivers] because their normal distribution patterns rely on salinity levels. That’s when you’ve seen attacks in Australia and around the world; a lot of them have to do with periods of rainfall. You see them also go into holes within the canals and river systems to possibly get some refuge from strong flowing amounts of rain.” Big enough rainfall can change the normal distribution patterns of Bull sharks within a river system and can move them out of that river system into a near-shore beach area. River mouths can also represent a food source for sharks due to runoff flowing into the ocean from upriver. Runoff from fertilizers and even sewage can cause fish to feed and congregate in the river mouth area, this congregation of prey will attract sharks.

Drop Offs and Deep Water

These are great opportunities for sharks, and large sharks, in particular, like to hunt near drop-offs, in-between sandbanks and on the edge of kelp forests where they wait to surprise seals, fish or turtles swimming by. The reason Great White sharks have a white belly and a darker colouration to the top of their body are so that they remain camouflaged with the ocean ground when looking down, and blend in with the sky when looking up from underneath. Seals and other large mammal prey are fast and can easily outmaneuver Great Whites, which is why Great Whites attack in a way that has the element of surprise, ultimately using their habitat to their advantage. This is why locations, where there is a vast amount of deep space underneath, can be dangerous if a Great White shark is hunting in the area. Even though sharks are capable of swimming in very shallow water, most shark activity occurs in deeper water. Shark Spotters in False Bay have recorded over 70% of Great White shark sightings behind the surf zone, in deeper water.





Water Temperature

One example of how water temperature influences shark activity is in northern New South Wales. In winter whales migrate up the east coast of Australia with their newly born calves, and Great Whites take this opportunity to follow the whales' movements, preying on the newborn calves and the straggling adults. The chances of seeing white sharks and shark attacks therefore increase in winter. Cold-water upwellings also carry nutrients that encourage Great Whites to push further inshore. University of Sydney lecturer Chris Neff also stated that every deadly attack in Western Australia (WA) had occurred in temperatures ranging between 18 and 20 degrees Celsius. "White sharks come inshore when the water surface temperature is about 18 degrees, and there hasn't been an attack in WA when the temperature wasn't 20 degrees Celsius or below." Great White Sharks are a cold-water species, and their bodies possess a counter-current artery and vein system. Their blood flow exchanges heat, by mixing the cold blood from the arteries with the warm blood from the veins. Great White sharks can therefore elevate their body temperatures up to 14 degrees Celsius higher than the surrounding water.

Increasingly warm waters around the globe due to climate change and El Niño can also affect sharks. This has been suggested to influence the highest number of shark attacks ever recorded in 2015, due to greater interactions between humans and sharks in the water, as temperature changes allow sharks to coexist in closer proximity to humans.

As oceans heat up, entire ecosystems are forced to adapt. Fish are migrating where they've never gone before and species behaviours are changing. It's happening in Australia too, species typically seen in northern tropical waters, are appearing in droves near the southern island state of Tasmania. The common Sydney octopus has shifted from the north-eastern state of Queensland down to Tasmania. Even plankton and plant life like kelp are moving south.

In 2020, the California State University's Long Beach Shark reported an increase in the number of white sharks they were able to tag. Also noticing they stayed in areas longer than ever before. These habits have been attributed to climate change, with a change in the distribution of prey species, and an increase of geographical range means the future of human shark interaction could be changing rapidly and remains unknown territory for us.

Research has predicated that the East Australian Current (E.A.C) will strengthen in the future with a changing climate. This will extend warm waters further south and change the tropical and subtropical environments and marine habitats, so you can expect to witness the change. Yes you will see more sharks.

Malia Rouillon, Physical Oceanographer



Whale Carcasses and Animal Remains

Whale carcasses and animal remains are an obvious reason for sharks to be present, as they are an easy food source for predators. When we decide to go into the ocean we accept that boat traffic and fishing boats are present, but we don't stop to think about the smells that they put through the water, which might attract sharks. A shark's strongest sense is its sense of smell, but human impact on the environment has meant more things are attracting sharks. In NSW waters, 50 deaths by sharks have been recorded, half of which occurred in Sydney Harbor between 1852 and 1915 when the Glebe Island abattoir was in operation. Stimuli like spearfishing, whale carcasses, or anything that could signal a potential food source to sharks, could be carried with the tide to a surfing location, and need to be considered. While human blood is not considered a major attractor of sharks (which is discussed further in this guide), fishing harbours and areas used regularly by fishermen should be avoided, especially when fish catches are high. We must also be aware of any whales that have been buried on nearby beaches or may have recently died in the area. There is no way to establish a 'safe distance' between you and the animal remains, tides and currents that carry the smell.

