NSW GOVERNMENT
Department of Primary Industries

SHARKSMART

THE TECHNOLOGY OF THE NSW SHARK MANAGEMENT STRATEGY

A workbook for students studying technologies, marine studies, and STEM


SHARKSMART
SHARK LISTENING
STATIONS
80
DRONE
SURVEILLANCE
SMART DRUMLINE
TAGGING
& TRACKING

INTRODUCTION

Sharks are a natural part of healthy oceanic and estuarine environments. When people enter open water, they are entering the shark's domain.

The word 'shark' is used to describe a broad range of aquatic creatures, but not all sharks are dangerous to humans. Nearly all shark bites in coastal waters are attributed to just three species: White Sharks (also known as Great White Sharks and White Pointers), Bull Sharks and Tiger Sharks.

The NSW Government launched the Shark Management Strategy in an effort to minimise shark human interactions - to help water users be as safe as possible and to learn more about the role and population of sharks in NSW waters.

The NSW Government's shark tagging program is now estimated to be the largest in the world.

Tracking sharks is helping NSW DPI scientists to determine their movement patterns and increase our knowledge of shark behaviour.

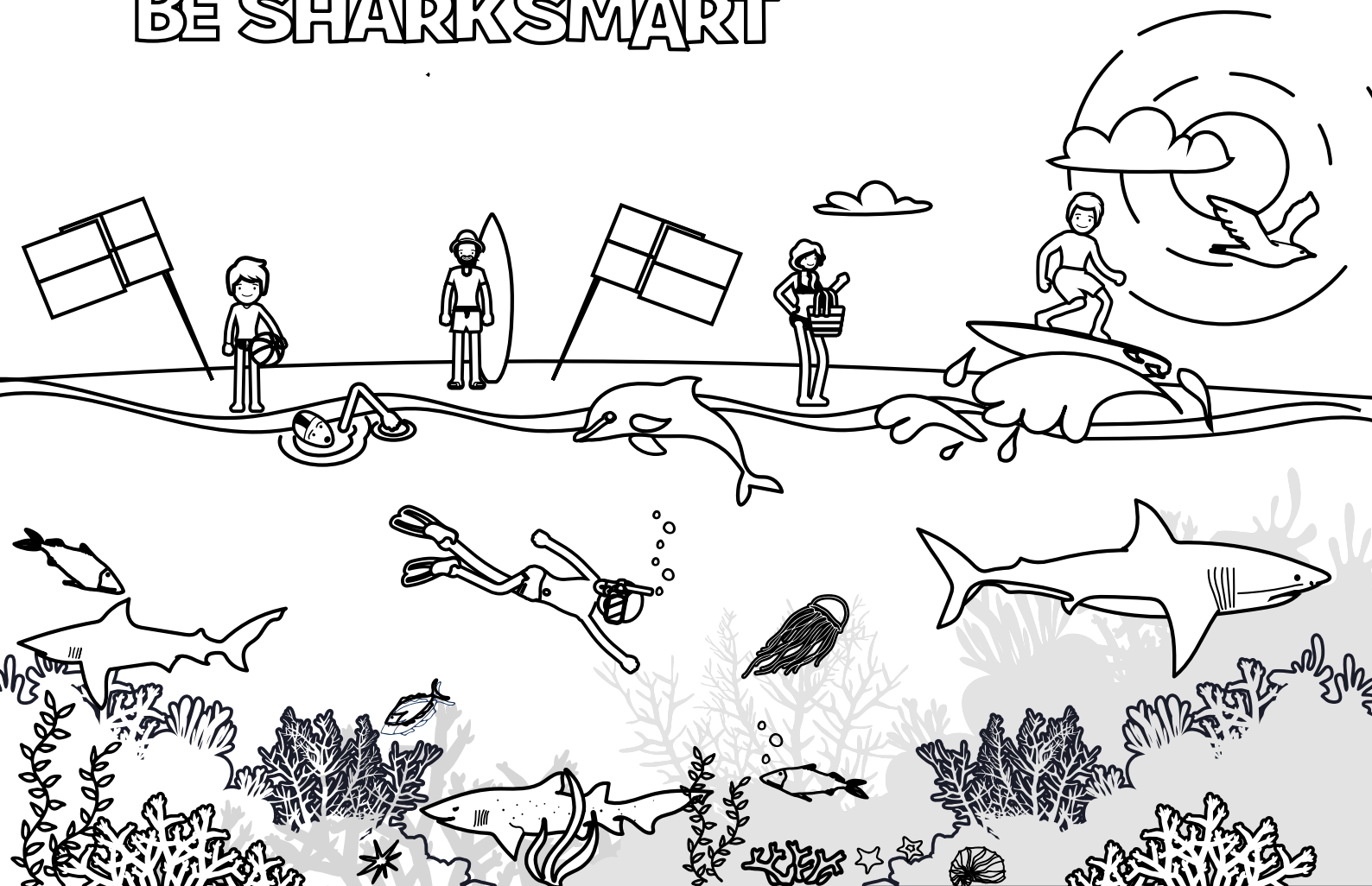
Research shows that some White Sharks travel tens of thousands of kilometres, some moving across the Bight to Western Australia, and one to New Zealand and Papua New Guinea, and others to Tasmania

