



Department of
Primary Industries



Unearthing the truth about sharks using satellite and drone-based technologies

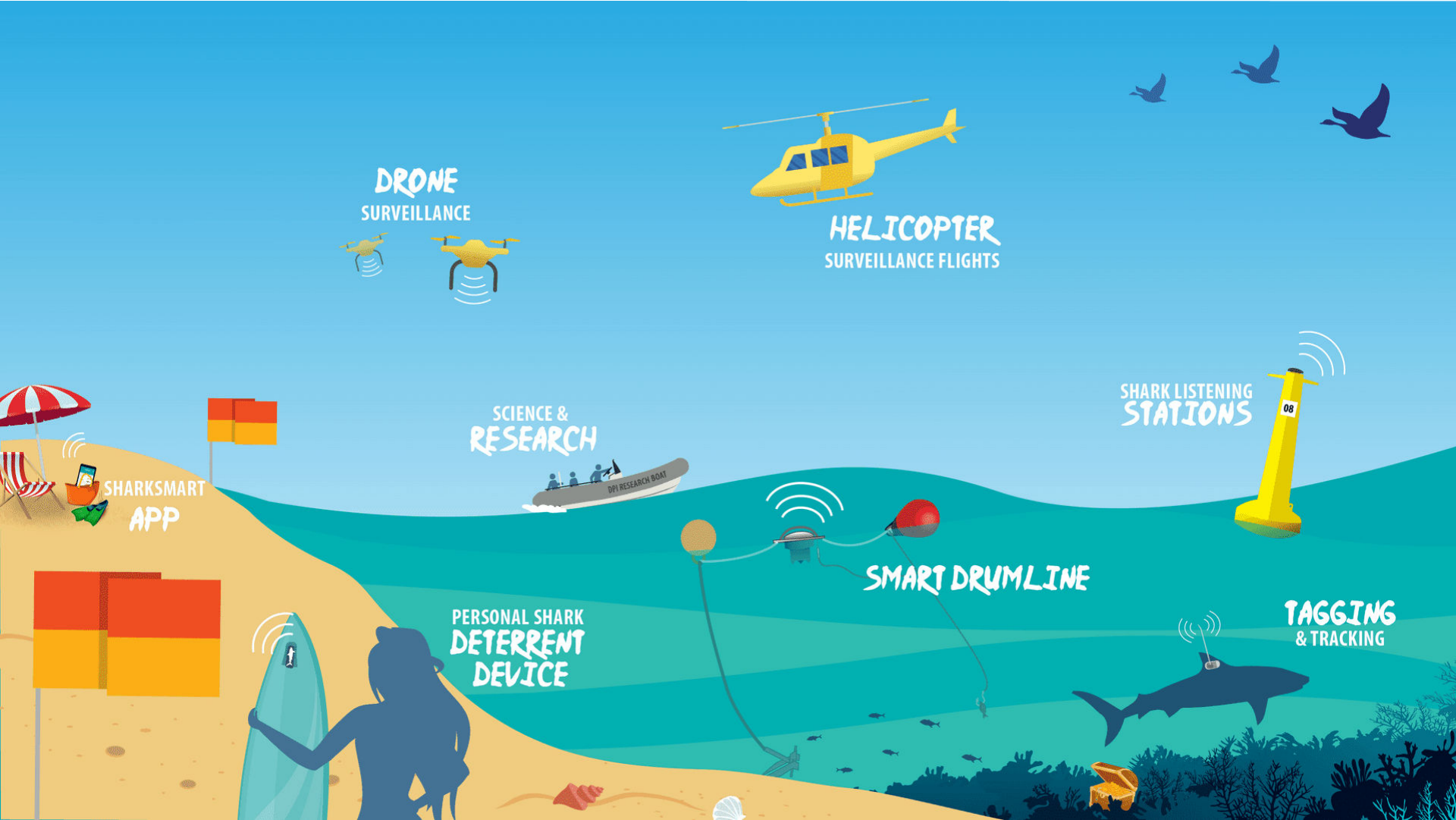
Dr Paul Butcher

Senior Research Scientist

New South Wales Fisheries, Australia

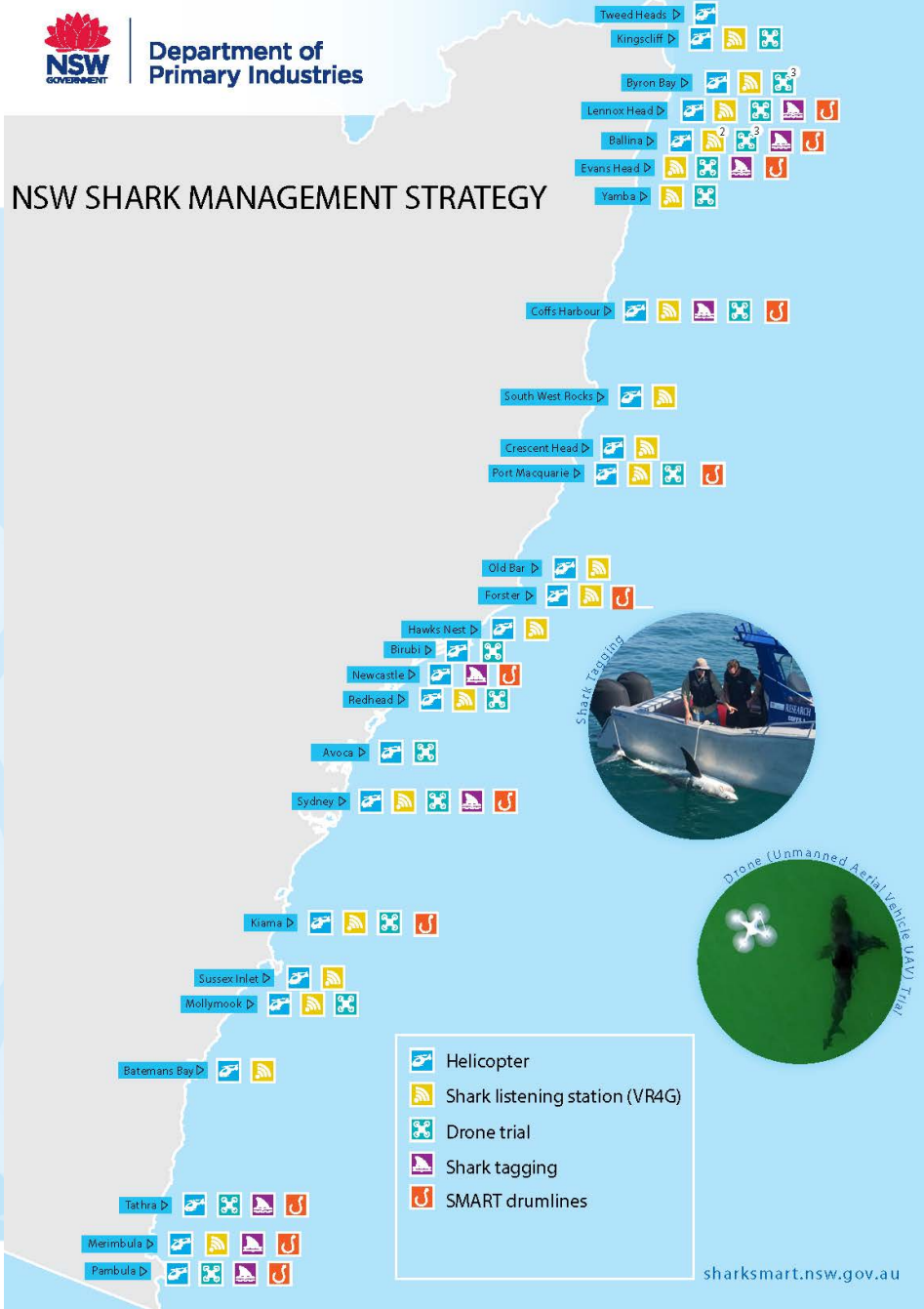
Russ Bradford, Craig Brand, Andrew Colefax, Robert Creese, Christopher Gallen, Marcel Green, Toby Patterson, Vic Peddemors, Amy Smoothery, Rick Tate, James Tucker, Julia Spaet and Natalie Moltschaniwskyj

Scientifically driven, integrated strategy involving innovative approaches to provide the most effective shark attack mitigation measures at NSW beaches.





NSW SHARK MANAGEMENT STRATEGY

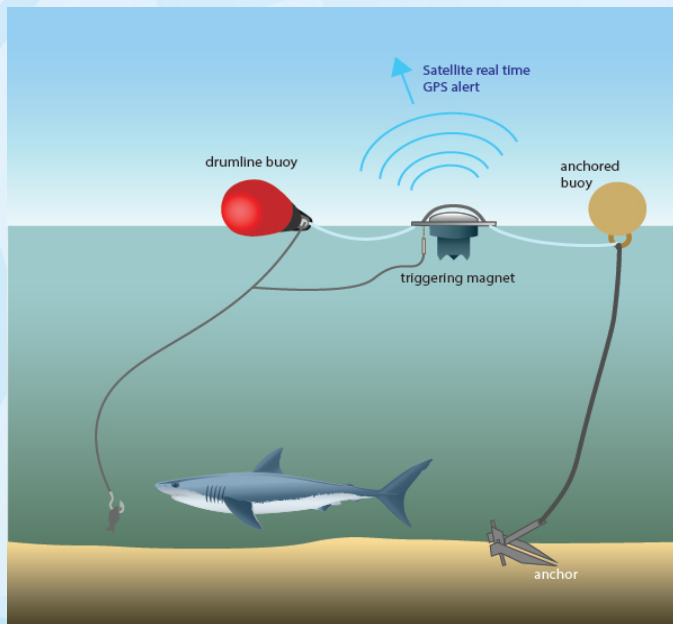


NSW Shark Management Strategy

- Surveillance, detection and deterrents
 - **SMART drumlines**
 - **Listening stations (VR4G)**
 - **Drones**
 - Helicopters
 - Shark barriers
 - Clever buoy
 - Seabed electric fencing
- Science and research
 - **Tagging and tracking**
 - Whale burial
- Education

Tool 1 - SMART drumlines

- Shark-Management-Alert-in-Real-Time
- Developed in Réunion Island as ‘catch alive system[©]’
- Designed to minimise impact on marine life
 - provides an alert via satellite (SMS, EMAIL and PHONE CALL)
 - allows operator to respond quickly while the animal is still alive



As a management tool

- Daylight hours – by contractors
- Quick (~17 mins) response
- 35 000 hrs soak time
- Intercept target sharks
 - Tag and release



SMART drumline research

- Quantify:
 - Temporal and spatial catch rates of target and non-target species
 - Catch rates across various gear designs
 - Behaviour of animals around SMART drumlines
 - The stress response of white sharks to capture
 - Post-release behaviour and survival



SMART drumline capture results

Species	Total caught	Total died
Target sharks		
White Shark	417	1
Tiger Shark	97	-
Bull Shark	29	-



