Mitigating the Risk: What Can Governments and People Do?

Shark Nets and Drumlines

- Historical approach to mitigating the risk and placating the public has been through the use of shark nets and drumlines.
  - These Shark Control Programs are now publicly termed “shark culls”.
  - Are deployed seasonally in the greater Sydney region and in selected locations along the Queensland coast.
- They work by reducing the number of sharks overall, but do not form a barrier that prevents sharks accessing a beach.

Why Can't the NSW Government Just Implement Shark Nets in Northern NSW?

- Current Shark Control Programs were activities existing at the time that the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) was implemented.
- As such, an environmental assessment of the existing activities against the Matters of National Environmental Significance (MNES) contained in the *EPBC Act 1999* was not required for the activity to continue.

Why Can't the NSW Government Just Implement Shark Nets in Northern NSW?

- Matters of National Environmental Significance:
  - World Heritage Properties.
  - National Heritage Places.
  - Wetlands of International Significance.
  - **Listed Threatened Species and Ecological Communities.**
  - **Migratory Species.**
  - Commonwealth Marine Areas.
  - Great Barrier Reef Marine Park.
  - Nuclear Actions.
  - Water Resource in Relation to Coal Seam Gas.

Why Can't the NSW Government Just Implement Shark Nets in Northern NSW?

- Expanding Shark Control Activities into northern NSW would require environmental assessment under the *EPBC Act 1999.*
  - The timeframe to complete the regulatory requirements and to do the environmental assessment would be in the order of 18 months.
  - The likelihood of the activities being approved under the *EPBC Act 1999* is low.

Conservation Status of the White Shark

- The white shark is a nationally listed threatened species (Vulnerable) under the EPBC Act.
  - Same conservation status as the greater bilby, numbat, green and golden bell frog, and populations of the koala.
- Since any new shark control activities have the intention to kill white sharks in particular, it is difficult to mount an argument that the activity will not significantly impact a threatened species.

What are the Factors Driving the Trend?

- **More people in the water.**
- Better global reporting of incidents
- More sharks of relevant species?
- Factors that (temporarily) change the amount of overlap between relevant shark species and water users:
  - Habitat modification.
  - Concentrations of prey (marine mammals and schooling fish).
  - Water temperatures.

Conservation Status of the White Shark

- Shark Control Programs have very high incidental capture on non-target species (bycatch) when first deployed.
  - This would include a number of other listed migratory and threatened species
    - Marine turtles and Cetaceans in northern NSW.
- The risk of significant impacts to listed species other than the white shark would be an important consideration in assessment of amy proposed new activities.

Mitigating the Risk: What Can Governments and People Do?

The Challenge

- We should not underestimate the challenge that addressing unprovoked shark bite poses.
- No one approach can be universally effective.
  - No magic bullet
- We are dealing with three main species (white, tiger and bull) that differ in key factors:
  - For example, pattern of habitat use (at different scales), hunting strategy.
  - Variation in the behaviour of individual sharks of the same species.
- Human usage patterns which differ based on the type of beach activity undertaken (surfing/bathing).

The Challenge

- The surf zone environment is a dynamic and difficult environment to work in.
  - Waves, turbulence, air bubbles, suspended sediment etc.
- What works effectively in relatively calm water may be less effective (or ineffective) in the surf zone.
- Rigorous scientific experiments with sound experimental designs are difficult (but not impossible) to implement with appropriate statistical power (practically and ethically).

What Can Be Done?

Individual

- Individual Deterrents
- Changes in Personal Decision Making

Government

- Whole of Beach Deterrents
- Shark Detection
- Provide Information for More Informed Decision Making

Individual Deterrents

What to look for in an Individual Deterrent?

- Has it been **independently** tested?
- Is it suitable for the relevant shark species?
- What is the area over which the approach is likely to be effective?
- Does it suit your individual use?