This workbook is designed to guide students in exploring the technology of the NSW Shark Management Strategy. The strategy itself can be viewed as a solution to a problem - as can each of the components.

The NSW Fisheries YouTube videos, Facebook page, Instagram and the NSW SharkSmart website will help you complete this workbook.

IF YOU SCAN THESE QR CODES YOU WILL LINK TO THE RELEVANT INFORMATION

BE SHARKSMART



IDENTIFYING AND DEFINING THE PROBLEM

The NSW Government is committed to keeping our beaches safe but there is no 100% safeguard, as the ocean is a wild space. A better awareness and understanding of sharks and their behaviour can help everyone enjoy the beach and reduce the risk of a shark encounter.

View the video *Shark Week - Shark Research Projects, Technologies and Careers in Marine Science* **(youtu.be/0JI6HirDvrE)**. The first 25 minutes of the video covers the need for and implementation of the NSW Shark Management Strategy (the Strategy).

Write a description of the major problem that the Strategy is designed to address. Include historic solutions and older technologies aimed at reducing shark - human conflict.

What is the major improvement that new technology attempts to implement? See **www.sharksmart.nsw.gov.au/shark-nets** for more information about ways that the risk of shark interactions have been dealt with since 1930's and check out what other Australian states and countries are doing.

FACTORS TO BE CONSIDERED IN PLANNING

When planning a program like the NSW Shark Management Strategy a range of water users, environments and components need to be considered.

List some factors that need to be considered when designing a strategy like this. Consider personal, environmental and financial aspects.

Whose needs and patterns of usage need to be considered? Consider some different groups of water users as well as the animals themselves.

THE RESEARCH TEAM

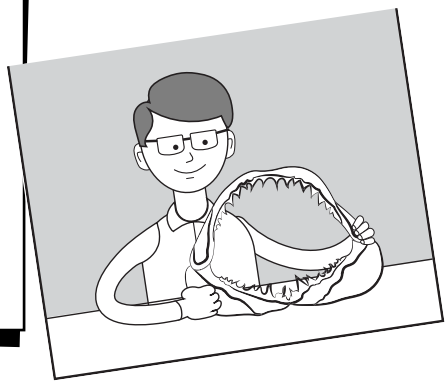
NSW Department of Primary Industries has a team of dedicated scientists working to better understand shark biology and ecology. This will inform shark management now and into the future. The videos on **www.sharksmart.nsw.gov.au/our-scientists** provide an overview of each of the roles.

Dr Vic Peddemors

Dr Vic Peddemors is the senior shark researcher at NSW DPI and oversees research into shark fisheries in NSW.

He manages the research into the NSW Shark Meshing Program, including collection of biological data from caught sharks to understand these animals better. Additionally, he collaborates on several projects within the NSW Shark Management Strategy.