SMART drumline capture results

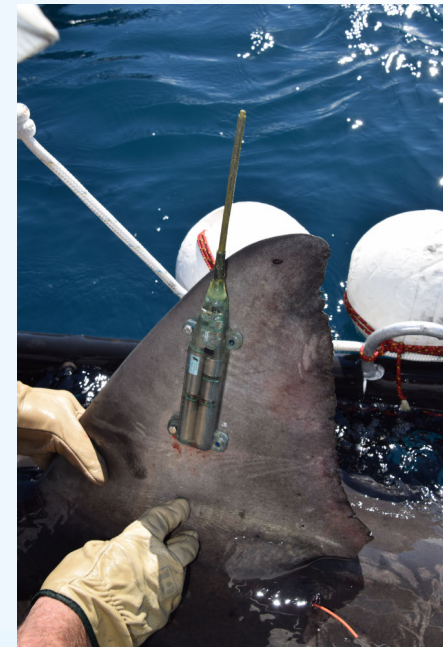
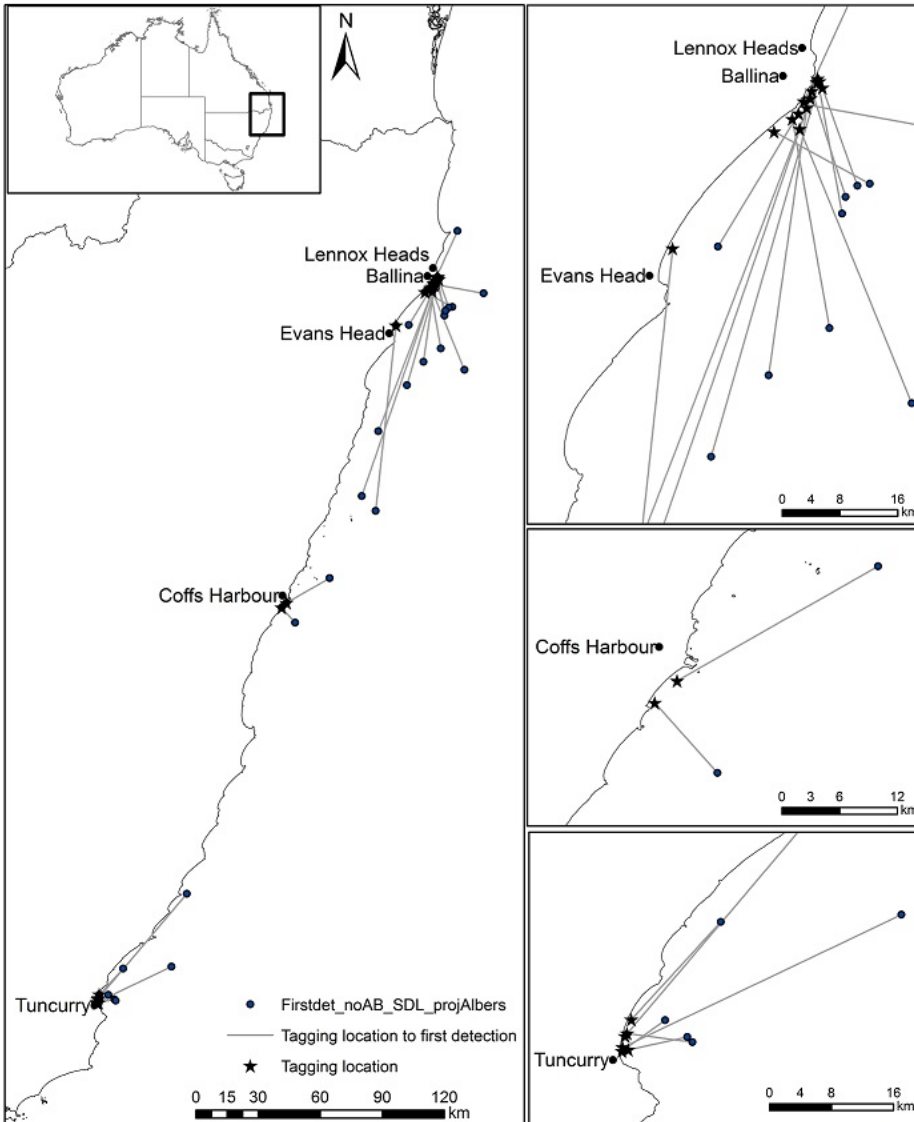
Species	Total caught	Total died
Target sharks		
White Shark	417	1
Tiger Shark	97	-
Bull Shark	29	-
Non target		
Dusky Whaler	61	-
Smooth Hammerhead	38	2
Grey nurse Shark	30	-
Common Blacktip	22	1
Shortfin Mako	12	-
Bronze Whaler	10	-
Thresher Shark	5	-
Black Ray	4	-
Black Marlin	2	1
Loggerhead Turtle	2	-
Lemon Shark	1	-
Sandbar Shark	1	-
Silky Shark	1	-
Spinner Shark	1	-



Animal behaviour?