Moon Phases

The influence of moon phases on shark behaviour is perhaps a less significant environmental factor, but nonetheless a fascinating one. When a spate of shark attacks occurred in northern New South Wales there were countless theories as to why such a peak in attacks had occurred. One observation documented by researchers Malia Rouillon and Nick Brennan was that the shark encounters and attacks were focused around the two lunar cycles after the first whales have made their migration. They theorized that due to the El Nino that year, whales migrated up the coast later than what could be considered usual. This slight change in whale migration patterns could have caused disruption amongst the Great Whites sharks feeding opportunities. This could have caused them to move closer to shore to feed on fish and therefore increasing their interaction with people. Wildlife activity increases and aggregates on the full moon creating more feeding opportunities for predators. Sharks have even been documented leaving shallow water on the full moon and returning on the new moon. Rouillon suggests that because the whales migrated later there were less feeding opportunities for the Great White sharks at a key time for them. A small number of sharks, becoming desperate, took the opportunity to feed on the full moon. This resulted in an increase in negative human/shark encounters and in the region.

In my short amount of time with Doctor George Burges, a world-leading authority on shark attacks, he believes that although we cannot prove it, there is a correlation between shark attacks and the cycle of the moon.



Time of Day

Time of day is also a significant factor in shark attacks. Dusk and dawn are high danger times due to the position of the light. Documented Great White hunting habits show that they are at a visual and tactical advantage at times of low light as it makes it harder for the prey to spot their camouflage. Dusk is also when fish are highly active, which can result in an increase in feeding frenzies.

It has also been found that Great Whites continued to hunt throughout the day when it was overcast, as this increases their ability to camouflage. As for the risk of humans being attacked at nighttime, Great White sharks' eyes make up suggests they are crepuscular hunters (resembling or relating to twilight). They, like other sharks, also have a layer of tissue behind the retina called tapetum lucidum, which acts to reflect light into the retina a second time, increasing the light available to the shark. This all suggests low light is more favourable to them than no light.

Other species of shark, such as Tiger Sharks, commonly attack at night. Dr Jonathan Werry, a Shark Research Scientist who tracked Bull sharks on the Gold Coast claims that "dusk, dawn, and during the night is when the shark's movement increases significantly." So although it seems white sharks are not a night time consideration, this is not the case for all species.

Andrew Fox, son of well-known shark attack victim Rodney Fox, now runs shark diving charters in southern Australia. He theorizes that attacks that don't occur during dusk or dawn, but rather in the middle of the day, could be because sharks are hunting their usual prey at these times. However, during the day, their behaviour becomes opportunistic and differs from their common behaviour, this is when we see attacks on humans when they aren't distracted by their usual hunting habits.

Shark attacks occur all year round in Australian waters. Over the past 20 years, 71% of the attacks occurred between November and April. This seasonal peak period coincides with warmest air and water temperatures and school holiday, Christmas, New Year and Easter holiday periods. This is the time of maximal use of beaches, harbours and rivers for recreation, and the time when most people are in the water, increasing the risk of a shark encounter.

- Changing patterns of shark attacks in Australian waters

John G. West, Coordinator, Australian Shark Attack File, Taronga Conservation Society Australia

An Attack

Potential steps to avoid a shark attack

1. Avoid wearing shiny jewelry, as the shimmer resembles the shine of fish scales. This is particularly true for bull sharks in murky water.
2. Avoid the colour orange. While this is not necessarily a scientifically backed statement, but one from experienced people who work with sharks. Great Whites in particular tend to favour certain colours.
3. Avoid peeing in your wetsuit. Sharks have been known to be attracted to such bodily fluids.
4. If you are confronted by a Great White in mid water, swim towards the shark as it swims towards you, making yourself as large as possible. Sharks will be more likely to investigate if you are rolled up in a small ball, but when you stretch your body out and become a large figure, they are more likely to leave you alone.
5. Watch the other animals around you, as the behavior of seals, dolphins, etc are often your first indication that a hunting Great White is in the area.
6. When sitting in the line up, it is best to make sure you're with a few people as sharks are less likely to approach a group, safety in numbers.
7. Leave the water when you see a shark's preferred choice of prey (seals, sea lions, turtles, seabirds, tuna, etc) to avoid mistaken identity. Make sure there is nothing nearby splashing unnecessarily as it can attract the shark to the surface to explore if it is a potential prey item in distress.