His research into better understanding interactions between humans and sharks includes investigations into all shark bites in NSW waters.



If you could speak to Vic, what would you ask him about his current research?

If you were Vic what would the topic or question of your next research project be?

Dr Amy Smoothey

Dr Amy Smoothey is a fisheries scientist who forms part of the Shark Research Group. Amy joined NSW DPI in 2003 where she worked until 2009 on a casual basis on various angling research projects.

More recently, she has led research projects to understand aspects of the biology and ecology of commercially and recreationally harvested sharks in estuaries and coastal waters of NSW. This research will provide scientific-based guidelines for minimising the risk of shark bites within estuaries such as Sydney Harbour, as well as some of the necessary information to ensure species of sharks in NSW are effectively managed in an ecologically sustainable way.

In her role, Amy is also responsible for investigating the movements of Bull Sharks in NSW waters, shark bites and is involved in various aspects of the NSW Shark Management Strategy.

If you could speak to Amy, what would you ask her about her current research?

If you were Amy what would the topic or question of your next research project be?

Dr Paul Butcher

Dr Paul Butcher's research, as part of the NSW Shark Management Strategy focuses on:

- Tagging and tracking Bull, White and Tiger Sharks;
- Using new technologies like VR4G shark listening stations to provide 'real time' alerts to the public;
- Optimising the efficiency of SMART drumlines by testing different gear configurations to maximise the catch of target species while minimising stress and bycatch;
- Quantifying the use of drones as a bather protection tool and observing how these animals move around in our marine environment;
- Using genetics to quantifying the size of the east coast White Shark population; and
- Quantifying if burying whale carcasses on coastal beaches is likely to attract sharks.

If you could speak to Paul, what would you ask him about his current research?

If you were Paul what would the topic or question of your next research project be?

PhD students

Four PhD students contributing to the shark research include:

Richard Grainger - currently undertaking his PhD in the School of Life and Environmental Sciences at the University of Sydney, examining the diet and foraging ecology of white sharks in New South Wales in collaboration with the NSW Shark Management Strategy. Richard is also deploying video cameras with a range of other integrated sensors onto White Sharks, allowing him to follow the sharks from their perspective, providing a detailed picture of what sharks are doing while close to shore.

Andrew Colefax - is studying his PhD through Southern Cross University, as part of the NSW Shark Management Strategy. His research is focused on developing drones for shark surveillance and beach safety. He is focused on developing shark surveillance procedures and improving detection rates of animals in the water. See Chapter 10 for more on Andrew's research.

James Tucker - is undertaking his PhD through the Southern Cross University National Marine Science Centre, and the NSW Shark Management Strategy. James is investigating the burial of whale carcasses on beaches to determine if they affect the behaviour of sharks; specifically, whether they have the potential to attract sharks to beaches. James hopes his research will assess the safety of beach burial as a disposal option for whale carcasses and potentially reduce the chances of negative shark interactions with beachgoers.

Rick Tate - is a PhD candidate studying through Southern Cross University and the NSW Shark Management Strategy. Rick's research is looking closely at SMART drumlines using the data collected from across the east coast of Australia to optimise SMART drumlines in NSW.

WHAT OTHER DPI ROLES ARE INVOLVED IN THE SHARKSMART PROGRAM?

Community Engagement Officers - Connecting with communities to listen to their views about sharks and communicating the results of the shark research and trials is an important part of the Strategy. These roles are filled by Kim Wolfenden, Emma Mudford and Sarah Morison. People can have very different views about sharks and it is important to listen and understand all perspectives. The video 'Community Engagement and the NSW Shark Management Strategy' provides more detail about these roles. **https://youtu.be/NagxhLYNOKQ**

Social Research Scientist - Employed by DPI to understand what the NSW community thinks about different shark management strategies. This role is currently filled by Dr Carol Martin. Carol's work includes designing surveys to assess the level of community support and preferences for different shark mitigation measures trialled in the Strategy. The information collected is used to inform DPI management decisions and recommendations for the Strategy and future shark management in NSW.