Fright and flight response

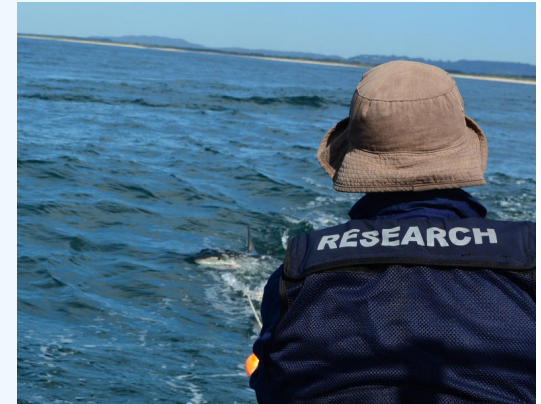




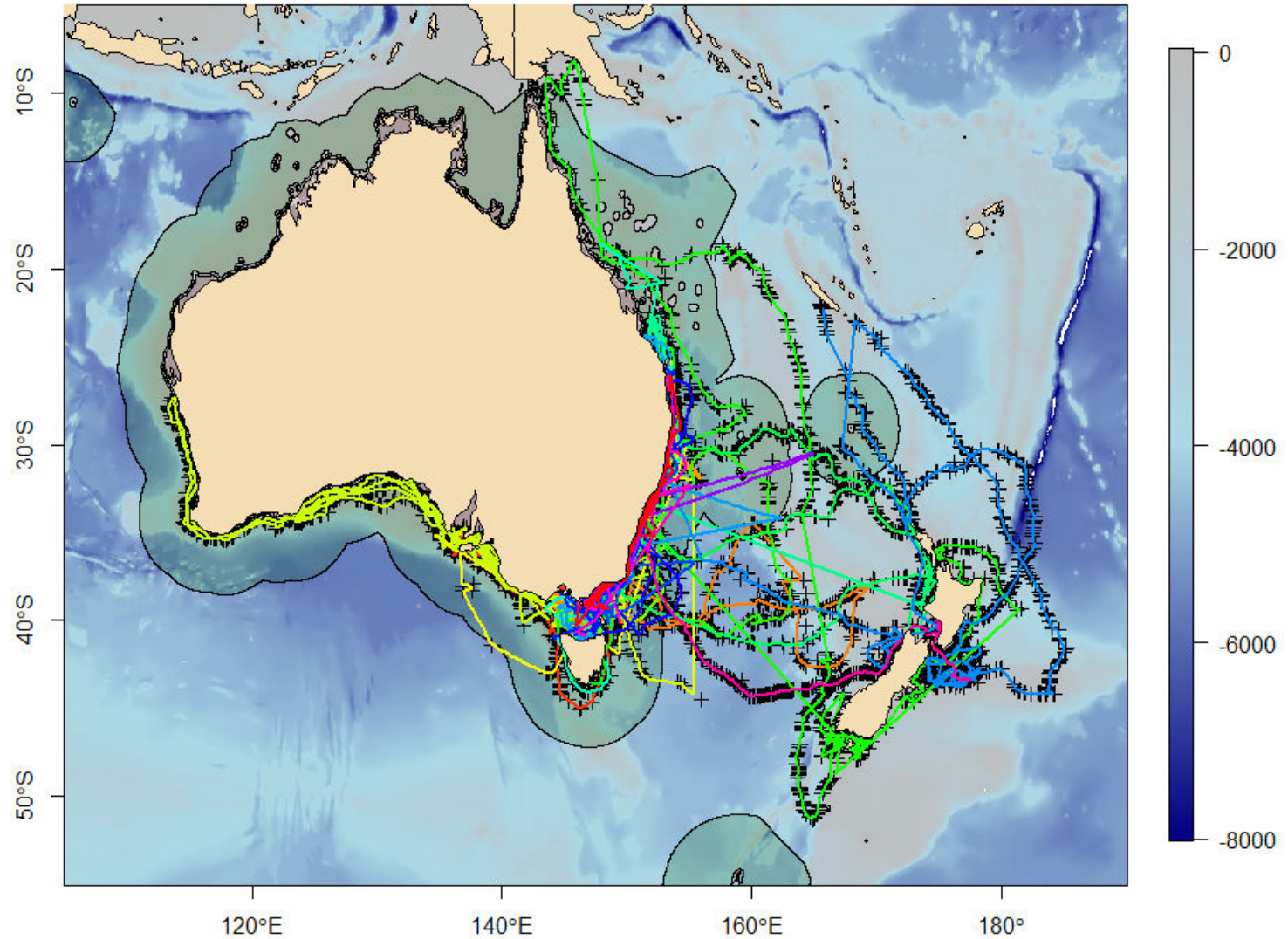
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Research

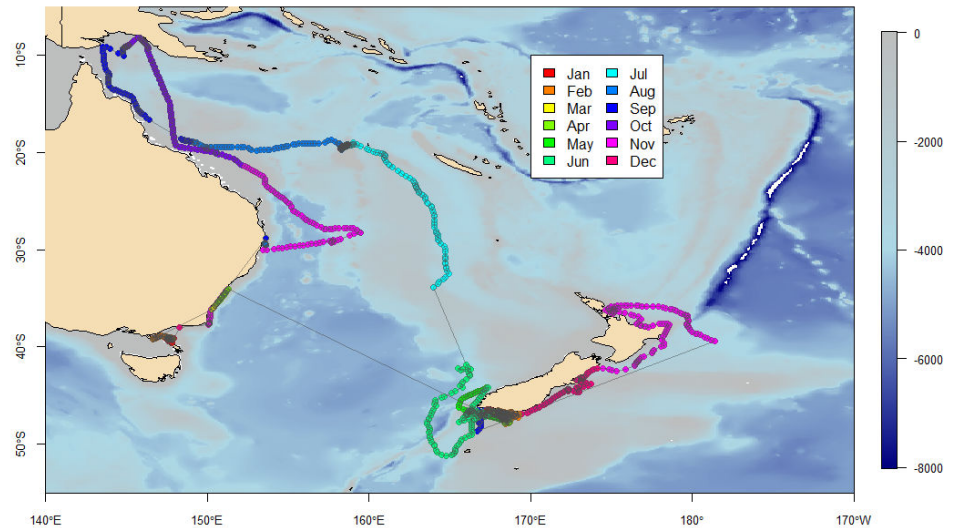
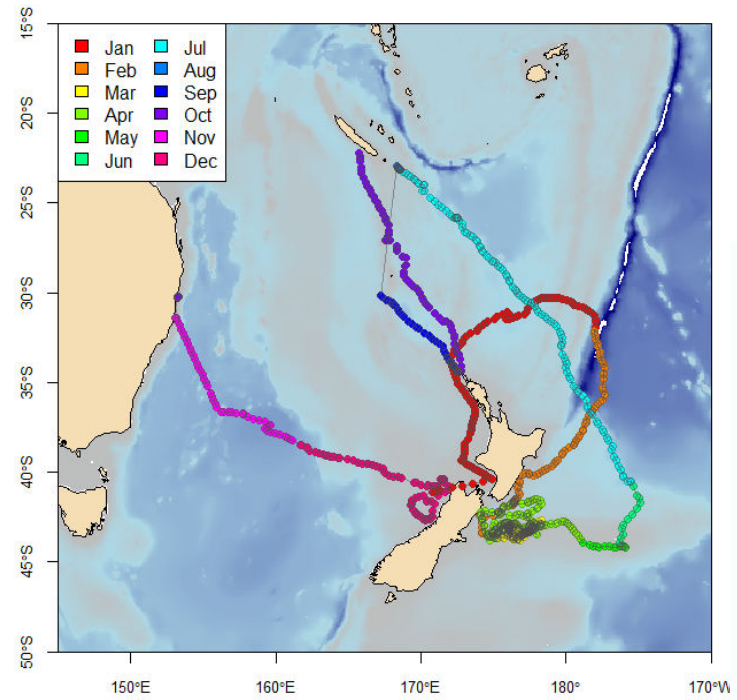
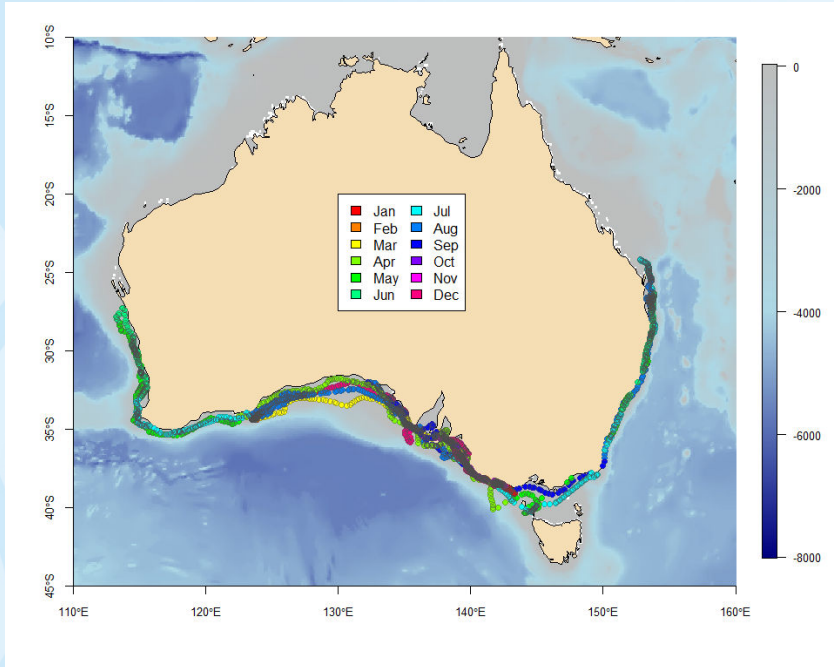
- Tags – ID, acoustic, satellite (spot/minipat)
- Caught
 - 420 White Sharks (2.6 m TL, 1.5–3.9 m)
 - 92 Tiger Sharks (2.3 m TL, 1.3–3.9 m)
 - 97 Bull Sharks (2.3 m TL, 0.9–3.1 m)
- Samples
 - Blood, fin and core, parasite, bacteria