Trust your gut feelings and your instincts; if it feels sharky, it probably is sharky.

What to do if an interaction occurs

1. If a shark is circling, it usually indicates pure curiosity, and what happens next will depend on your reaction.
2. Panicking and swimming to the shore fast is more likely to increase your risk of being attacked.
3. Remaining in a group will help deter an attack; sharks like most predators are more likely to go after an individual.
4. An inquisitive shark can usually be discouraged if you swim towards it, and if it is faced with aggression.
5. If a shark is coming towards you, try to place anything you may have with you between you and the shark, like your surfboard.
6. It is important to try not to panic, as there is a chance once the shark has lost curiosity, it will leave you alone. Research has shown that when a kayaker stopped paddling and remained still, Great Whites lost interest, but frantic paddling was shown to stimulate the shark's pursuit behaviour.
7. If you feel a bump, calmly leave the water.
8. Coming across a shark in the water does not mean the end. Sharks are very inquisitive, and the key to survival is to make sure you see them before they attack and use every means possible to make the shark see you as a fellow predator and not as prey.
9. If the shark persists and gets close enough to do so, punch it in the nose or gills as both are very sensitive areas on a sharks body.

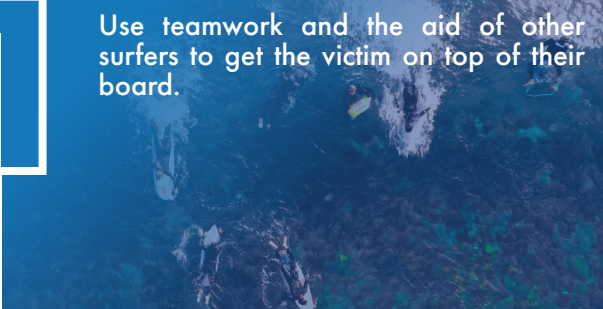
First Aid

The International Paramedic College based in the Ballina, Evans Head and Byron Bay corridor has seen several shark attacks and a number of “incidents” over the last few years. In response, they developed a “Shark Attack Pack”. It combines a number of first aid products to deal with traumatic life-threatening injuries.

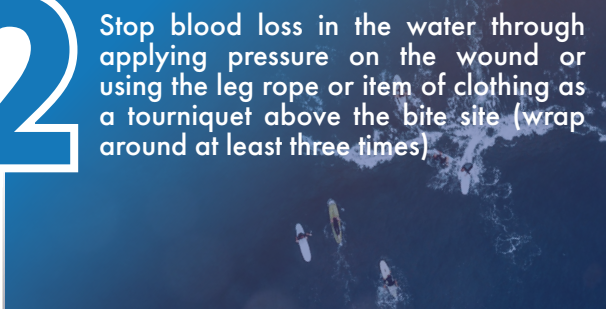
The kit consists of a Combat Application Tourniquet (CAT), two emergency bandages sometimes referred to as an Israeli bandages, a pair of paramedic shears to cut wetsuits and gloves and training in their use. It’s worth investing in these items and keeping them in your car. Fast responses to these injuries can be the difference between life and death. They also offer first aid courses specific to this type of incident.

Terra Australis also have a small video online showing you the best first aid in a shark attack situation. Please check out the video for more details. Below are some of the pointers featured;

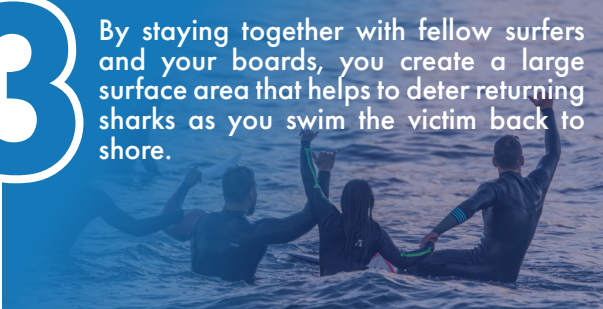
1 Use teamwork and the aid of other surfers to get the victim on top of their board.



