SGSSI MPA Review Science Symposium

13-14 June 2023
Aurora Conference Centre
Cambridge, UK

Hosted by the Government of South Georgia & the South Sandwich Islands

Higher Predators

- **Albatross and Petrel Research at Bird Island, South Georgia.** *Richard Phillips (BAS)*
- **Spatial Segregation of Wandering Albatross.** *Vicky Warwick-Evans (BAS)*
- **Advances in Image Monitoring for Conservation.** *Tom Hart (Oxford Brookes University)*
- **Fixed Wing Wildlife Surveys at South Georgia.** *Nathan Feeney (BAS)*
- **Baleen Whale Recovery and Habitat Use in South Georgia Waters.** *Stephanie Martin (BAS)*

Richard Phillips

British Antarctic Survey

ESA

Sue G

Judith Brown

Albatross and Petrel Research at Bird Island, South Georgia

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

Research themes

- Diverse questions about ecology & life history
- Roles of competition and habitat/diet specialisation in structuring seabird communities
- Intrinsic and extrinsic drivers of movements, behaviour, physiology, life history
- Conservation esp. impacts of fisheries & changing environment
- Pollutants
- Results to:
  - international treaties (esp. ACAP)
  - NGOs (BirdLife, IUCN)
  - RFMOs (ICCAT, IOTC, CCSBT) and national fisheries bodies

Data collection

- Long-term annual monitoring
  - Population trends
  - Breeding success
  - Individual breeding histories
  - Demography
  - Breeding chronology
  - Diet (conventional, SIA, genetics)
  - Provisioning rates
  - Chick growth
- Habitat use (tracking, SIA)
- Population genetics
- Pollutants

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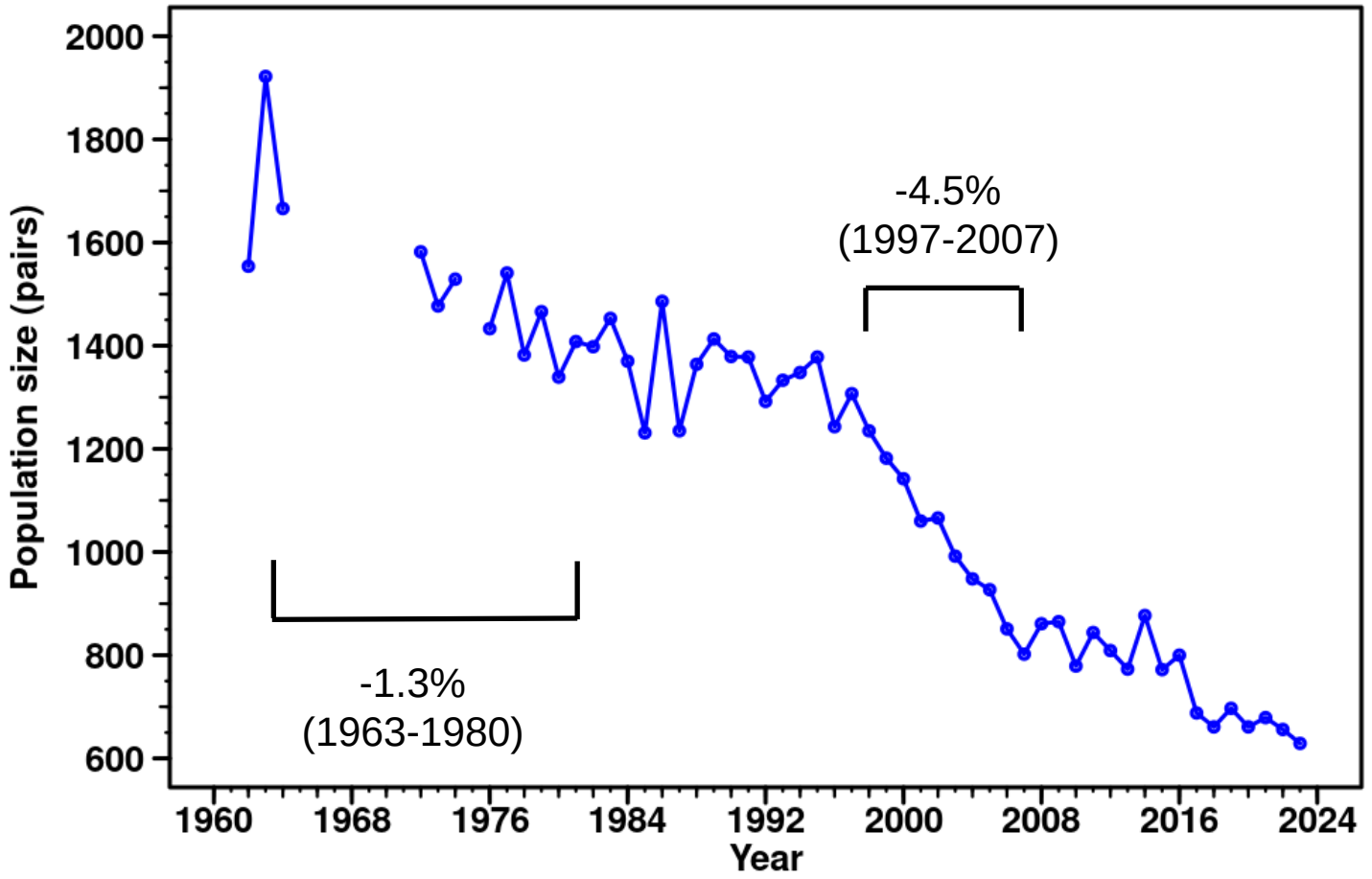
Albatross population trends at Bird Island