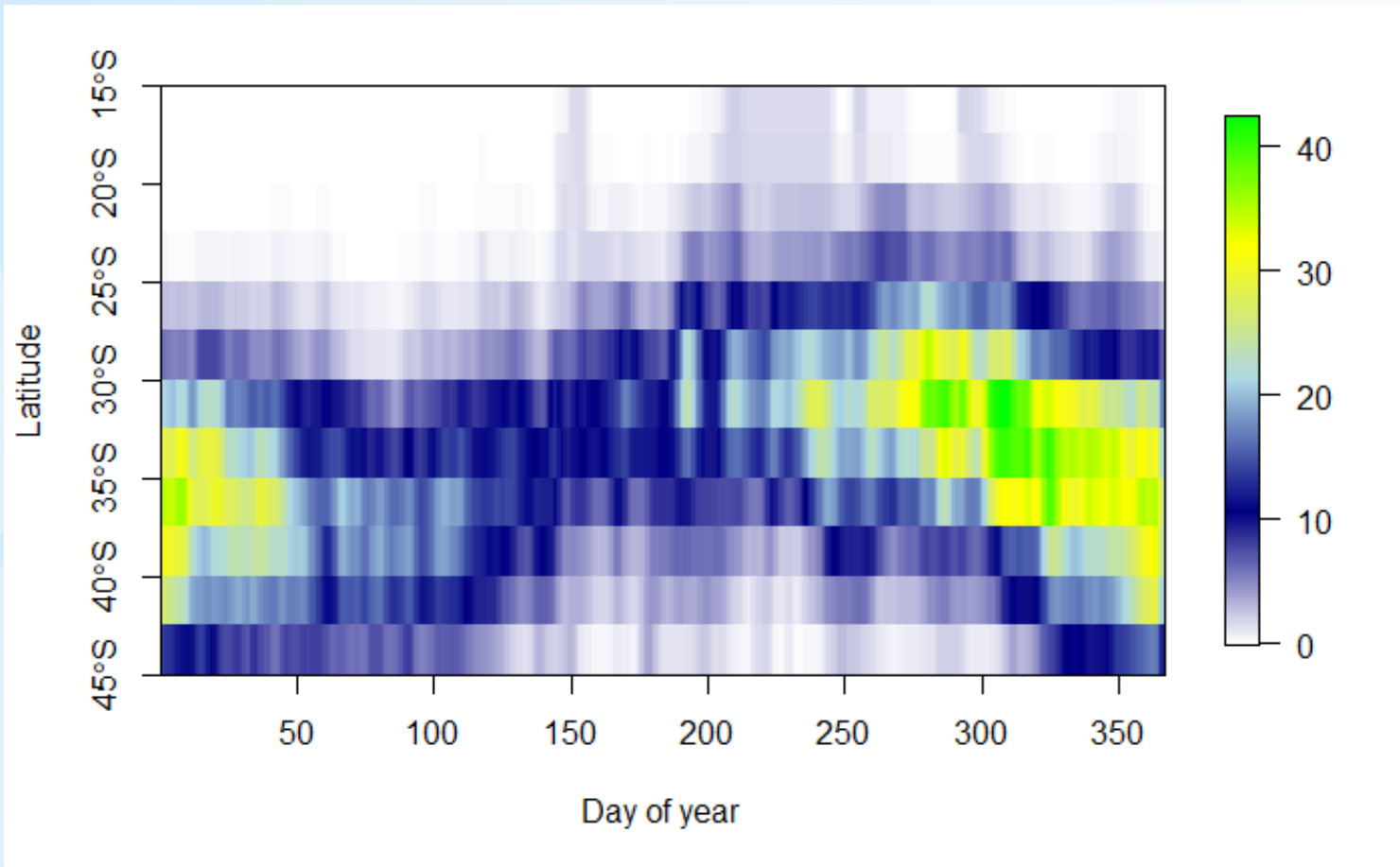
Satellite data



Where do they go?