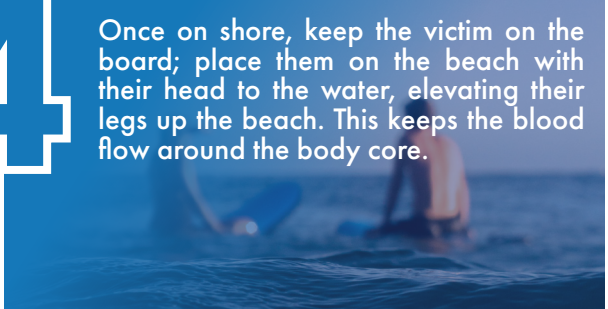
2 Stop blood loss in the water through applying pressure on the wound or using the leg rope or item of clothing as a tourniquet above the bite site (wrap around at least three times)



3 By staying together with fellow surfers and your boards, you create a large surface area that helps to deter returning sharks as you swim the victim back to shore.



4 Once on shore, keep the victim on the board; place them on the beach with their head to the water, elevating their legs up the beach. This keeps the blood flow around the body core.



5 Use a towel to apply direct pressure and then check the breathing status of the victim.



6 Once on the beach use a proper tourniquet to stop the bleeding.



7 Perform CPR if necessary.



Why Do Sharks Attack Humans?

With over 517 shark species scientifically identified, the three attributed to the most attacks on humans are the Great White shark (*Carcharodon carcharias*), the Tiger shark (*Galeocerdo cuvier*), and the Bull shark (*Carcharhinus leucas*).

A paper investigating changing patterns of shark attacks in Australian waters by John West, the curator of the Australian Shark Attack File in Taronga Zoo, gives us a good insight into shark attacks.

Great White sharks

Of the 15 fatalities attributed to Great White sharks, seven involved a single bite and seven resulted from multiple bites (and an unknown number of bites for one fatality). Seven fatal attacks by Great White sharks occurred at the surface while the victim was surfing (33%), swimming (7%) or sailboarding (7%). Eight of the fatalities by Great White sharks occurred while the victim was submerged, either SCUBA diving (40%) or snorkelling (13%).

Bull sharks

Of the four fatalities attributed to Bull sharks, one involved a single bite and three involved multiple bites. All four fatal incidents occurred at the surface; three while swimming and one while surfing. Two of the four fatalities occurred in human-made canals.

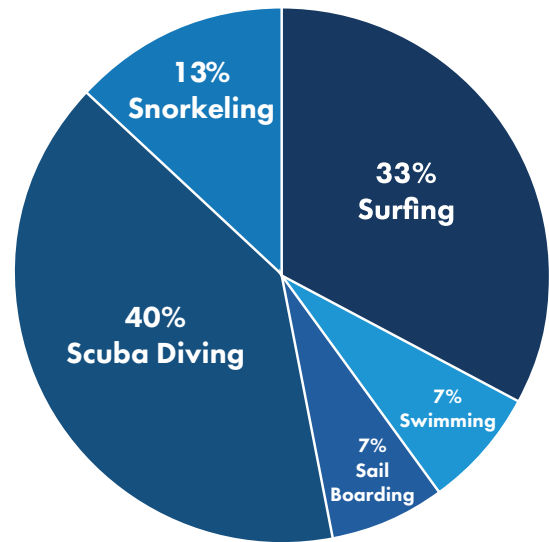
Tiger sharks

Of the three fatalities attributed to Tiger sharks, two involved a single bite. One fatal attack occurred at the surface on a sailboarder and two occurred subsurface on a snorkeler and a hookah diver.

Why sharks attack people is a question with multiple answers, with the most common being due to 'mistaken identity'. There is a lot of truth to this. As we often go into the ocean dressed as seals, we become silhouettes of the perfect meal from underneath to a white shark. Although mistaken identity is a solid theory, I need to document my own opinion. We are below white sharks in the food chain, we are mammals, we are not fluid or fast in the water, we are just prey. I will make no excuses for these animals; I will not create a false idea of their nature or purpose in the ocean. Are these animals mindless killers that seek to eat humans? Absolutely not. What they are, however, is a large animal incredibly skilled at ambush hunting and extremely dangerous, and sometimes they attack humans, and sometimes, although rare, they attack a human for the purpose of consuming them.

Having said that, we aren't common food for them, if sharks wanted to attack humans or had a taste for us, the beaches would be a no-go zone for humans, and the number of fatalities would be far greater. So, it is safe to say sharks are not

Fatal Attacks by Great White Sharks (By Activity)





after humans, we are not part of their common diet. The high metabolic rate of Great Whites suggests they prefer food with high-fat content such as seals. They even have ways of detecting the fat content of their prey once they bite down. It is suggested that non-consumptive strikes on sea otters, seabirds, inedible objects, and humans may represent food rejection because of the inadequate energy content.