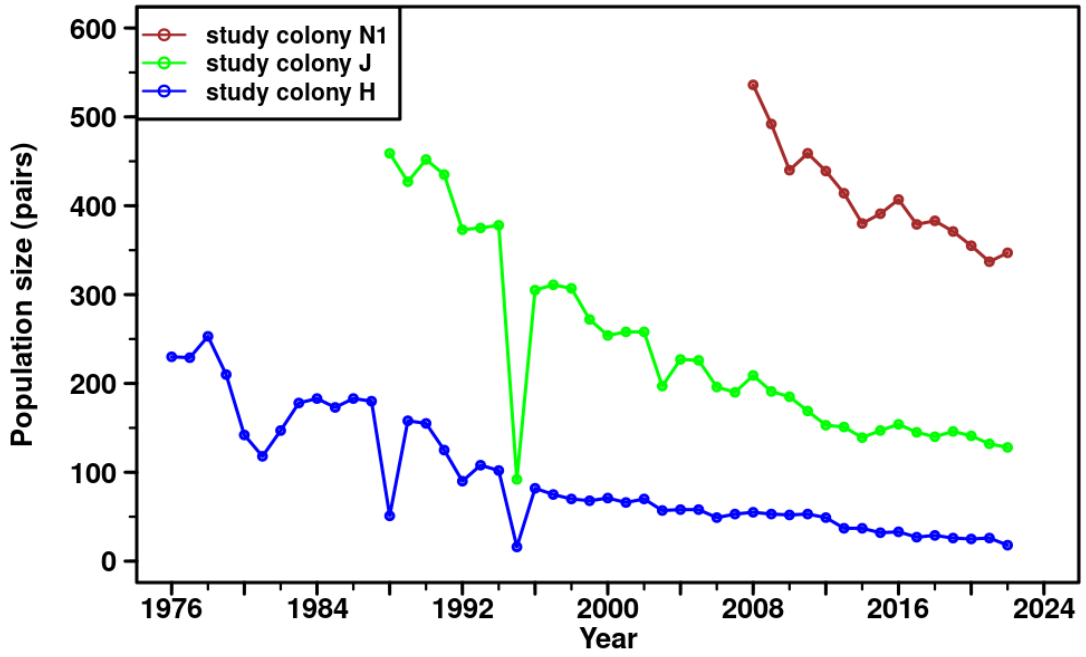


Agreement on the Conservation of Albatrosses and Petrels

- South Georgia population is 18% of global total; 61% of South Georgia population breeds at Bird Island