Whose backyard?



Tool 2 - VR4G Listening Stations - detection



- 21 placed off beaches with regional centre, a history of shark interactions, close to SLS clubs.
- Real time alerts of a **tagged** shark within a 500m radius of the buoy using 'iridium' satellite network.

VR4G Listening Stations - detection



- 45 000 detections in three years from nearly all tagged white sharks, most bull sharks and only a couple of Tiger sharks.



Telling the community



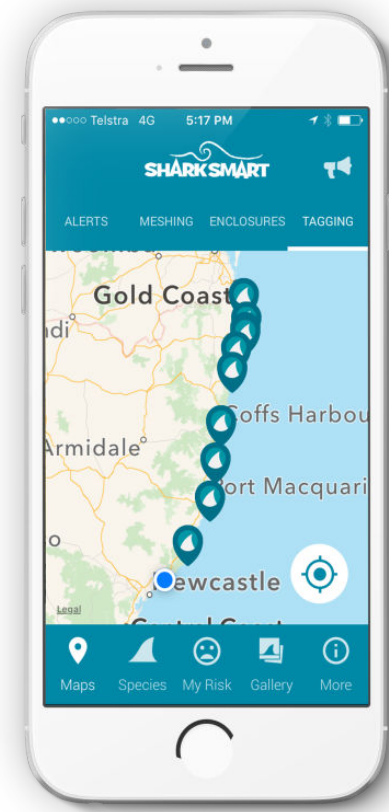
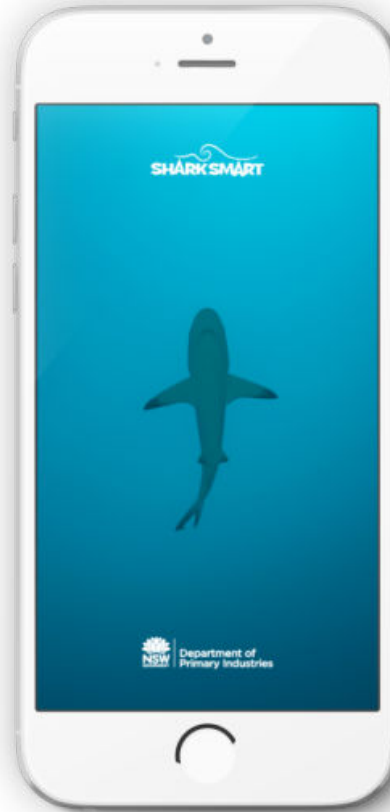
SharkSmart
@NSWSharkSmart

Tweets 25K | Following 18 | Followers 5,713 | Likes 273

Tweets | Tweets & replies | Media

- SharkSmart** @NSWSharkSmart · 6h
SLS NSW report 2m target species sighted between BRONTE & TAMARAMA Waverley at 10:00 am on 7 Aug 2019. Beach closed. Please be #sharksmart
- SharkSmart** @NSWSharkSmart · 6h
DPI Fisheries advise: tagged bull shark detected by Sharpes Beach, Ballina receiver at 09:15:00 AM (AEST) on 7-Aug-2019
- SharkSmart** @NSWSharkSmart · 6h
DPI Fisheries advise: tagged bull shark detected by Sharpes Beach, Ballina receiver at 09:13:00 AM (AEST) on 7-Aug-2019
- SharkSmart** @NSWSharkSmart · 9h
DPI Fisheries advise: tagged white shark detected by Front Beach, South West Rocks receiver at 06:13:00 AM (AEST) on 7-Aug-2019
- SharkSmart** @NSWSharkSmart · 10h
DPI Fisheries advise: tagged white shark detected by Front Beach, South West Rocks receiver at 06:04:00 AM (AEST) on 7-Aug-2019
- SharkSmart** @NSWSharkSmart · 11h
DPI Fisheries advise: tagged bull shark detected by Lighthouse Beach, Ballina receiver at 04:08:00 AM (AEST) on 7-Aug-2019