This can be seen when studying Great White sharks selectively feeding on the blubber but not the underlying muscle layers of a carcass of a whale. What sharks do to humans and most other potential food is merely a 'test' bite, which is why most victims end up onshore with the severity of blood loss (another reason for the importance of a first aid kit) as the determining factor of life or death. In the majority of cases, Great White sharks do not eat people; as their aim is not to eat us, but to 'test' us. White sharks are, however, very smart, incredibly inquisitive, which can be dangerous with both of these traits being present in a large marine predator.

Another potential reason for bite attacks could be the habit of the Great White shark to bite their prey once, then leave it to bleed out and die before coming back to eat it. This prevents the shark from getting any injuries as the prey struggles of fights back whilst being eaten.

"My volunteers and I were tracking a large male in Shark Alley, an animal we know has been returning to the island for more than 12 years. For the first eight hours he patrolled back and forth, seemingly uninterested in prey. Then, to our surprise, he rushed directly up to the rocks and grabbed a seal as it was half out of the water on the rocks and devoured it. Another younger white shark we tracked west of the island tried predation on a seal, missed it and proceeded to chase its own tail."

Great White sharks have adapted their techniques to the specific locations they hunt. Great Whites hunt seals, and due to the speed and evasiveness of seal, they need to hunt injured or unsuspecting seal. To do this Great White's launch from underneath, near the ocean floor, coming up at its prey. If you look at a surfer from underneath, the silhouette is almost identical to that of a seal, at least to a Great White. Realistically, compared to Tigers and Bull sharks, Great White sharks show relatively little aggression towards humans, it is merely the power of their teeth and sheer size that makes their movements fatal. Sharks are designed to hunt weak and injured animals, and the way we look in the water is the way struggling and easy prey looks and is interpreted by a shark.

There is also a common theory that Great Whites of a certain size are still learning. Juvenile Great White sharks have a diet of fish and stingrays and other smaller prey, their jaws don't yet have structural power to take on larger prey like small mammals or people, this is something they develop the ability to do later on in life. When they begin to change their hunting habits and are learning how to identify and how to target new prey, they make mistakes, such as attacking humans. This can also be confirmed by the Taronga Conservation Society's Australian Shark Attack File stating that over 80% of incidents involved Great White and Tiger sharks less than three meters in length. Scientist Alison Towner who has conducted extensive research into the hunting habits of Great Whites saw a significant difference in the experienced and not so experienced Great Whites.

Other culprits include Tiger sharks, which are essentially large scavengers and will opportunistically attack something they believe poses no threat to them, as well as Bull sharks, which were mentioned earlier. It is a good idea to learn which of these are in your local area, and then study up on that particular shark species. Each species has specific traits and diets and time that influence the chances of an attack. Knowing what you are up against is the safest way to share their home. Another theory I read about in the Shark Attack Theories documented by John West, is that sharks are as aggressive to humans, as they are to other sharks. Many species of sharks display social and aggressive behaviours towards each other. These behaviours, which are common in species that congregate in large schools, are usually associated with size and hierarchies of dominance. It has been observed that smaller white sharks give way to larger white sharks especially when feeding. The types of wounds seen on some sharks are similar to those inflicted on humans from a single raking type bite.

Are Shark Nets and Shark Culls The Answer?

If the solution to stopping shark attacks on humans was as simple as the presence of shark nets or enforcing shark culls, it would not be so widely opposed. The reason most people who work with and study sharks oppose these methods is not just because they are against the death of sharks, but predominately because they know that these methods are ineffective. Often, Government's paint the issue as solved, leaving a false sense of security amongst the community that can, in turn, lead to more shark-related deaths.

Nets

More than 30 shark attacks have occurred at beaches with shark nets on the Gold Coast, but the reason you never hear about them is that they have not become fatalities. That is because beaches with shark nets are typically patrolled; the shark attack has an immediate response from lifeguards and a far quicker response time from paramedics, meaning no death occurred from blood loss. In fact, the Government appointed body established for the management of these nets themselves to admit the nets do not prevent shark encounters; 'the Shark Control Program relies on nets or drum lines, or a combination of both, to minimize the threat of shark attack on humans in particular locations. It is not designed to provide a distinct barrier between sharks and humans and to remove high-risk sharks from a particular location'.