Broad Types of Personal Deterrents

- Chemical
- Electric
- Magnetic
- Visual

Personal Chemical Deterrents

- Chequered history.
- Most prominent is Repel Sharks

  - Based on biologically relevant chemical stimuli (semiochemicals) rather an irritant.
  - Is a necromone.
  - Effectiveness described in peer reviewed literature on Caribbean reef sharks and some other reef species.
  - Uncertain effectiveness on species that scavenge or predate on sharks (whites and tigers).

Personal Electrical Deterrents

- Require a power source.
- Most prominent is the various models of the Shark Shield.
- Independently tested in a number of scientific trials.

Results of Independent Testing of the Shark Shield

Data from Huveneers et al. (2013)

Personal Magnetic Deterrents

- The use of magnets to deter sharks is equivocal at best
- Influenced by the species of shark, level of food deprivation, presence of conspecifics etc.
- Their advantage is that they are small, lightweight are wearable.
- Their disadvantage is that the area of field generated is very small (~10 cm).
  - The manufacturer themselves identifies that they are largely ineffective against white sharks.
- If the magnets are shiny and exposed they may attract sharks.

Personal Visual Deterrents

- Various commercial types including wetsuits and surfboard stickers.
- Also homemade remedies based on the commercial available products.
- Ongoing and promising research looking at illumination.