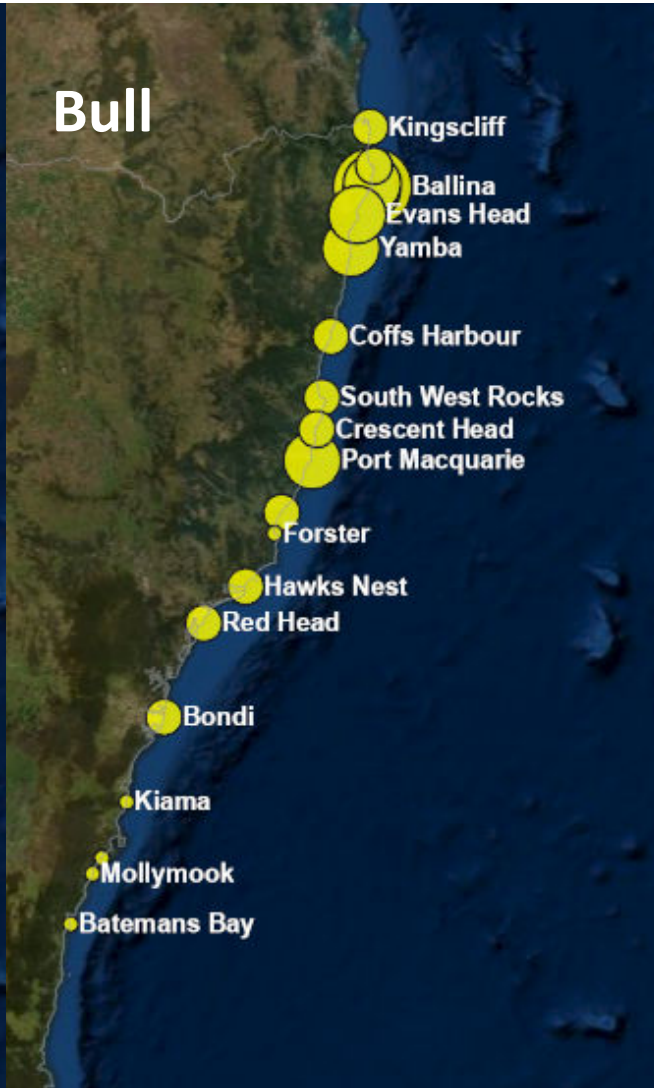
SharkSmart app



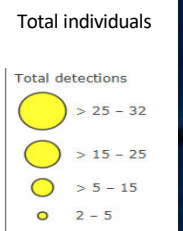
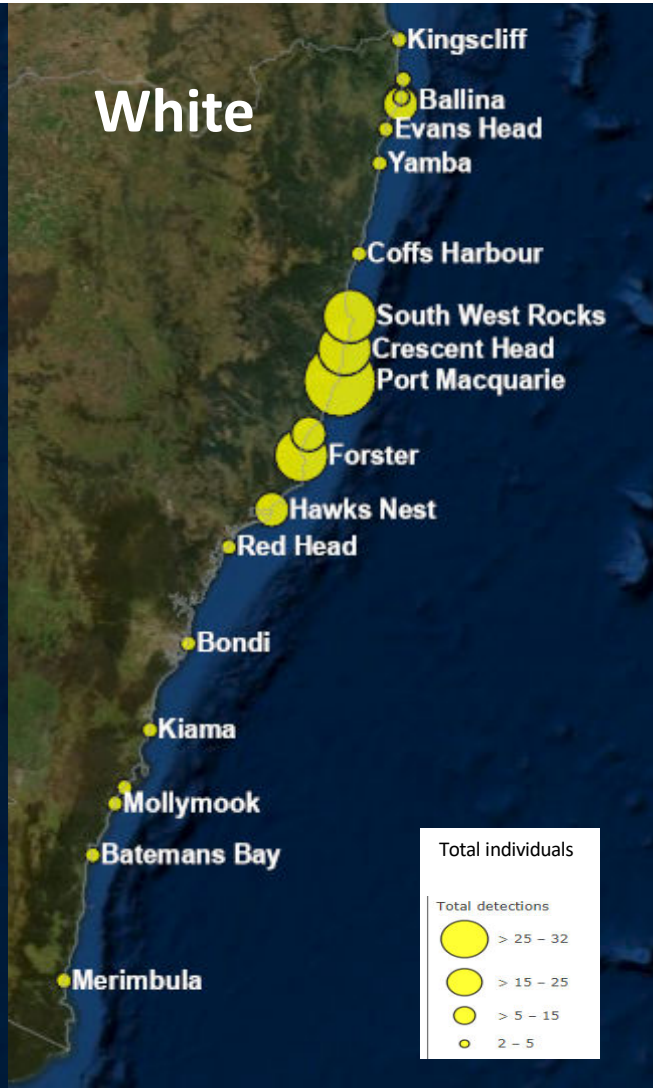
Tiger