The nets do not stop attacks. The program in Queensland has captured approximately 78,000 marine animals since the sixties. Most of the animals caught in the nets are caught heading from the beachside back out to sea. There is also a long list of animals such as dolphins and turtles that have been caught in these nets, later being found half-eaten by something much bigger. This suggests that contrary to their purpose of reducing sharks in the area, the nets are acting as a form of chumming, a buffet of dead animals, attracting sharks to feed on them.

Culls

We witnessed an attempt by the Western Australian government to implement a shark cull after a series of attacks on surfers in a short time period. The shark cull caught over 100 sharks, mostly Tiger sharks, and not a single Great White. Tiger sharks have not been responsible for an attack on humans in that area for over 80 years. The species implicated with attacks on humans are mostly Great Whites. These species cross oceans, they migrate, and therefore eliminating their local population would not prevent a new one from coming in. The other thing that needs to be remembered, is that baited drum lines are food to sharks, as the tide runs out and carries the smell of rotting food potentially chumming the area, having the perverse effect of attracting sharks.

A local shark cull will only accelerate the long-term decline in a vulnerable global population of Great Whites sharks and therefore will not make local beaches safer in the short-term. The consequence of removing a slow-growing apex predator whose place in the food chain already means there are so few of them also has huge environmental ramifications. I think it is also important to point out that protection measures against sharks are a wonderful idea of great importance and I am not against it, but a cull is not one of those measures. I am often asked if I am against shark culls and most people incorrectly associate my answer with a lack of respect for human life. Oceangoers deserve a more sophisticated and effective means of shark protection.

In addition to this, it is known that the removal of a large shark from an area exposes it to be filled with smaller sharks that would otherwise be pushed out of the territory. When we think of Great White sharks, we know the smaller ones are more likely to be implicated in attacks, making culling not only ineffective but potentially dangerous. George H. Burgess, the former director of the International Shark Attack File, describes shark culling as "a form of revenge, satisfying a public demand for blood and little else". He added shark culling is a "retro-type move reminiscent of what people would have done in the 1940s and 50s, back when we didn't have an ecological conscience and before we knew the consequences of our action". Burgess also states shark culling will not make surfers safer.



Sharks and Blood

It's true, sharks can detect one drop of blood in a million drops of water, but do they react to it? The truth is sharks are attracted to the blood of fish and other marine animals, while human blood is not on their radar. I've suffered cuts and even a nosebleed in the middle of a shark feed with no reaction from the sharks. However, sharks CAN pick up electricity, like the faint signals created by the bioelectrical impulse of a heartbeat (more on this in the next section). The skin acts as an insulating layer and blocks a lot of that signal. When you are cut, this sends a signal that the insulation is compromised, allowing your own electricity to go through the water easier and therefore stronger. If you are injured in the water and have a cut, your heartbeat will be stronger. To a shark, that means injured or scared, and sharks' prey on the injured and scared. This only takes effect within a few meters of contact. However, it must be noted that human blood does not turn sharks into Jaws.

Additionally, blood, urine, body odour and electromagnetic fields will quickly dilute or dissipate in the ocean. One drop of odour concentration in moderately turbulent flowing water would dilute at one kilometre away, which would not be recognized as blood or even register as a stimulus. There would need to be large amounts of blood flowing from the source for this to occur. As an example, one need only consider the amount of 'chum' or 'burley' needed to attract a shark to a fishing boat. Some sharks have been known to swim past several people in the water to focus their attention on an individual within a group of swimmers or surfers. It is more likely that the shark's selection process may be more related to the behaviour or activity of an individual rather than the scent of an individual's blood or other excretions.

Sharks and You

Shark scientists say a shark can hear you from 1,000 to 10,000 meters away; smell, see and sense you at from 10 to 100 meters; and perceive you electromagnetically via sensors called Ampullae of Lorenzini at half a meter (50 cm), before switching to direct contact. We see examples of this when metal is in saltwater as it emits a very strong electromagnetic field which can overstimulate the shark's sensory perception and influence them to bite things like a metal boat propeller or a shark cage. It is more likely that a shark is attracted by a person's activity in the water rather than the relatively low level of the electromagnetic field a human may produce.

It has been well documented that sharks are attracted to low-level frequency sounds particularly in the range of 10 Hz - 50 Hz, which is within a frequency also given off by struggling or injured fish. Tests have determined that sharks use their lateral line and inner ears to locate prey as far away as 250m or more. Human activities in the water may attract a shark's attention. Sound, rather than sight or smell, seems to be a shark's primary cue for moving into an area from any distance. However, once they are attracted to the source of the sound, they are more likely to investigate the object relying more on sight than hearing.

