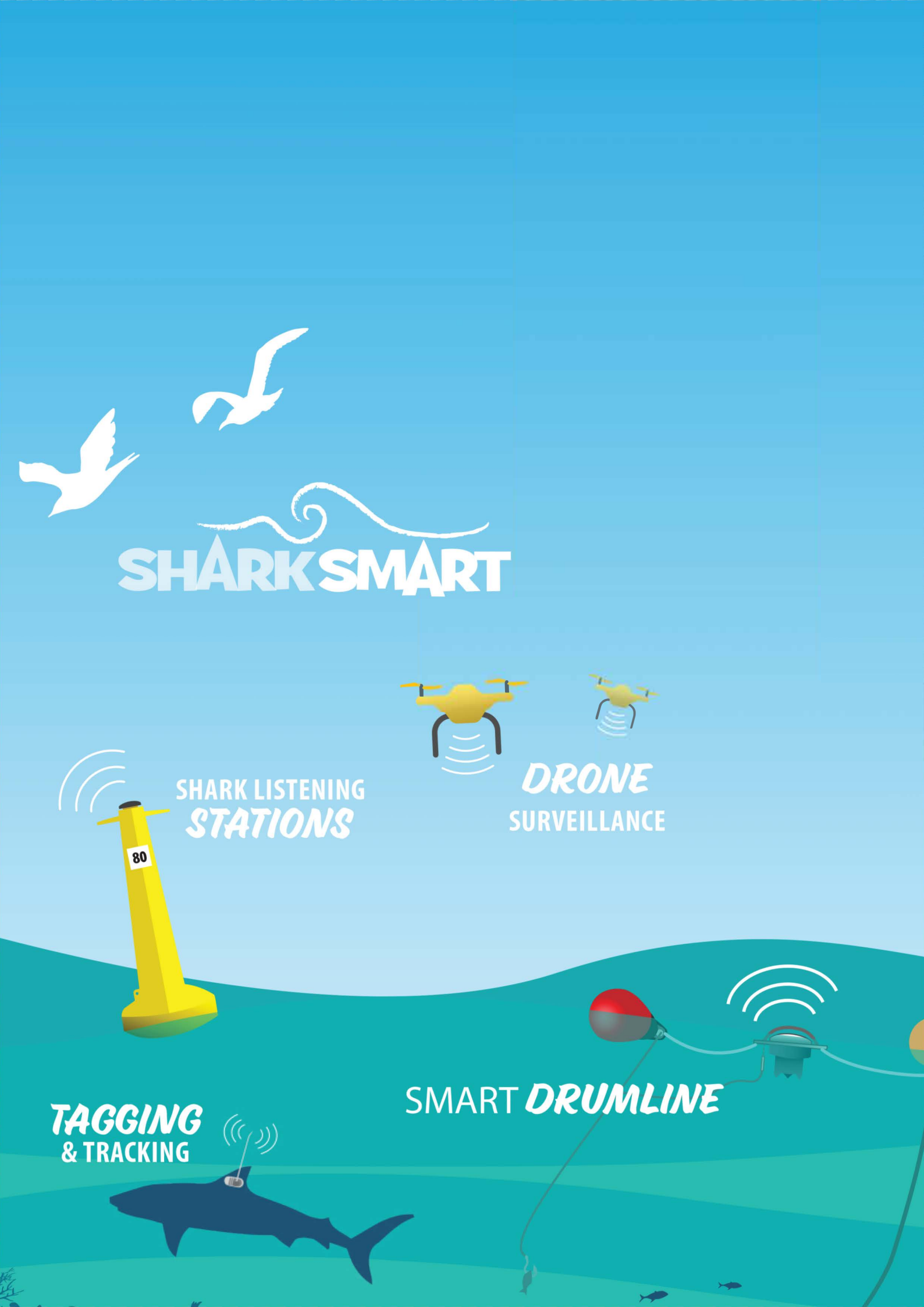
Department of Primary Industries

SHARKSMART

THE SCIENCE OF THE NSW SHARK MANAGEMENT STRATEGY

A workbook for students studying science, marine studies, STEM and geography

sharksmart.nsw.gov.au


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

INTRODUCTION

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.