Implementing the strategy requires a team of staff. Other roles include:
Tick the ones that interest you…

- ☐ Shark Management Strategy Manager - manages all the different parts of the strategy so that they work together to give DPI useful information and practical recommendations.
- ☐ Media Manager - ensures that information about the Strategy is available and accurate.
- ☐ Fisheries technicians - build and maintain SMART drumlines, skipper shark tagging boats, maintain boats and equipment.
- ☐ Fishing contractors - respond to SMART drumline alerts to tag and release sharks and work with DPI scientists.
- ☐ Digital communications staff - look after the website and social media.
- ☐ Policy staff - work to create guidelines and recommendations that ensure Strategy activities are safe and beneficial for staff, the public and marine life.
- ☐ Phd students studying shark behaviour and diets.
- ☐ Helicopter and Drone operators - carrying out surveillance operations.
- ☐ Social researcher - gathering information from the community both about the Strategy and to inform the strategy.
- ☐ VR4G maintenance contractors - maintain the listening stations

The testing and evaluating phase of the NSW Shark Management strategy includes the trials and research described on the following pages. Review the videos and website content to complete the following pages(including the shark).

RESEARCH - SHARK TAGGING

Where in NSW? North coast, central coast, metro, south coast

Trial or research? Research

The NSW Government's shark tagging program is now estimated to be the largest in the world.

Tracking sharks is helping DPI scientists to determine their movement patterns and increase our knowledge of shark behaviour.

More information and updated statistics are available at **www.sharksmart.nsw.gov.au/shark-activity.**

Complete the following:

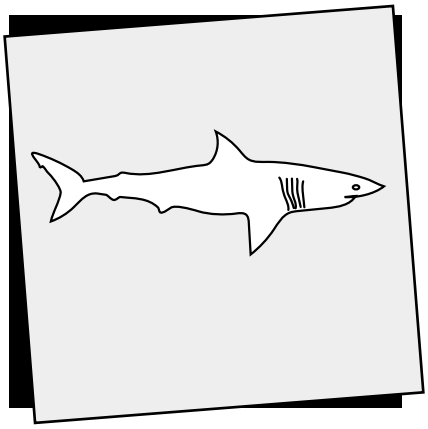
PURPOSE

METHOD

TYPES OF DATA

FINDINGS / IMPACT

RESEARCH - SHARK BIOLOGY AND ECOLOGY



Where in NSW? North coast, central coast, metro, south coast

Trial or research? Research

A number of projects are researching shark biology and ecology, to inform future shark safety measures.

More information and updated statistics are available at **www.sharksmart.nsw.gov.au/technology-trials-and-research/shark-biology-and-ecology**

Complete the following:

VIDEO AVAILABLE: SHARK ADAPTIONS

PURPOSE

METHOD

TYPES OF DATA

FINDINGS / IMPACT

See our video about the shark movement patterns that were observed during the Strategy - scan this QR code or click the link

RESEARCH - COMMUNITY PERSPECTIVES

Social research

Where in NSW? North coast, central coast, metro, south coast

Trial or research? Research

Understanding the relationship between people, communities and sharks is a key component of the NSW Shark Management Strategy.

More information and updated statistics are available at **www.sharksmart.nsw.gov.au/technology-trials-and-research/social-research**

Complete the following:

PURPOSE

METHOD

TYPES OF DATA

FINDINGS / IMPACT

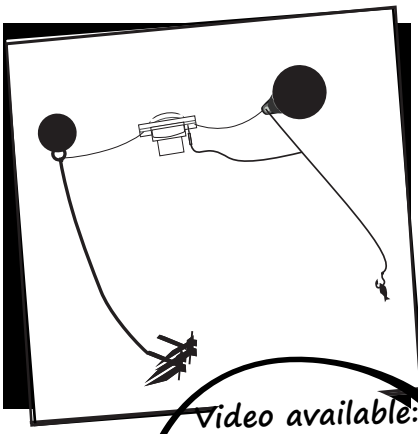
BEACHGOER INFORMATION

Download the SharkSmart app for useful tips on reducing the risk of a shark encounter and for the latest advice, alerts and information.