Their vision varies between species, but research has suggested they can see colours but mainly contrasts, which is why a lot of shark deterrent work has been done around the visual capabilities of sharks. Great Whites are suggested to be more attracted to yellow than any other colour for unknown reasons (see page 7). However, the strongest sense of a shark still remains its smell. This is why it is important to notice if fishing is occurring in the area, or if a dead whale has been washed up, as it means there is a smell line going out to the ocean which may attract sharks into shore.

Have Shark Populations Boomed?

There has been speculation that overfishing is depleting the world's fish stocks and sharks are starving and seek out humans as a source of food. While it may be true that commercial fishing has depleted fish stocks in some areas of the ocean most large predatory shark species (particularly those species known to attract humans) have the ability to travel long distances to other feeding grounds and do so as part of their normal distribution and migration behaviour. Changes in prey item preference and the diversity of food items found in the stomach of sharks would also give these sharks a broad range of food items to pick from. A 'starving' shark is more likely to move to where their preferred food is more available, not less.

Another myth is that shark populations have exploded. Within the animal kingdom, sharks are famously slow reproducers. Female Great White sharks, for instance, typically produce a couple of offspring every other year and only start reproducing once they reach 17 years of age. As a result, sharks are biologically incapable of "baby booms" and indeed are very sensitive to even low levels of fishing. We may be seeing more sharks in some specific areas due to changes in ocean conditions, but not more sharks in general, and not booms in their populations. Of over 500 species of sharks, only a handful of species have been linked to any incidents with humans (that is less than 5% of all shark species).

One indicator of shark abundance is the beach protection program in New South Wales where catches have been monitored for decades and provide a long-term data series. From the introduction of the shark meshing program (SMP) in Sydney in 1937, 1500 sharks were caught in the first 17 months, an average of 88 sharks per month. Within a decade, catches from the SMP averaged less than eight sharks per month in the Sydney region. Almost all species have declined over that period. Declines in the number of sharks captured following the introduction of shark-control measures were also found in Queensland. The shark meshing and commercial catch-rate declines suggest that the increase in reported shark attacks over the past two decades is not a result of increasing shark numbers. There is a need for me to address that shark populations, particularly Great Whites, have not boomed, but have gradually increased. This is something that fishermen will confirm visually compared to times when both whales and sharks were less abundant.



Shark Mitigation Devices

Eyes

As we've discussed, sharks are ambush predators, so one technique I've heard about surfers using was eyes on the bottom of their surfboards. I followed their tactic with a big pair of contrasting black spray-painted eyes on the bottom of my surfboard. Low light times of day make it hard to see the eyes on a silhouetted board backlit from the surface, so making the eyes large and visible is important. I have seen the effects of eye contact with sharks a number of times. Eye contact deters them from an ambush pattern they rely on to get close to their prey. It makes sense that appearing to maintain eye contact with a shark would give you that little bit of extra safety. The water is not the only place this works, in Africa, a lion can ruin a small farmer's livelihood by killing even a single cow, especially one that is pregnant or producing milk. After observing a failed attempt of a lion to ambush an impala, a team tested this by painting large eyes on a third of a herd of cows on a farm on the edge of a wildlife area near Maun. Lions killed three of the 39 unpainted cows but none of the 23 painted cows was taken.

Stripes

The banded sea snake is a highly venomous creature and is defined by its distinctive stripes. While these stripes do not help with camouflage, they do help the animal with defence against predators. Sea kraits and other brightly striped or coloured animals have that distinctive pattern because it is nature's way of signifying to predators that they are venomous and therefore dangerous to eat. So the idea of having stripes on the surfers' board, is to signify to the sharks that you too are venomous. Both designs can be done with a simple stencil or freehand with some paint. However, this isn't the only reason why stripes are considered a deterrent these days. The new theory with more scientific backing is that the stripes break up your contrast in the water, and instead of a seal shaped silhouette, you are now a broken up pattern and not one large object. This is a very handy thing to have around ambush predators and this theory is illustrated by a company called SAMS who are developing wetsuits and boards that use this method. It was first documented by scientist Eugene Clark, who discovered captive lemon sharks were able to associate pushing a yellow button with receiving food, however, when the button was painted with black and white stripes, they simply couldn't find it.