Bull

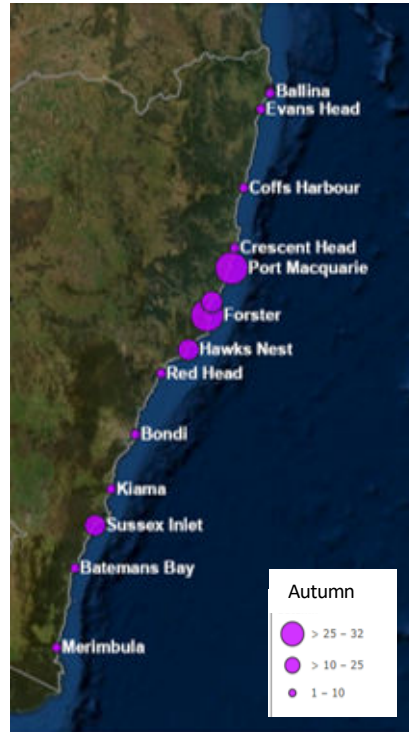


White



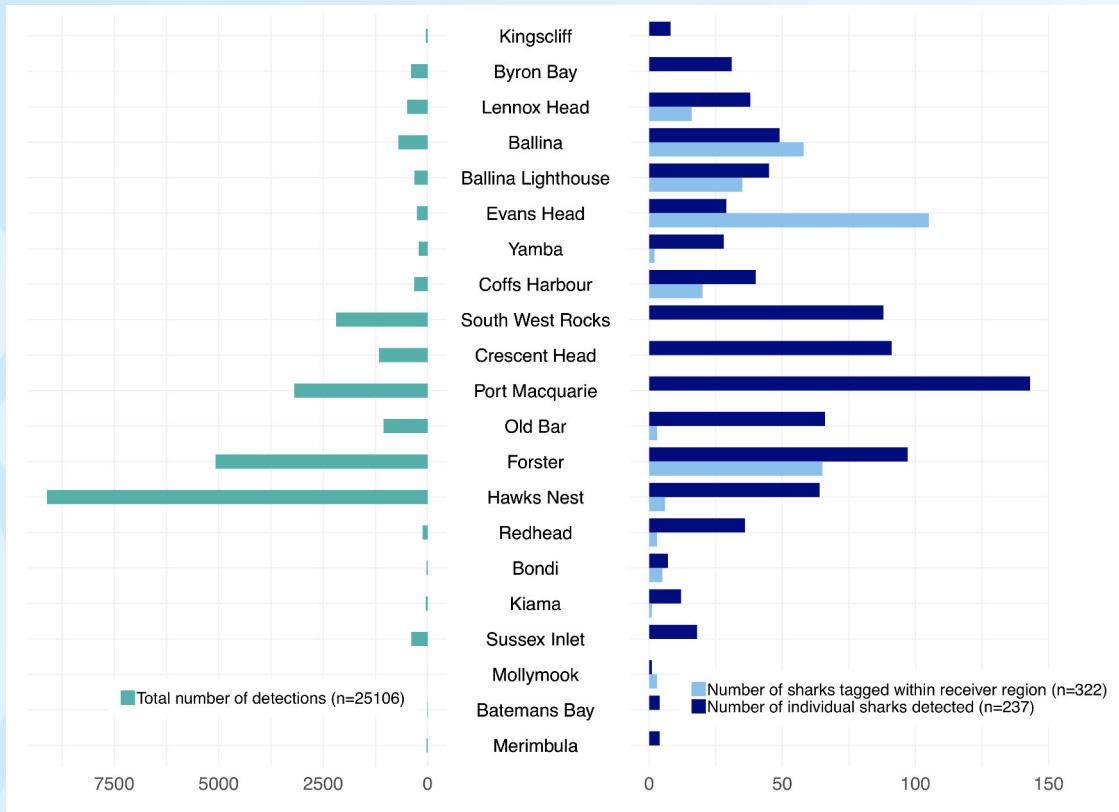


White Shark seasonal movements



*Number of individuals detected

Hot spots - detection



- Distinct trend in detections
- Increase in the nursery area
- Animals do not stay in the same spot for long
- Evidence that some sharks stay together

Are they predictable?

Detection Distance from shore
Inshore <1km
Offshore >1km

Tool 3 – Drones and sharks

Aim:

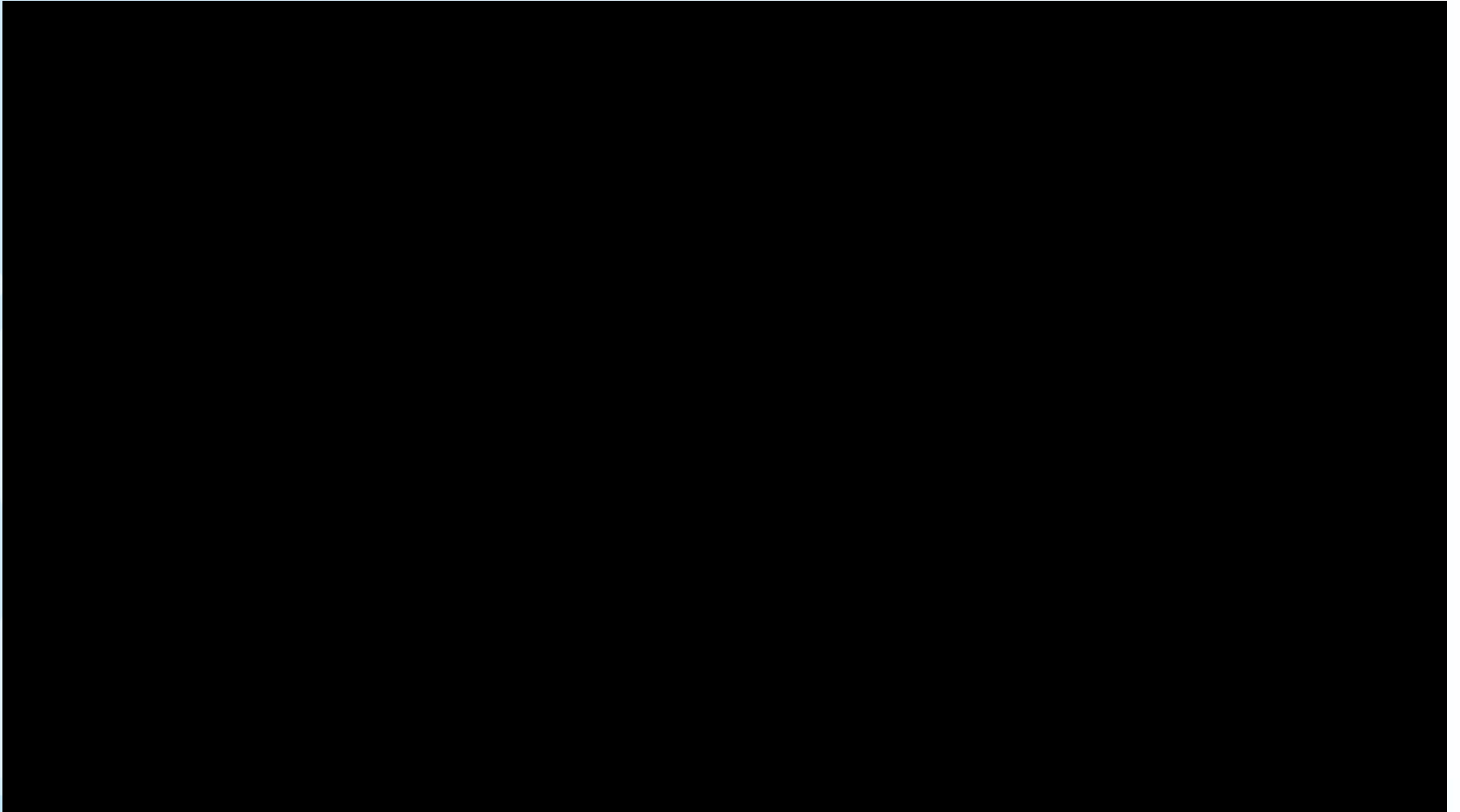
1. Ability to detect sharks
2. Test and develop drone based procedure
3. Helicopter vs drone vs spotter
4. Perception errors of field based assessments
5. Behaviour of white sharks off NSW beaches
6. Hyperspectral cameras to track sharks
7. Artificial intelligence and autonomous flight
8. PhD candidate Andrew Colefax (SCU)



How do they work?



Science (shark behaviour)



Drones



- Proven effective – shark detection & swimmer safety (+ science)
- Different cameras (RGB) plus hyperspec (research)
- Program with surf lifesaving orgs & councils.
- Trials of AI models to automatically detect sharks and other wildlife
- Extended and beyond line of site

Aerial Surveillance - drones

Extension of research



Use contracted professional drone pilots

- Not sustainable, expensive to go State-wide
- Excellent fee for service
- No investment into future



Operational



Embed into beach authorities

- Relies on non-professionals
- Fits a State-wide model
- Investment into future
- Greater than just sharks
- Greater challenges





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Thank you

Shark Management Strategy