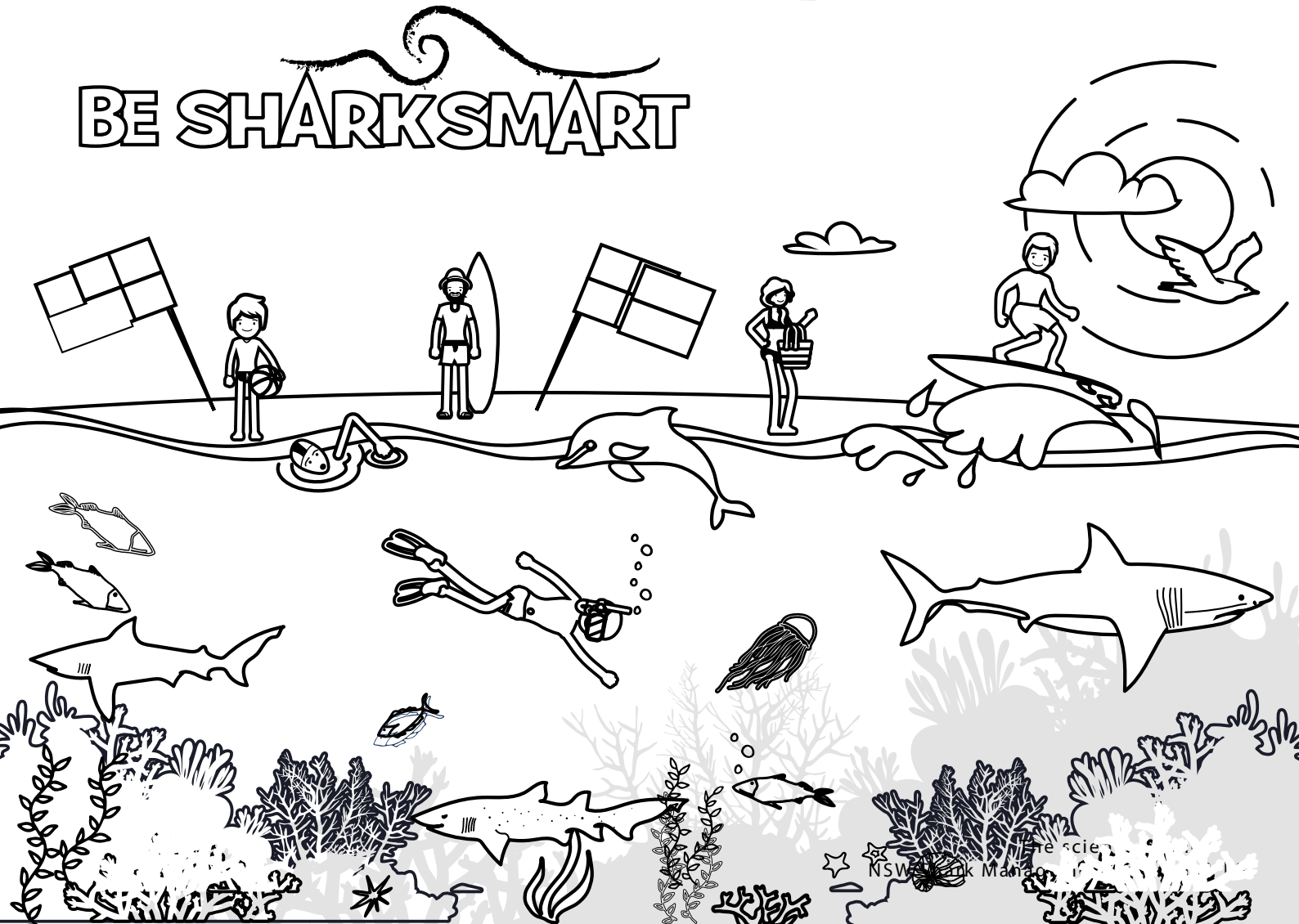
The NSW Government's shark tagging program is now estimated to be the largest in the world.

Tracking sharks is helping NSW DPI scientists to determine their movement patterns and increase our knowledge of shark behaviour. During the process of tagging sharks samples are also collected. These samples are analysed to help us understand shark biology of the particular species found in our waters, information that will help us share the water with them more safely and sustainably.

This workbook is designed to help students explore the science of the NSW Shark Management Strategy. Work that is particularly relevant to students studying science, marine studies, STEM and geography. It is designed to be completed with the information on the NSW SharkSmart website and the videos in the secondary SharkSmart YouTube playlist.

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



THE ROLE OF THE NSW DEPARTMENT OF PRIMARY INDUSTRIES IN THE MANAGEMENT OF MARINE ENVIRONMENTS

The Department of Primary Industries (DPI) works to increase the value of primary industries and drive economic growth across NSW. DPI Fisheries is one of the divisions of DPI whose role it is to support economic growth and sustainable access to aquatic resources through commercial and recreational fisheries management, research, aquaculture development, habitat protection and rehabilitation, regulation and compliance.

Go to the DPI Fisheries website (www.dpi.nsw.gov.au/fishing) and record here the main responsibilities for the following programs:

Recreational fishing

Compliance

Aboriginal fishing

Commercial fishing

For more detail about commercial fishing in NSW download the Commercial fishing Primefact (www.dpi.nsw.gov.au/fishing/commercial/info/commercial-primefact)

Aquaculture

With increasing demand for high quality seafood, aquaculture is a growing industry in NSW. The Aquaculture Management and Research sections of NSW Department of Primary Industries are responsible for working with aquaculture industries, the community and other agencies to ensure aquaculture develops in a sustainable manner.

Pests and Diseases

More information about marine pests and diseases in NSW is available at www.dpi.nsw.gov.au/fishing/pests-diseases/marine-pests.

SharkSmart

List the priority fisheries research programs from the DPI website at www.dpi.nsw.gov.au/content/research/fishing-aquaculture

Where are the two major fisheries research centres in NSW and what are their areas of research?

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DPI is concerned with habitat management and works to assess and map aquatic habitats, identify threats to habitats, as well as protect and rehabilitate habitats through education and on-ground works.

DPI also represents the NSW government in relation to the management and implementation AQUAPLAN **(www.agriculture.gov.au/animal/aquatic/aquaplan)** and works with other NSW government bodies on the Marine Estate Management Strategy **(www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy)**

THE NSW SHARK MANAGEMENT STRATEGY

What is it?

The NSW Government is researching White, Bull and Tiger Shark movements and ecology as well as testing and trialling new technologies to increase protection at beaches. There is no 100% safeguard, as the ocean is a wild space.

What is the aim?