Download the SharkSmart app for iOS from the iTunes store

Download the SharkSmart app for Android from Google Play

TRIAL - SMART DRUMLINES



Video available: SMART drumlines

Where in NSW? North coast, central coast, metro, south coast

Trial or research? Trial

NSW is leading the world in trials of shark-management-alert in real time (SMART) drumlines, which are both a shark mitigation and a research tool. Unlike traditional drumlines, the research trials show that SMART drumlines have minimal impact on marine species.

Preliminary trial results show that SMART drumlines are successful in catching target sharks (White, Bull or Tiger sharks), allowing us to tag and release them along with any non-target animals.

The relocation of captured target sharks by the response team and the natural reaction of sharks to move offshore after release for a few months, indicates that SMART drumlines are a useful non-lethal protection tool.

More information and updated statistics are available at www.sharksmart.nsw.gov.au/technology-trials-and-research/smart-drumlines

View the fact sheet

PLUS

MINUS

INTERESTING

Information and results of location specific trials is available at https://www.sharksmart.nsw.gov.au/technology-trials-and-research/smart-drumlines

TRIAL - BARRIERS

Where in NSW? North coast

Trial or research? Trial - ceased

DPI trialled two environmentally friendly shark barriers on the North Coast to provide an enclosed shark-free area for beachgoers.

Neither of the two shark barriers could be installed effectively and safely, and so both trials were terminated.

The Aquarius Barrier trial was discontinued after it was unable to be effectively and safely installed. A second trial was discontinued after Contractor Eco Shark Barrier Pty Ltd identified significant installation and maintenance issues.

View the fact sheet

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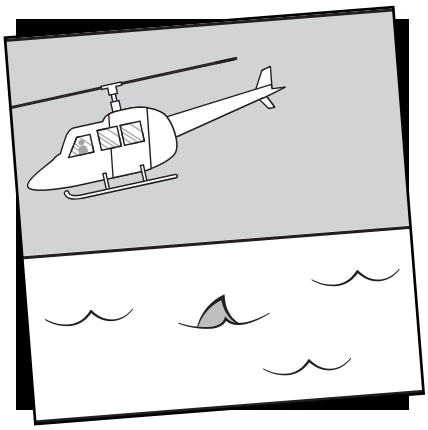
INTERESTING

TRIAL - HELICOPTER SURVEILLANCE



Where in NSW? North coast, central coast, metro, south coast

Trial or research? Ongoing technology and trial (location dependent)

Aerial surveillance is used to monitor sharks that may be dangerous to swimmers and to record other marine wildlife that will help scientists understand factors that may influence shark movements and distribution.

Aerial shark surveillance from helicopters in metropolitan NSW coastal waters has been in action since 2009 as part of the Shark Meshing Program. Aerial surveys are also being trialled along the rest of the NSW coast as part of the Shark Management Strategy.

If the pilot spots a shark that poses a threat to surfers or swimmers, a call is immediately made the local Surf Lifesaving Club. Information is also available via @NSWSharkSmart on Twitter and the SharkSmart App.

More information and updated statistics are available at **www.sharksmart.nsw.gov.au/technology-trials-and-research/helicopter-surveillance**

View the fact sheet

PLUS

MINUS

INTERESTING

Video available: Helicopter Shark Surveillance

TRIAL - DRONES

Where in NSW? North coast, central coast, metro, south coast

Trial or research? Research and trial

Drones offer emerging surveillance technology that provides aerial surveillance of coastal waters and real-time vision of the area.

DPI is collaborating with Surf Life Saving NSW to trial Drones at beaches along the coast as a shark detection tool, and to assess the extent to which they could potentially become part of the standard beach safety equipment used by SLSNSW and other beach authorities.

Drones have been trialled at Kingscliff, Main Beach Byron Bay, The Pass, Suffolk Park, Lennox Head, Sharpes Beach, Lighthouse Beach, Shelley Beach in Ballina, Evans Head, Yamba, Coffs Coast, Tacking Point Port Macquarie, Birubi, Redhead, Avoca, Kiama, Mollymook, Pambula, and Tathra.