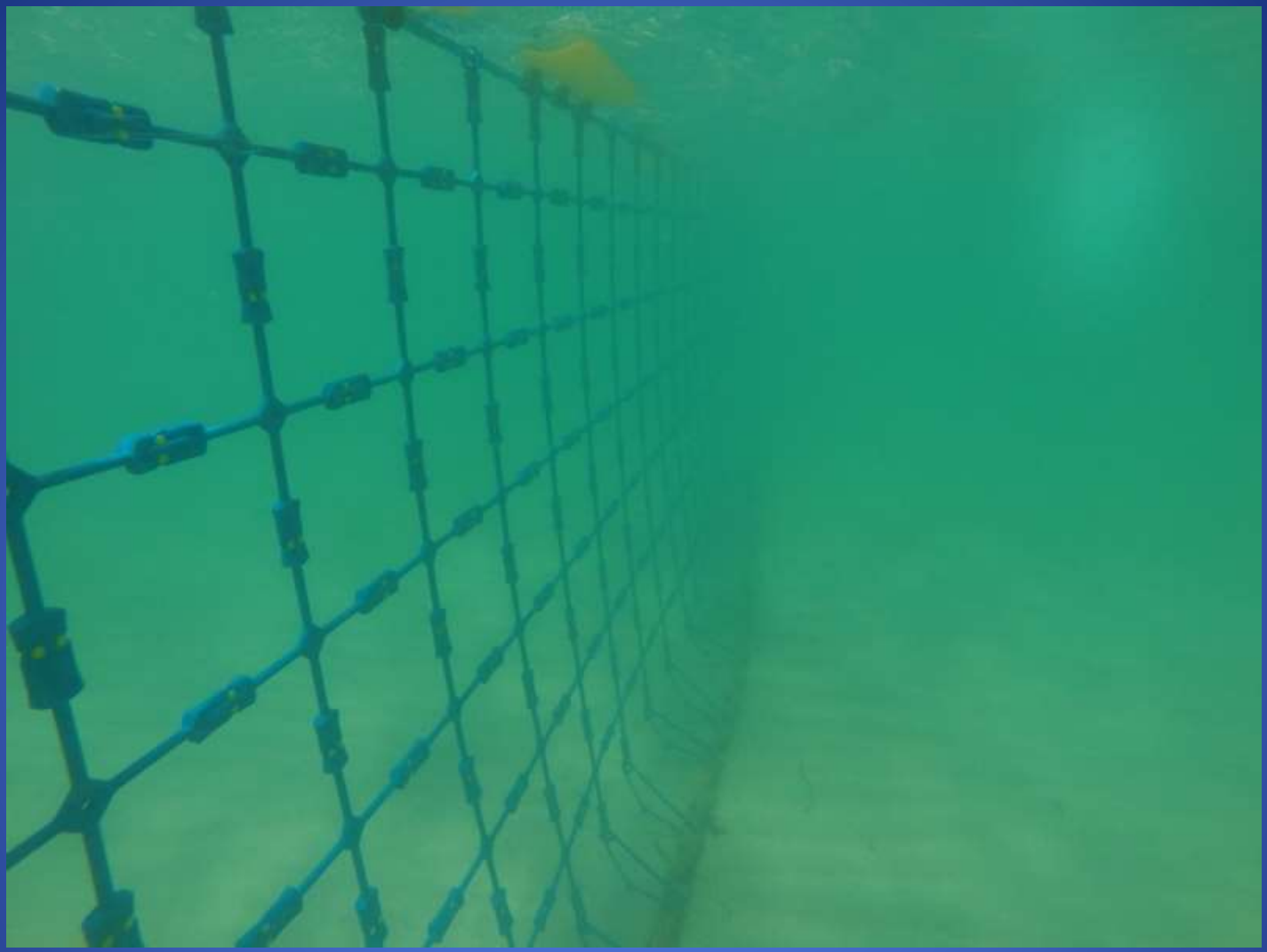
Whole of Beach Barriers

Main Mitigation Measures: Barriers

- Physical barriers
  - Aim to provide a physical separation between sharks and bathers/surfers.
- Electric deterrent barriers
  - Aim to provide an electric or magnetic field that can be detected shark and