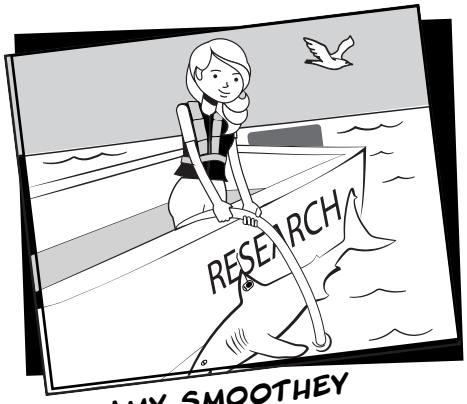
The Shark Management Strategy aims to increase protection for beachgoers with minimal harm to sharks and other marine life. The Strategy also aims to encourage a better awareness and understanding of sharks and their behaviour to help everyone enjoy the beach and reduce the chance of a shark encounter.

What does it involve?

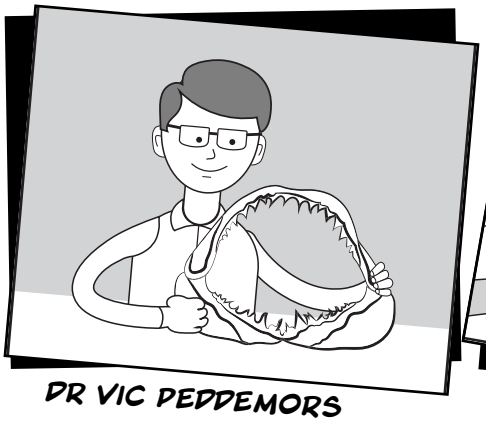
The strategy includes research into shark behaviour and biology through tagging and tracking sharks and surveillance programs. The knowledge that this research provides makes it possible to make recommendations for ways that water users can enjoy the ocean and beaches, as safely as possible. Part of the strategy is also trialling various ways of identifying sharks that pose a risk to water users and alerting them to the possible danger.

MEET THE TEAM

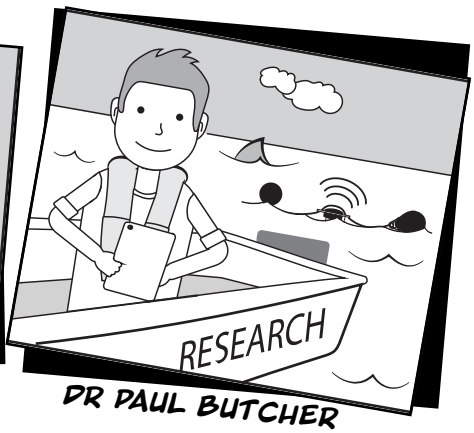
NSW Department of Primary Industries has a team of dedicated scientists working to better understand shark biology and ecology. This will inform shark management now and into the future. The videos on www.sharksmart.nsw.gov.au/our-scientists provide an overview of each of the roles.



DR AMY SMOOTHEY

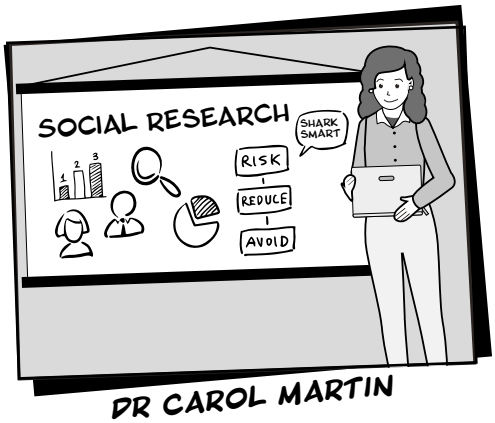


DR VIC PEDDEMORS



DR PAUL BUTCHER

KIM WOLFENDEN, EMMA MUDFORD AND SARAH MORISON



DR CAROL MARTIN

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, overseeing the data collected by the helicopter surveys and co-supervises investigations into White Shark foraging ecology.

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 quantify 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.

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.

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. Including those listed below:
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.
- ☐ Social researcher - gathering information from the community both about the Strategy and to inform the strategy.
- ☐ Phd students studying shark behaviour and diets.
- ☐ Helicopter and Drone operators - carrying out surveillance operations.