VIDEO AVAILABLE: DRONES AND CAMERA DEVELOPMENT

View the fact sheet

More information and updated statistics are available at www.sharksmart.nsw.gov.au/technology-trials-and-research/drones

PLUS

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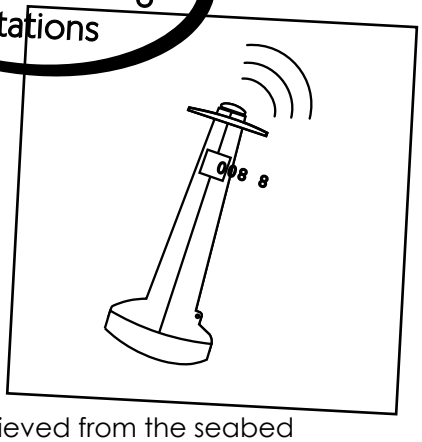
INTERESTING

TRIAL - LISTENING STATIONS

Video available Shark listening stations



Where in NSW? North coast, central coast, metro, south coast

Trial or research? Trial and research

DPI is currently trialling 21 VR4G shark listening stations. These are receivers that record the presence of tagged animals swimming within a 500 metre radius of the listening station and provide real-time updates of tagged sharks close to key swimming/surfing locations.

Captured information goes straight to a satellite and is then instantly sent to the public and beach authorities via Twitter and the SharkSmart App. This data from the full network of listening stations also provides important insights into the movements of sharks in our waters.

DPI also manages several hundred VR2W listening stations that must be retrieved from the seabed to download data. This retrospective shark movement data provides finer scale information on shark movements and habitat use that will assist in understanding factors affecting shark distribution and their interactions with humans.

More information and updated statistics are available at **www.sharksmart.nsw.gov.au/technology-trials-and-research/vr4g-locations**

View the fact sheet

PLUS

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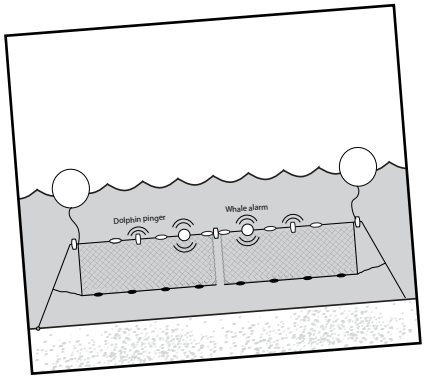
INTERESTING

Video available: Shark Listening Stations

TRIAL - NORTH COAST NET TRIAL



Where in NSW? North coast

Trial or research? Trial now complete

Two shark nets trials were undertaken at five beach locations on the North Coast of NSW: Lennox Head, Sharpes Beach (Ballina), Shelly Beach (Ballina) Lighthouse Beach (Ballina) and Evans Head.

Trial one was undertaken from 8 December 2016 and 30 May 2017 and trial two was undertaken from 23 November 2017 and 2 May 2018.

Shark net facts

Shark nets are installed near a beach, according to prevailing conditions, generally parallel to the beach near surf clubs and patrolled swimming areas

Shark nets do not create an enclosed area, or provide a barrier between beachgoers and sharks. They are designed to reduce the likelihood of shark interactions.

Shark nets used in the trial were 150 metres long by 4 to 6 metres deep, with a mesh size of 60 cm, set below the surface in about 10 to 12 metres of water, approximately 500 metres from shore.

Shark nets are fitted with 'whale alarms' and 'dolphin pingers' to alert marine mammals to the netted area.

More information and trial results
www.sharksmart.nsw.gov.au/shark-nets/north-coast-net-trial

View the fact sheet

PLUS

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INTERESTING

TRIAL - PERSONAL DETERRENTS

To reduce the risk of an interaction with a shark, surfers should consider using a personal deterrent.

There are several commercially available shark deterrent products but the NSW Government recommends investing in a device that has been independently tested and verified.