deter (but not prevent) a shark from entering a beach area.
- Visual barriers
  - Aim to provide a visual barrier that can be detected shark and deter (but not prevent) a shark from entering a beach area.

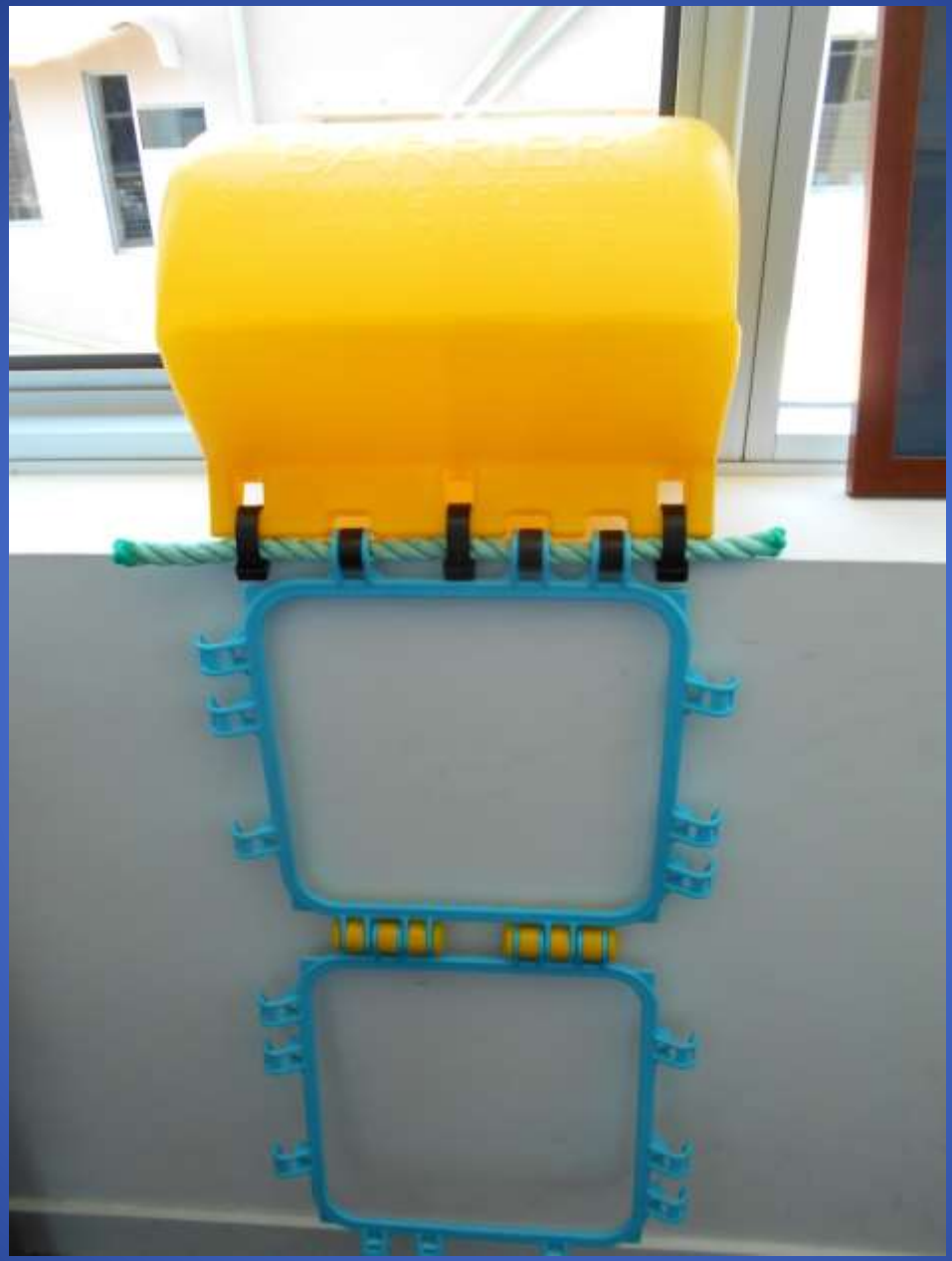
An example of the Eco Shark Barrier in place at Coogee Beach (WA)