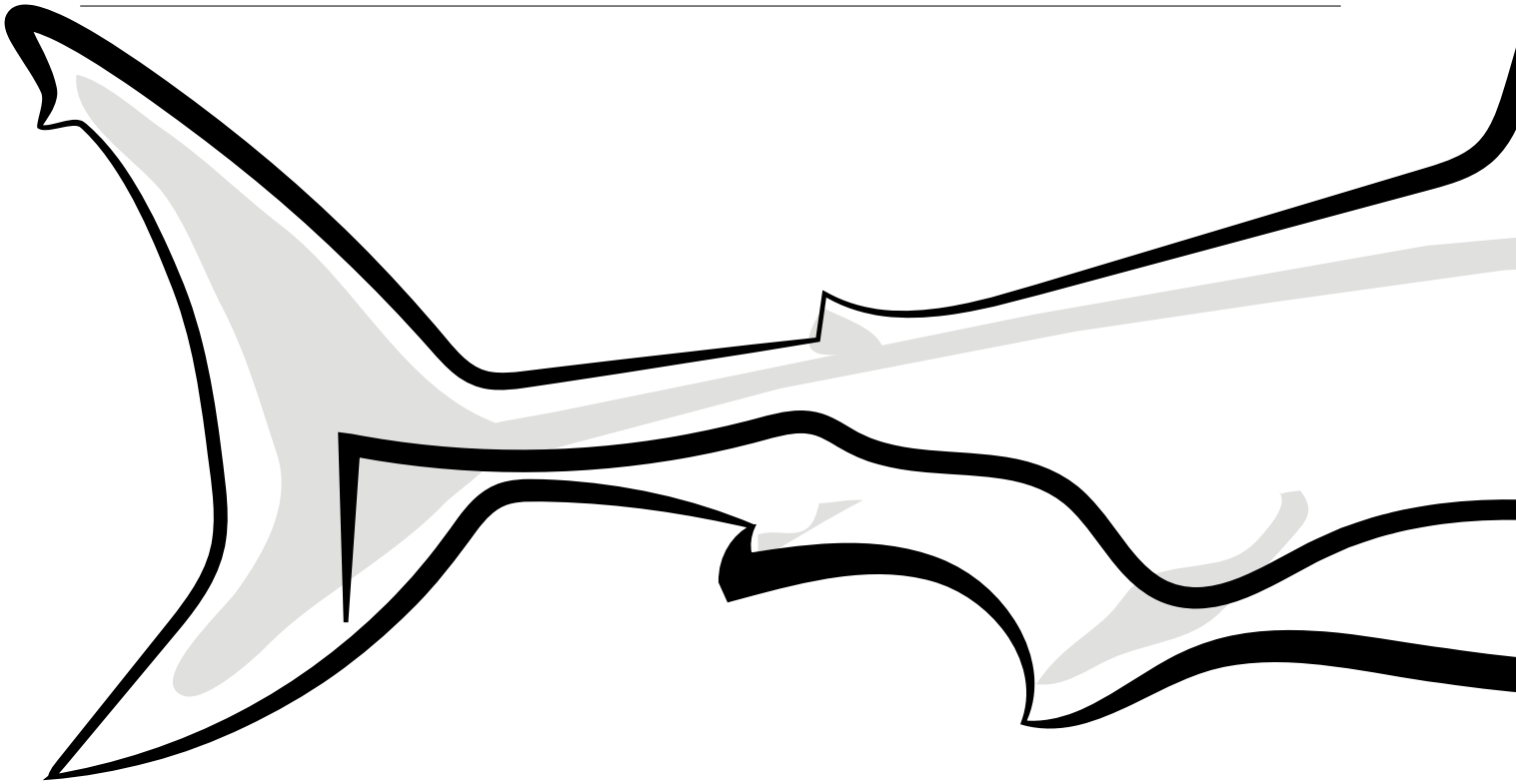
WHAT IS A SHARK?

Listen to Dr Amy Smoothey describe what a shark is and what helps them to thrive in the marine environment in the video 'Shark Adaptions and identifying sharks.' Label each of the features on the diagram below, include a description of where and how they vary from other marine animals.

- Dorsal fin

- Strong jaw

- Skeleton of cartilage (not bones)



- Highly developed sense of smell

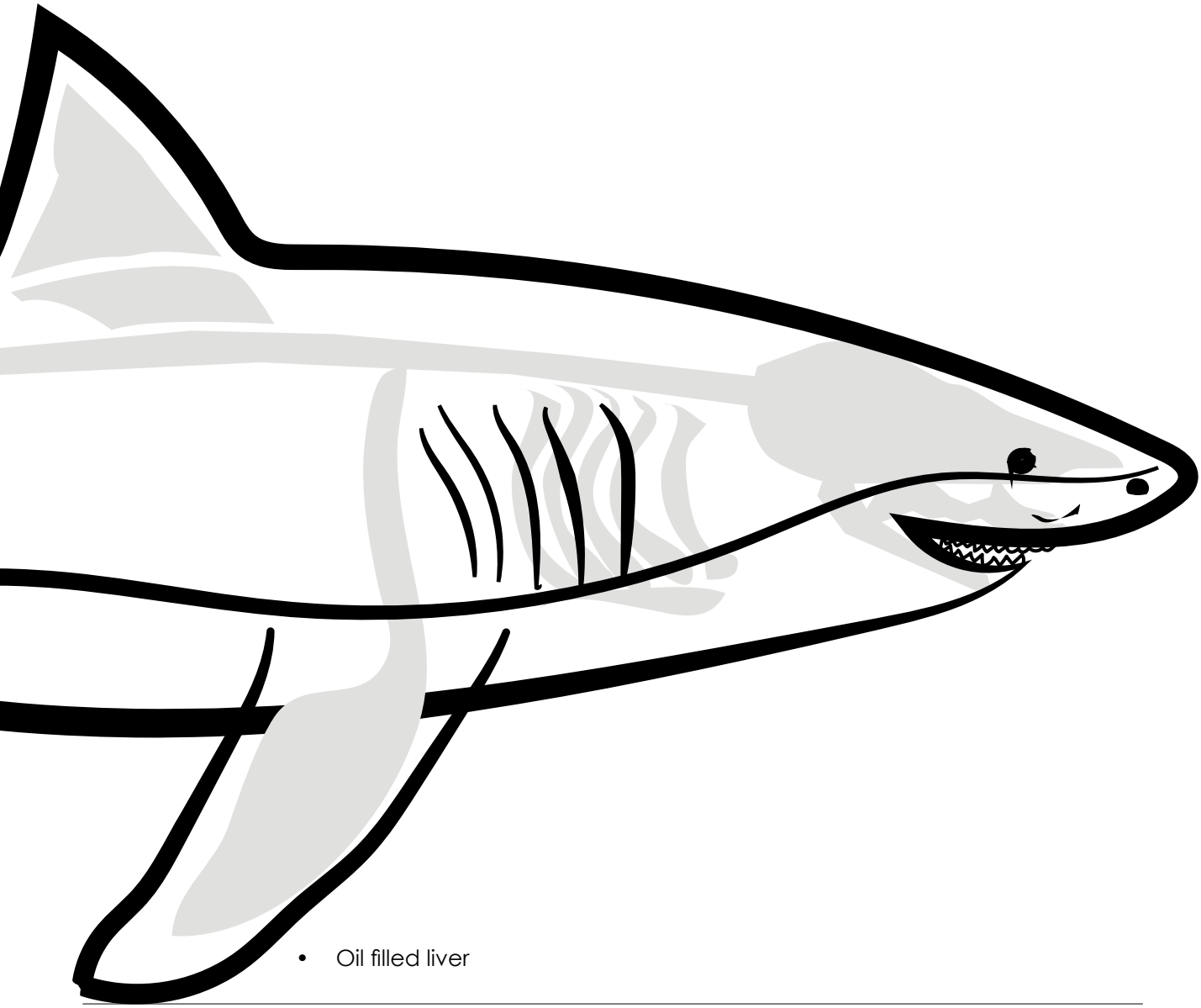
- Sensory organs to help detect vibrations