More information
www.sharksmart.nsw.gov.au/technology-trials-and-research/personal-deterrents

Video available Personal Shark Deterrents

View the fact sheet

PLUS

MINUS

INTERESTING

TRIAL - CLEVER BUOY™

View the fact sheet

Where in NSW? North coast

Trial or research? Trial - now concluded

Clever Buoy™, developed by ASX-listed Australian company Shark Marine Systems (SMS), uses sonar and associated software to try to detect the distinctive movement patterns made by sharks and transmit critical information to local beach authorities.

DPI undertook a collaborative project with the University of Technology Sydney and SMS to explore the ability of sonar technology to detect White Sharks and relay information to shore. The trial of Clever Buoy™ was undertaken at Hawks Nest in Port Stephens, where White Sharks are known to be present. Underwater camera footage within the sonar detection area confirmed the presence of White Sharks.

The Clever Buoy™ successfully identified White Sharks 45% of the time within a 46m range and the length estimates provided were reliably close to the lengths estimated by the video camera footage. The range and accuracy of the data was influenced by the trial design and water depth. Post-testing, it was found that the sonar configuration was not correctly positioned for the water depth and as the algorithm was developed using sharks 2.5m and greater, it did not detect all of the smaller juvenile White Sharks that dominated this trial.

The Hawks Nest trial showed that the behaviour of marine animals was not affected by the presence of the Clever Buoy™ system.

www.sharksmart.nsw.gov.au/__data/assets/pdf_file/0007/815866/evaluation-of-clever-buoy-shark-detection-system-summary.pdf

PLUS

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INTERESTING

COMMUNITY ENGAGEMENT

An important aspect of the Strategy is to gather input and feedback from the public and water users. Gathering of community input has been integrated into the Strategy and has informed the research – nothing beats local knowledge.

Communicating findings

Sharing the results of the shark research and trials of technologies with beach authorities and communities is an essential part of the Strategy.

The deeper understanding of shark biology, populations and behaviour from the research and trials will inform shark mitigation on beaches in NSW and future SharkSmart recommendations.

The findings are communicated through:

WEBSITE:
WWW.SHARKSMART.NSW.GOV.AU/

SOCIAL MEDIA:

FACEBOOK:
WWW.FACEBOOK.COM/NSWDPIFISHERIES/

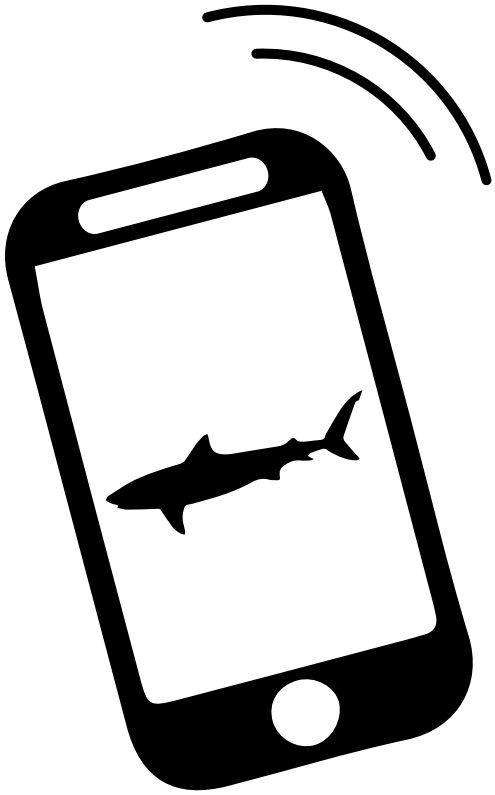
TWITTER:
TWITTER.COM/NSWSHARKSMART

YOUTUBE:
WWW.YOUTUBE.COM/USER/NSWFISHERIES

INSTAGRAM:
WWW.INSTAGRAM.COM/NSW_SHARKSMART/

MEDIA:

SIGNIFICANT MILESTONES OF THE STRATEGY OR NEW EXCITING FINDINGS ARE SHARED WITH THE MEDIA. THESE STORIES ARE OFTEN PICKED UP BY NATIONAL NEWSPAPER, RADIO, TELEVISION AND ONLINE OUTLETS.