Shark Shields

Although the Shark Shield was recently found effective at deterring large sharks, it relies on a number of factors, for example, when or if it has been turned on and how the shark approaches. It is, however, the world's only scientifically proven and independently tested electrical shark deterrent and has been under development for more than 20 years. It is important not to surf under an illusion of full protection, but shark deterrents like this one, although expensive, are undoubtedly useful.

"From my reading of the various scientific testing that has been done on shark shields and other similar deterrent devices, their effectiveness is really context specific and depends on the motivational state of the sharks. For example, a shark shield may be effective for a curious Great White that approaches a surfer with curiosity, but not for a Great White that is charging from below in full attack mode."

- Dr Peter I. Macreadie

Senior Lecturer, Australian Research Council DECRA Fellow & Plant Functional Biology and Climate Change Cluster,
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Conclusion.

There is an island off Esperance in Western Australia, a classified Hope Spot, and an isolated haven for multiple species, it is suggested that it is even a White shark nursery ground. My first dive there, under the supervision of scientists and experienced abalone divers, saw me encountering my first real White shark. Why real? Because this shark had likely never seen humans before. There was no hesitation for it to approach the cage as soon as it saw us. It managed to balance caution and curiosity enough for me to immediately know my place in its environment, and that my place was at its mercy. When our cages hit the ocean floor we emerged from them into the open, the kelp on the ocean floor was calm and peaceful, but above it was a lot of blue space to keep an eye on. We came close to the shark that day. He came up to us many times, he swam above us, the entire time exposed outside the cage felt like a lifetime, my gauge was low when my dive buddy checked my air because I had forgotten to do so. We left the floor and headed up. I remember vividly, the big black eye, the complete shock of the size of the animal. I couldn't have anticipated its demeanour, its power or its presence. Just like I cannot pretend to understand what the people who have negatively encountered these animals have gone through. That's why I won't pretend to understand, but I am open to doing so to the best of my ability. The victims of shark attacks represent an important need to reduce the gap between people like myself devoted to the preservation of sharks, and the people who are encountering them in our oceans. This guide was a statement for them, to not only acknowledge that I see the impact these animals have on humans, but to firmly enforce the need to stop pretending sharks aren't dangerous, and also that that makes us responsible, not them.

The reality of the environment here in Australia, and anywhere around the world, is a reality we have forgotten. It is not ours, and it means we may have to abandon a perfect break every now and then to avoid becoming a victim to a shark attack. It is also important to remember that while reacting to shark attacks in the name of the public is a good political move, it is not always done with the intention of truly helping people. The very real threat of sharks needs to be taken into our own hands, and not just that of Governments. Sharks are not a mystery, they are not an enigma, there are many things you can and should learn about the dangerous predator you enter the water with, just as a hiker does with a bear. Our entitlement to the ocean will be our undoing. So, my advice to you is this, know your place in the ocean, and accept that risk and your own personal attempts to make it safer for yourself, but never forget that it is not our ocean. Although they can be called the enemy of every surfer, spearfishermen and even the unsuspecting snorkeler at times, and it seems odd to protect an animal that is bred in nature to destroy us if we find ourselves in the wrong situation with them, it is our responsibility. If we want to exist in the oceans, surf in them and take from them, then the issues these sharks face are not for people like myself whose life revolves around them, but everyone one of us whose lives revolve around the ocean they control as apex predators. We need to make coexistence part of today's culture, being in the presence of greatness like the sharks, although sometimes terrifying, is not only an inevitability... it is a privilege.

“The thought that we can engineer nature to make it safer for humans sends a chill to my heart. People need to take responsibility for their actions, which includes being aware of and accepting the risks of entering the ocean. I believe that the best way for us to protect sharks is to better understand galeophobia (fear of sharks) and, most importantly, change our cultural views of sharks. Our biggest investments should be in rewiring society’s views of sharks.”

Trisha Atwood

Assistant Professor, Watershed Sciences and Ecology Center, Utah State University

It is important to keep the risk of a shark attack in perspective. On average, 87 people drown at Australian beaches each year (SLSA 2010), yet there have been, on average, only 1.1 fatalities per year from shark attack over the past two decades. It is clear that the risk of being bitten or dying from an unprovoked shark attack in Australia remains extremely low.

Changing patterns of shark attacks in Australian waters

John G. West

Coordinator, Australian Shark Attack File, Taronga Conservation Society Australia

Major thank you to all those who’s scientific findings were featured and for anyone who took the time to read and take responsibility of entering the oceans into their own hands.

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