- Electroreceptors

- Dermal denticles

- 5 – 7 gills

- Highly developed caudal fin



- Oil filled liver

- Lateral line of sensory organs

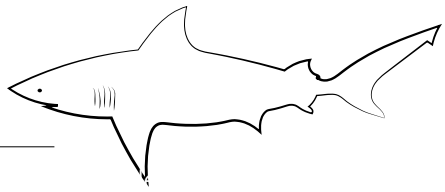
- Ampullae of Lorenzini

SHARKS IN AUSTRALIAN WATERS

White, Bull and Tiger Sharks are referred to as 'target sharks' as they are the three sharks that are most frequently involved in serious shark bites in NSW and are the focus of the NSW Government's tagging, tracking and shark mitigation programs. The distinctive features of different shark species are shown in videos on the SharkSmart website.

Go to www.sharksmart.nsw.gov.au/about-sharks to complete the following information about the shark species in NSW waters.

Bull sharks



Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Bull Shark: _____

_____

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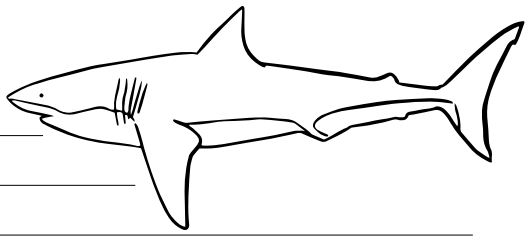
White sharks



Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

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Interesting facts: _____

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Identifying the White Shark: _____

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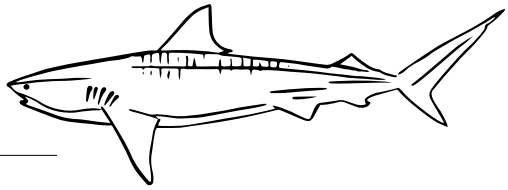
Tiger shark



Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Tiger Shark: _____

_____

_____

_____

OTHER SHARKS OF NSW INSHORE WATERS

Bronze Whaler

Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

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Interesting facts: _____

_____

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Identifying the Bronze Whaler Shark: _____

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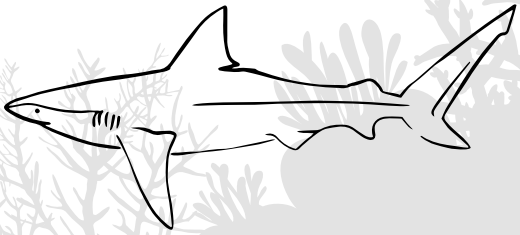
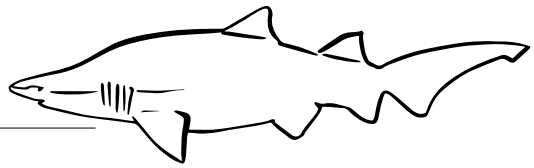


Greynurse shark



Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Greynurse Shark: _____

_____

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_____

Smooth Hammerhead

Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Hammerhead Shark: _____

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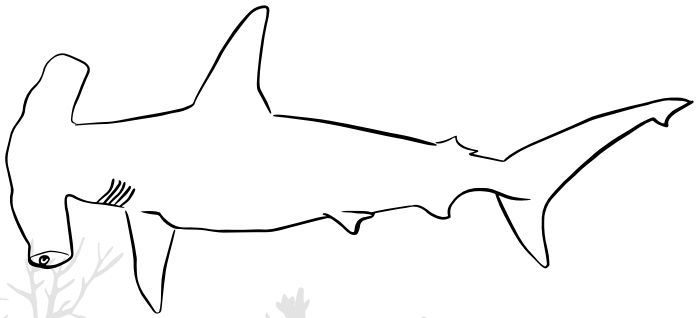
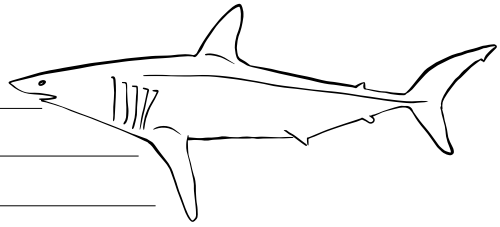


Shortfin Mako shark



Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Mako Shark: _____

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Ornate Wobbegong

Alternative names: _____

Scientific name: _____

Diet: _____

Size: _____

Range: _____

_____

Interesting facts: _____

_____

_____

Identifying the Wobbegong Shark: _____

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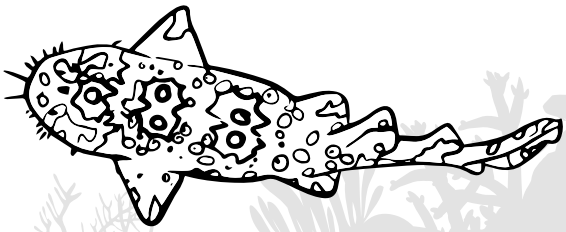


See our video about the shark movement patterns that were observed during the Strategy - scan this QR code or click the link

SHARKS IN THE ENVIRONMENT

Why do we care about protecting sharks?