SHARKSMART APP:

THE SHARKSMART APP PROVIDES USEFUL TIPS ON REDUCING THE RISK OF A SHARK ENCOUNTER AND THE LATEST ADVICE, ALERTS AND INFORMATION.

THE SHARKSMART APP IS AVAILABLE FOR IOS FROM THE ITUNES STORE AND FOR ANDROID FROM GOOGLE PLAY

COMMUNITY EVENTS:

A MOBILE SHARKSMART EDUCATION STATION ATTENDS COMMUNITY EVENTS TO SHARE THE LATEST SHARK SCIENCE WITH BEACHGOERS.

RECOMMENDATIONS

How do the recommendations below reflect the results of the research and trials?

SHARKSMART SWIMMERS AND SURFERS

Tell an on-duty lifesaver or lifeguard if you spot a shark near swimmers or surfers.

Don't swim too far from shore.

Don’t swim with bleeding cuts or wounds.

Always swim, dive or surf with other people.

Avoid swimming and surfing when it's dark or during twilight hours.

Avoid murky water or waters with known effluents or sewage.

Avoid areas used by recreational or commercial fishers.

Avoid areas with signs of bait fish or fish feeding activity; diving seabirds are a good indicator of fish activity.

Do not rely on sightings of dolphins to indicate the absence of sharks; both often feed together on the same food.

Be aware that sharks may be present between sandbars or near steep drop offs.

Avoid swimming in canals and swimming or surfing in river/harbour mouths.

Avoid having pets in the water with you.

Do not swim/surf near or interfere with shark nets.

Consider using a personal deterrent.

SHARKSMART DIVERS, SNORKELLERS AND SPEARFISHERS

Understand and respect the environment. Find out which species of shark you are most likely to encounter and what behaviour to expect from them.

Realise that diver safety becomes increasingly difficult with decreasing visibility, such as at night or in turbid water and with increasing depth and current.

Discuss dive logistics and contingency plans such as hand signals, entry and exit considerations and separation procedures with your dive partner before you enter the water.

Be aware that using bait to lure fish may attract sharks.

Don't chase, grab, corner, spear or touch a shark.

Don't use bait or otherwise attempt to feed a shark while underwater. Feeding may radically change the shark's behaviour and may lure other sharks.

Observe and respond to a shark's behaviour. If it appears excited or agitated, exhibiting quick, jerky movements or other erratic behaviour, leave the water as quickly and calmly as possible. Try to minimise splashing and noise.

Be aware of the behaviour of fish. If they suddenly dive for cover or appear agitated, leave the water as quickly and calmly as possible. A shark may be nearby.

Do not attach speared fish to your body or keep them near you; use a float and line to keep your catch well away.

THE FUTURE

The NSW Shark Management strategy aims to reduce shark / human interactions – while protecting sharks. A healthy ocean ecosystem is dependant on all the parts of the system, including predators, being in balance and human activities being managed.

The NSW Government has also released a Marine Estates Management Strategy (**www.marine.nsw.gov.au/strategy-implementation**). It includes policy for the management of marine protected areas (**www.marine.nsw.gov.au/nsw-marine-estate/marine-protected-areas**). Discuss with your classmates the ways that this Strategy works with the NSW Shark Management Strategy to protect sharks and marine habitats.

Record a summary of this discussion below.

HELICOPTER
SURVEILLANCE FLIGHTS

SHARKSMART
APP

SCIENCE &
RESEARCH

PERSONAL SHARK
DETERRENT DEVICE

DONT SURF OR SWIM AT DAWN OR DUSK

SURFERS CHECK CONTITIONS AND ASSESS THE RISKS

BE AWARE IF YOU SEE BIRDS & BAITFISH, SHARKS MAY BE PRESENT, LEAVE THE WATER

DON'T SWIM OR SURF IN MURKY WATERS

AVOID RIVER MOUTHS AND STEEP DROP-OFFS SHARKS COULD BE PRESENT