Source: www.ecosharkbarrier.com.au/case-studies/coogee-beach-trial-perth-western-australia/



An example of the Eco Shark Barrier in place at Coogee Beach (WA)

Source: http://www.ecosharkbarrier.com.au/the-product/



Section of a Bionic Barrier. Source: D.McPhee


PASHA BULKER

The Fish Hoek Bay temporary net barrier being deployed.
Source: http://fishhoek.info/shark-exclusion-net-trial-ends-successfully/

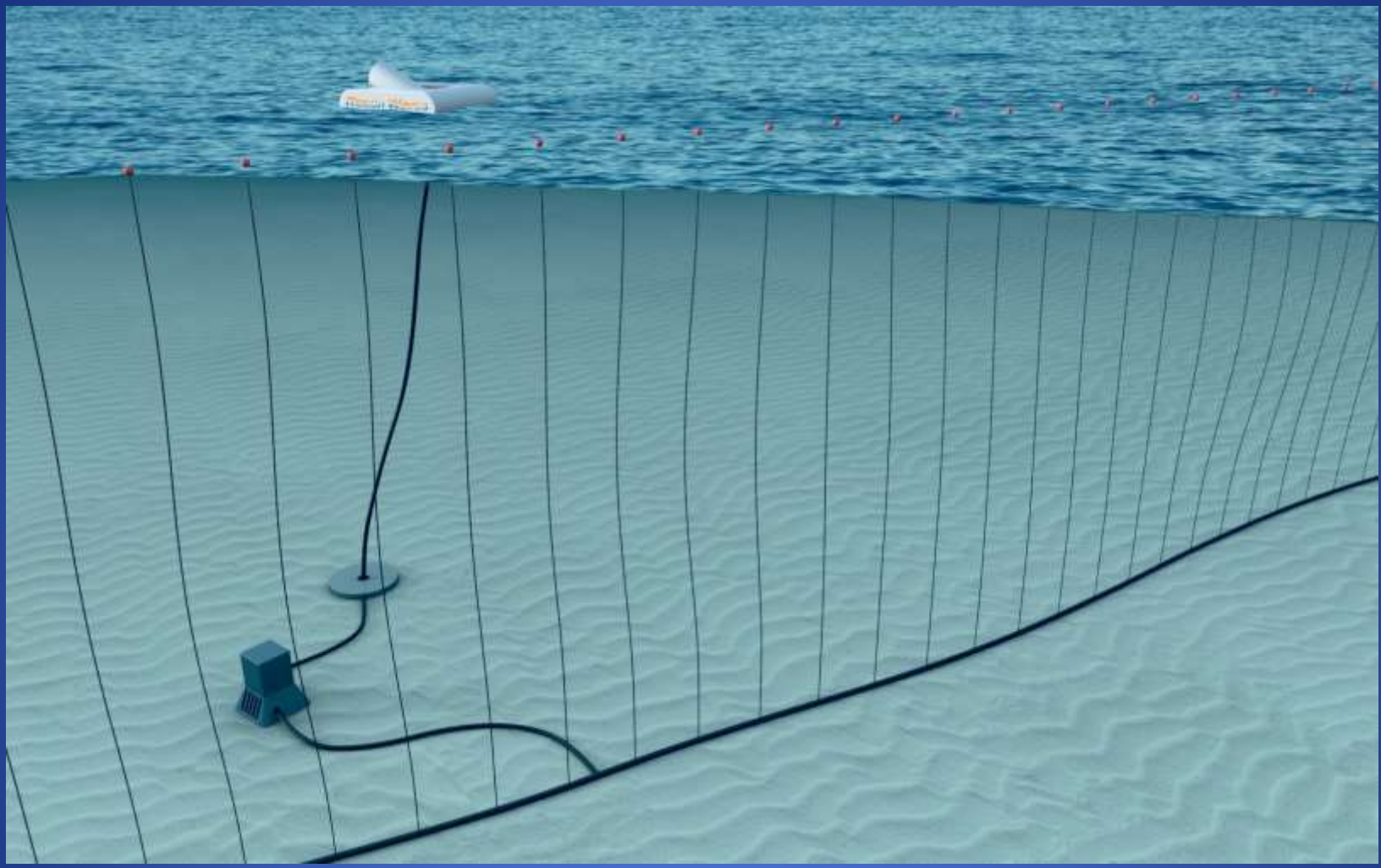
Electric Deterrent Barriers

- Aim to create an underwater electric field that deters sharks from entering a swimming beach.
- Concerns over the impacts on people with pacemakers or heart conditions if they come to close to the device.
- Potential to use small wave energy generators to provide the power source.
- Approaches are continuing to be developed and trials are ongoing.

Shark Repellent Cable in place at Glencairn Beach (South Africa)
Source: G. Cliff

Underwater view of the Shark Repellent Cable in Place at Glencairn Beach (South Africa)

Source: G. Cliff



Schematic of Rubber Guard Underwater Fencing. Source: Pers Resen Steenstrup

Visual Barriers

- Two examples the bubble curtain and the Sharksafe barrier (a combination of a visual element and permanent magnets).
- The science on the efficacy of the bubble curtain is equivocal at best.
- Practical challenge of delivering bubbles over a large distance from the source of the air.

The Surfsafe barrier in position.
Source:innovationbridge.org.za/the-sharksafe-barrier/

Detecting Sharks

Detection Methods

- Aerial surveys (manned and unmanned)
- Cleverbuoy (sonar system)
- Detecting tagged sharks
- Shark Spotters Program

Aerial surveys

- Relatively longstanding approach that can address multiple objectives.
- Advantage is the large area that can be covered.
- Disadvantage is that the time window at a specific beach is limited.
- Effectiveness can be limited by conditions (e.g. murky water, wind)
- Drone technology has scope, but camera resolution needs improvement.