Sharks are a natural part of healthy oceanic and estuarine environments. When people enter open water, they are entering the shark's domain. Listen to Dr Amy Smoothey describe the role that sharks play in the oceanic environment in the video 'Role of sharks in the environment and threats'.

The word 'shark' is used to describe a broad range of aquatic animals, 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.

So how do sharks contribute to a healthy ecosystem? View the video 'How wolves change rivers' (**youtu.be/ysa5OBhXz-Q**). This video has been around for a while and has been criticised as an over-simplification of the restoration of Yellowstone National Park – the three links below provide some more detail about this. But it is a good illustration of how important all the parts of an ecosystem are.

Having viewed this video think about how this lesson in environmental management might apply to the oceanic environment if there were no sharks. Start by illustrating an oceanic food web of a specific area (eg seagrass beds, coral reefs, an estuary or open ocean) on the page opposite.

Research the term trophic cascade. Write a definition and describe how this phenomenon might impact the food web you illustrated if a particular species of shark were removed from the ecosystem.

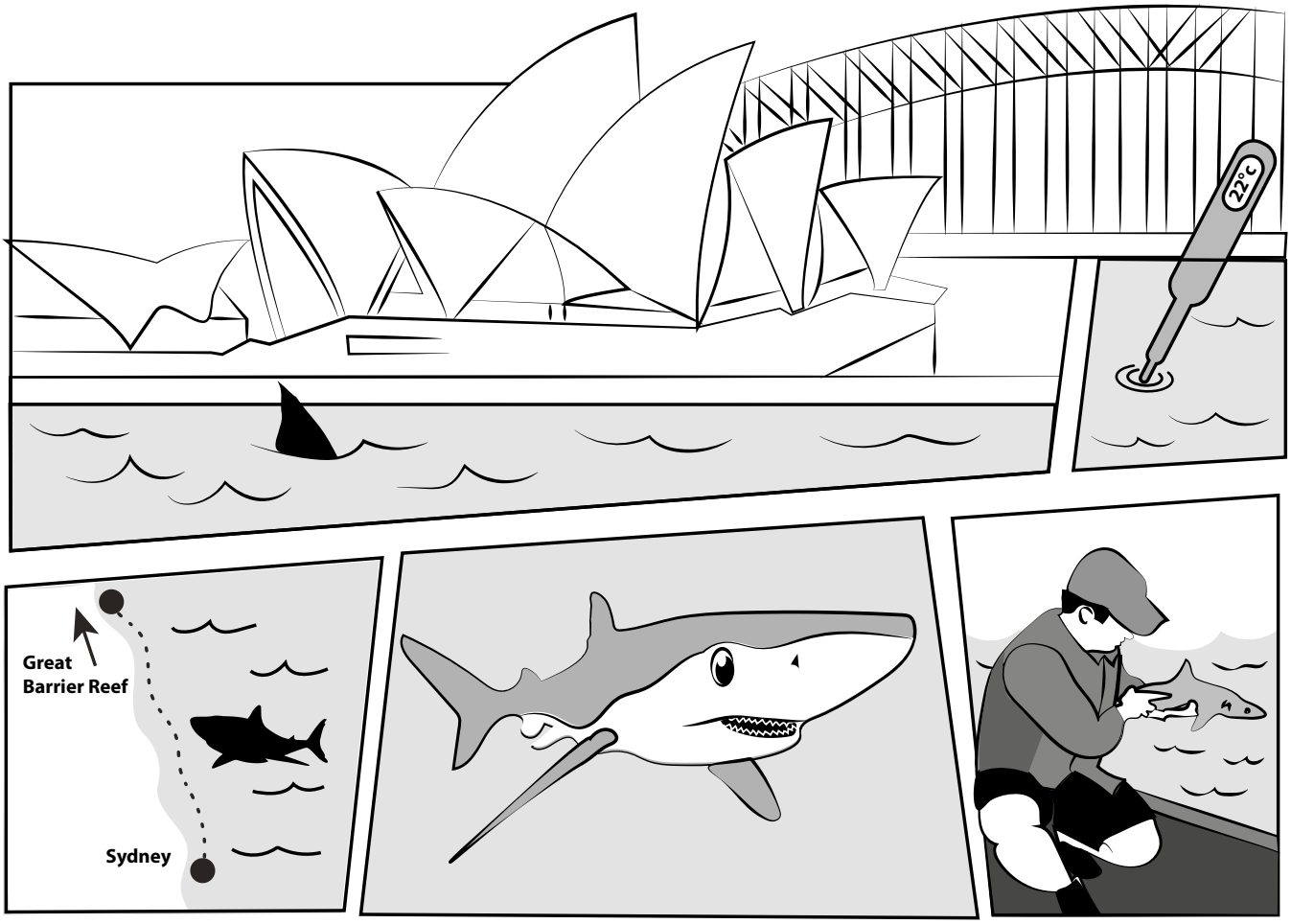
MORE ABOUT YELLOWSTONE...

How the return of just 66 wolves rejuvenated Yellowstone's entire ecosystem provides context https://aeon.co/videos/how-the-return-of-just-66-wolves-rejuvenated-yellowstone-s-entire-ecosystem

BBC review including some Australian context **www.bbc.com/earth/story/20170516-when-wolves-return-to-the-wild-everything-changes**

2018 update **www.businessinsider.com.au/the-scientists-behind-the-viral-how-wolves-change-rivers-video-are-back-and-have-made-a-small-update-to-their-claim-2018-11]**

KEY FINDINGS OF THE SHARK RESEARCH



Cross out the incorrect option:

Bull sharks have been tagged as part of a research program that initially focused on **the Great Barrier Reef / Sydney Harbour**. This research first began in **2009/ 2019**.

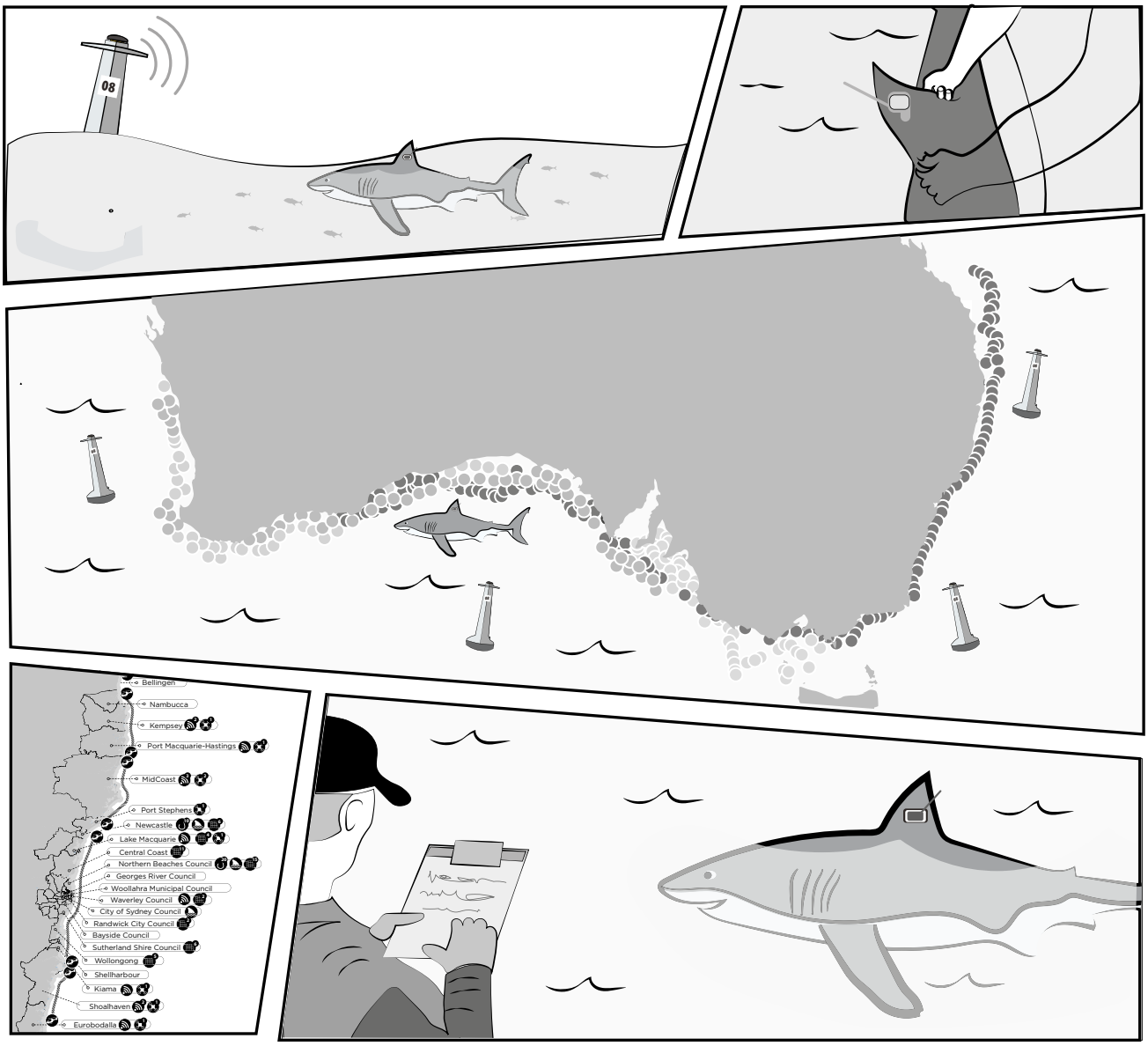
The data has shown that Bull sharks are **the only / one of the many** predatory sharks that occur in Sydney Harbour and their presence is **unpredictable / predictable**. The presence of large Bull sharks is predicted by water temperature of **34°C / 22°C**.

Bull sharks travel down from the Great Barrier Reef at the start of summer (December/January) and stay **until late April early May / only a week or so**. These animals travel **huge / insignificant** distances - around 1700km one way per year between Sydney and the Queensland.

In the beginning researchers were only catching large male sharks in Sydney Harbour so they reached out to local fishing communities around Ballina and Yamba **north of Sydney region/south of Sydney region** and found they were catching juveniles.