Source: Craig Anderson

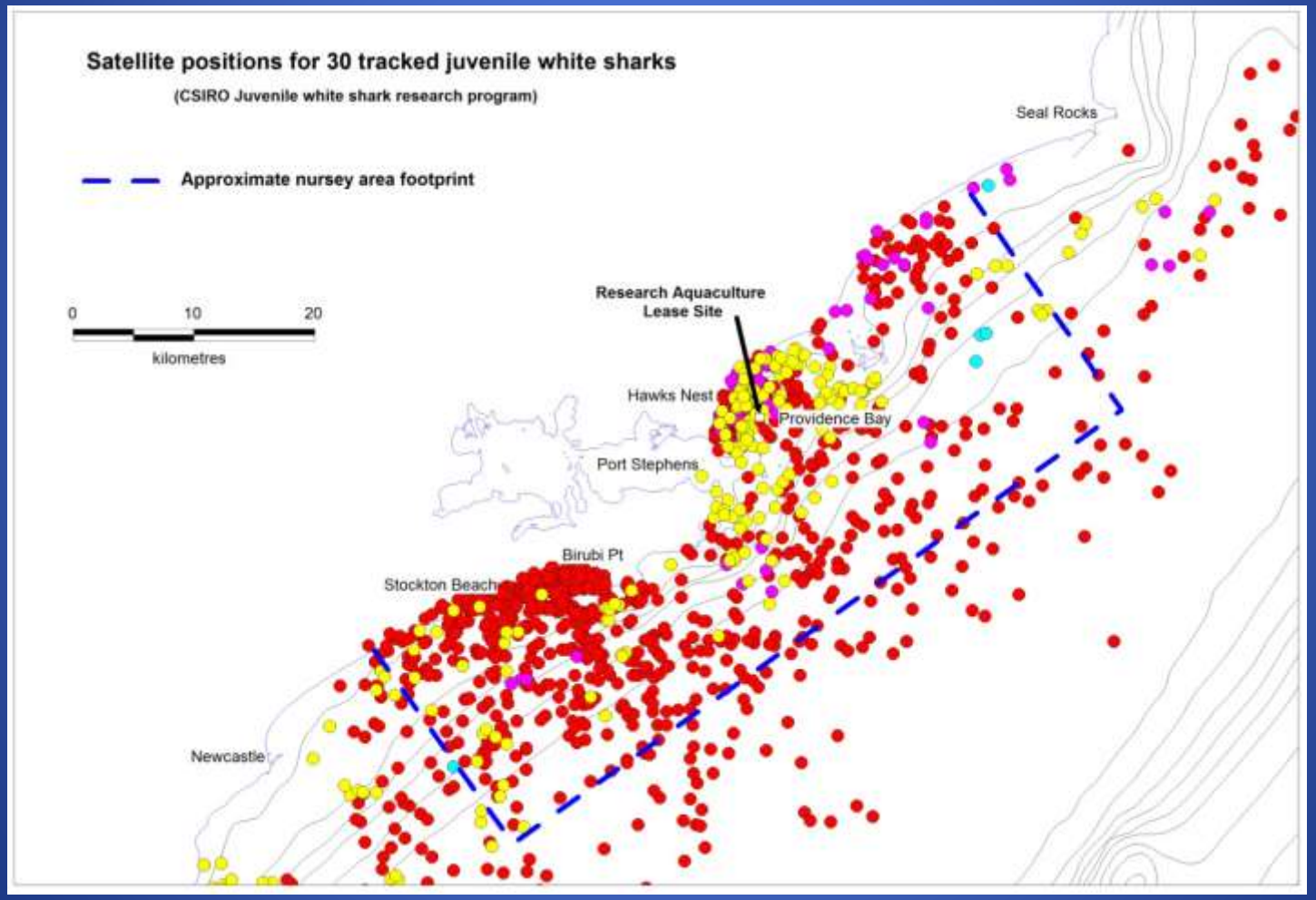
Cleverbuoy

- The effective range of an individual Cleverbuoy in the surf zone needs to be determined.
  - This influences the number that need to be deployed at a beach and hence the cost.
- The ability of Cleverbuoy to reliably detect large sharks in the surf zone also needs to be independently confirmed.