The research has since established that pregnant females and juveniles are found in the rivers and estuaries. They appear to stay there until they are around 5-6 years and **large / sensible** enough to join the adult populations in the **larger rivers / open ocean**.

Fast forward to **2015 / 2020** and the implementation of the Shark Management Strategy.



Dr Paul Butcher and the team began tagging and tracking sharks captured on SMART drumlines. Sharks tagged with acoustic tags are detected for **10 years / months** around the Australian coastline as they pass by a **VR4G listening station / surf club**. This data is collated and provides information on their movements around Australia.

Sharks have **also / not** been tagged with satellite tags which sends a message about the shark's location whenever it comes close to the surface. This data maps shark movements around the **world / country**.

Data is also collected for age and growth as well as genetic samples for population data when sharks are captured.

Data shows that the majority of tagged White sharks move up and down the Victorian, NSW and QLD coast seasonally but some individuals cover **minor / huge** distances including one that has been to Western Australia and back three times and another that has been to New Zealand and Papua New Guinea.

Hopefully the research will provide scientific evidence of what drives White sharks up and down the east coast.

NOTE:

More detail about the research is included in the Shark Week virtual excursion videos on YouTube.

HOW HAS THE RESEARCH INFORMED THE SHARKSMART RECOMMENDATIONS?

Briefly describe the shark biology or behaviour that underpins the following recommendations.

The video Intro to Sharks: Myths and Facts will help you answer some of these **youtu.be/2LxM6mesguU.**

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, 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 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 seek shelter 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.

For a round up of the technology and the findings of the Shark Management Strategy see the playlist at https://youtube.com/playlist?list=PLs5bUyTM7_ggls-xNxQIKKQVBshS42JU3 or scan the QR code.

OTHER PROGRAMS WORKING TOWARDS PROTECTION OF MARINE ENVIRONMENTS

Research and describe the work that the following organisations do towards protecting marine environments. What are their motivations, actions and intended outcomes?

Sydney Institute of Marine Science

Keep Australia Beautiful

Friends of Cabbage Tree Bay

Biosecurity Warrior (DPI)

Citizen Science organisations eg Reef Life Survey

Redmap

Don't dump that Fish (DPI)

Clean up Australia

Surfrider Foundation

Marine Stewardship Council

Your local council (or closest coastal council)

NSW Department of Education Environmental Education Centres

Streamwatch

Marine Discovery Centres

Landcare / Coastcare

Fisheries Research and Development Corporation

Local Aboriginal Land Councils and cultural centres

REPRESENTATION OF SHARKS IN THE MEDIA

A major factor in people's attitudes towards sharks (and therefore the perception of whether they should be protected) is the way that they are represented in the media. The following texts present different perspectives on sharks and coastal habitats. View the texts and respond to the questions.

The cultural significance of sharks and rays in Aboriginal societies across Australia's top end by Matthew T. McDavitt accessed online (12/7/2019) www.mesa.edu.au/seaweek2005/pdf_senior/is08.pdf
What lesson can modern storytellers take from the perspective of Indigenous Australians about sharks and rays?

Ngurdungurdu: The Tiger Shark – animation of an Aboriginal Dreaming story from the Yanyuma people who are the custodians of the Tiger Shark Dreaming (accessed online 12/7/2019) **abcspla.sh/m/1814351**

What do you think about the way the tiger shark is represented in this story? Compare it to the rock wallaby. Is this consistent with the way sharks are represented in modern movies?

Read ***Indigenous surfers have a great respect for sharks that dates back over 40,000 years*** *on NITV* https://www.sbs.com.au/nitv/article/2015/05/24/indigenous-surfers-have-great-respect-sharks-dates-back-over-40000-years. (published June 2015, accessed 12/7/2019)

The attitude towards sharks expressed by Otis Carey in this text is reflected by many water users. Often the media reports high profile human/shark interactions. Why do you think we need to also hear the perspectives like those expressed in this article?

People and organisations work in a variety of ways to share environmental messages and to encourage positive action – artists create artworks, politicians change policy, scientists carry out research and share their findings.

Consider how you feel about sharks. Has the information available through the NSW Shark Management Strategy changed your opinion about sharks? Describe how you could share this message to encourage a greater understanding in others.

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 beach authorities about 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

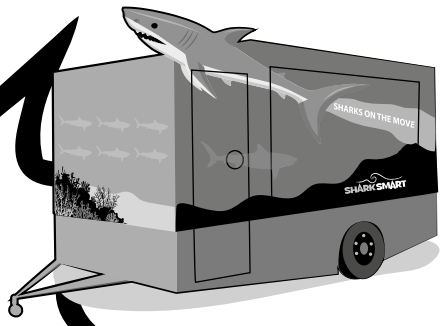
MEDIA:

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 HOW TO REDUCE 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.

NOTES


HELICOPTER
SURVEILLANCE FLIGHTS
SHARKSMART
APP
SCIENCE &
RESEARCH
DPI RESEARCH
PERSONAL SHARK
DETERRENT
DEVICE

RESPECT THE OCEAN, SHARKS ARE IMPORTANT FOR HEALTHY SEAS

DONT SURF OR SWIM AT DAWN OR DUSK

SWIM BETWEEN THE FLAGS

DON'T SWIM OR SURF ALONE– ALWAYS BUDDY UP

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

CONSIDER A PERSONAL DETERRENT DEVICE, TAKE CARE OF YOURSELF AND YOUR MATES