Tagging and Tracking of Sharks

- A well established technique.
- The advantage of it is that it can collect valuable and detailed information on shark behaviour which in the long term will be important in understanding unprovoked shark bite.
- The probability of the method detecting a shark at a beach where receivers are stationed is proportional to the number of sharks that have been tagged that are utilising the near coastal habitat.
- Can provide real time information on the presence of relevant shark species at a beach.

Satellite Tracking of Juvenile White Sharks.



Shark Spotters Program

- Developed in Cape Town in response to a number of unprovoked shark bites in that region.
- The program is an early warning initiative that provides information in real time on the presence or absence of dangerous shark species to beach goers.
- When a dedicated observer sights a shark, this is communicated to a second observer on the beach.
- There has been an unprovoked bite at a beach when the program is in operation.

SHARK SPOTTING PROGRAMME

HAAIKYKYPROGRAM / INKQUBO YOKUJONGWA KOOKREBE

The Shark Spotting Programme is an early warning initiative provided as a service to communities. Although effective, shark spotting can never guarantee your safety 100%. Sharks spotters are not responsible for your safety.

As 'n vroeëwaarskuwingsinisiatief lewer die haaikykyprogram 'n diens aan gemeenskappe. Hoewel doeltreffend, kan haaikyk nooit jou veiligheid 100% waarborg nie. Haaikykers is nie vir u veiligheid verantwoordelik nie.

Iinkqubo yokulongwa kooKrebe liphulo lokulumkisa abantu kwangexesha neboneleleka njengenkonzo eluntwini. Nangona isebenza, ukujongwa kookrebe akunokho ukuqinisekisa ukuba ukhuseleko ngokugqibeleleyo (100%). Amagosa ajonga ookrebe awanaxanduva lokhuseleko lwakho.

FLAG WARNING SYSTEM

VLAGWAARSKUWINGSTELSEL / INKQUBO YOKULUMKISA NGEEFLEGI

GREEN FLAG

- Spotting conditions good
- Haaikyktoestande goed
- Iimeko ezilungele ukujonga ookrebe

BLACK FLAG

- Spotting conditions poor
- Haaikyktoestande swak
- Iimeko ezingakulungelanga ukujonga ookrebe

RED FLAG

- High shark alert
- Ernstige haaiwaarskuwing
- ISilumkiso sooKrebe abaNinzi

WHITE FLAG

- A shark has been spotted - siren will sound. Leave the water immediately.
- 'n Haai is gesien – sirene sal loei. Verlaat die water onmiddellik
- Kubonwe ukrebe – kuza kukhaliswa isilongo lokulumkisa. Phumani ngokukhawuleza emanzini.

USE OF OCEAN AT OWN RISK

GEBRUIK DIE OSEAAN OP EIE RISIKO

ULWANDLE ULUSEBENZISA NGOBAKHO UBUTYALA

EMERGENCY NUMBERS / NOODNOMMERS / IINOMBOLO ZEXESHA LIKAXAKEKA

107 | 021 480-7700 / 080 911-4357 | 021 449-3500

Source: www.sharkspotters.org.za/how-it-works/flag-system-protocol

Shark Spotters Program

- Public available publications on the efficacy of the program in South Africa are available.
- In terms of its potential application in NSW:
  - Uncertainties regarding efficacy at detecting tiger and bull sharks.
  - Uncertainties regarding how many days will be good spotting days.
  - Common to SA no estimate currently of how many sharks that are present are sighted.
  - Potentially use 4 hour shifts only to reduce observer fatigue.

In Summary

- The number of unprovoked shark bites globally is increasing.
- There continues to be clusters of bites at specific regions in a relatively short space of time.
- Our fear of sharks is not irrational.
- The expansion of shark nets into northern NSW can not be done quickly or indeed can not be done at all.

In Summary

- At least one individual deterrent has been shown to reduce the probability of a bite, but not eliminate it.
- There are a range of tools that can potentially be implemented by a government to reduce risk or placate the public.
- Improved detection of sharks and the communication of detected animals may not necessarily allay public fears.