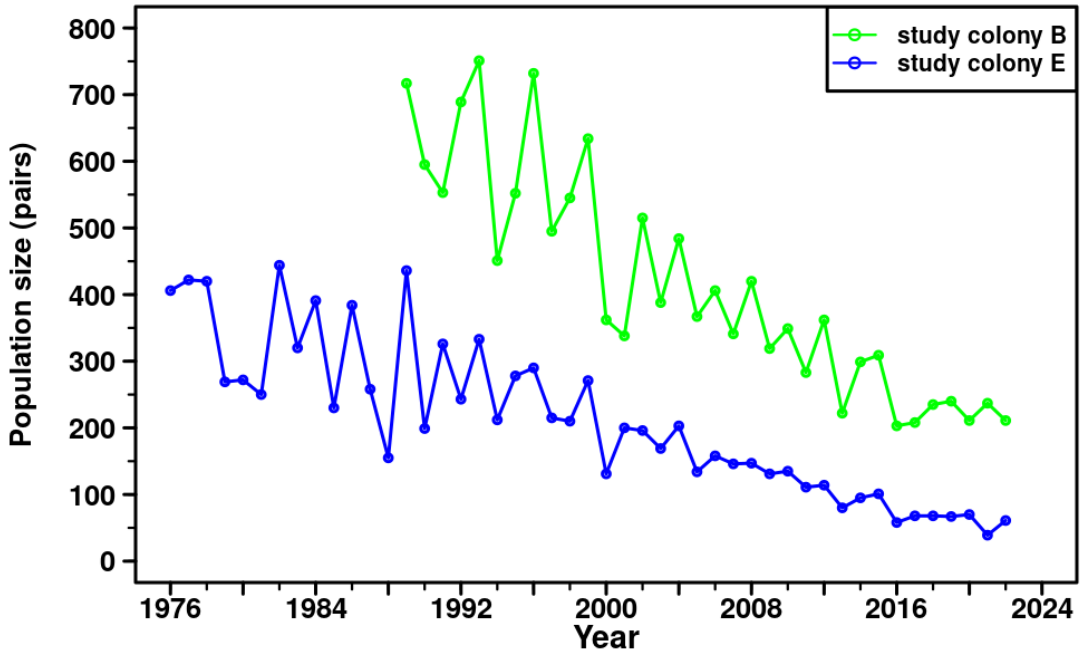
Albatross population trends at Bird Island

Black-browed Albatross breeding population at Bird Island



Source: British Antarctic Survey

Grey-headed Albatross breeding population at Bird Island



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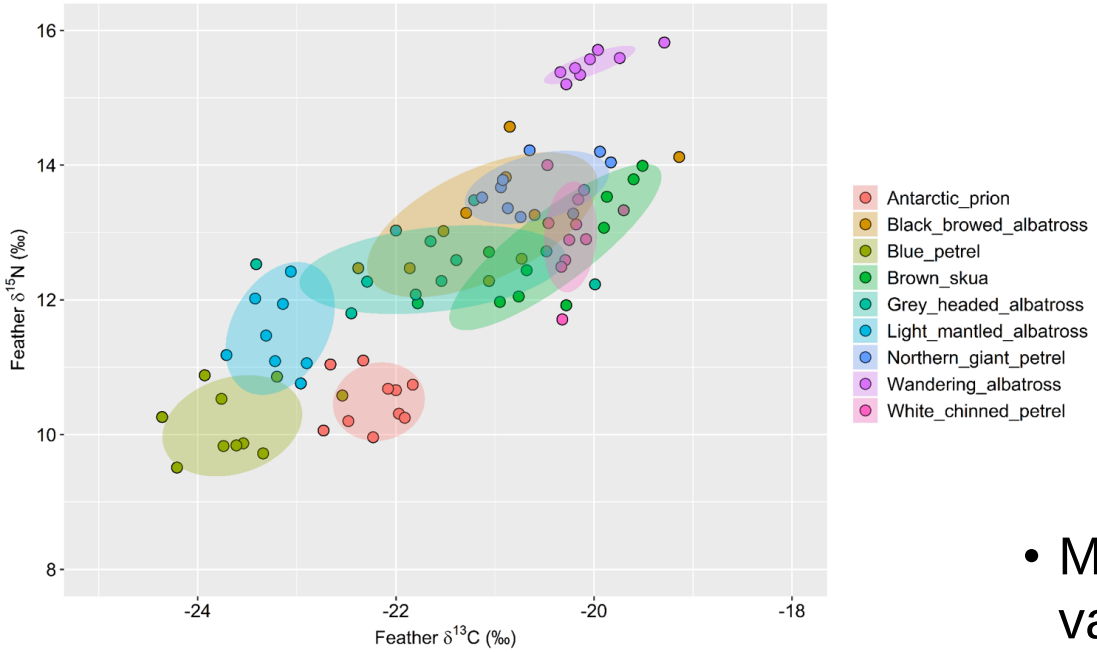
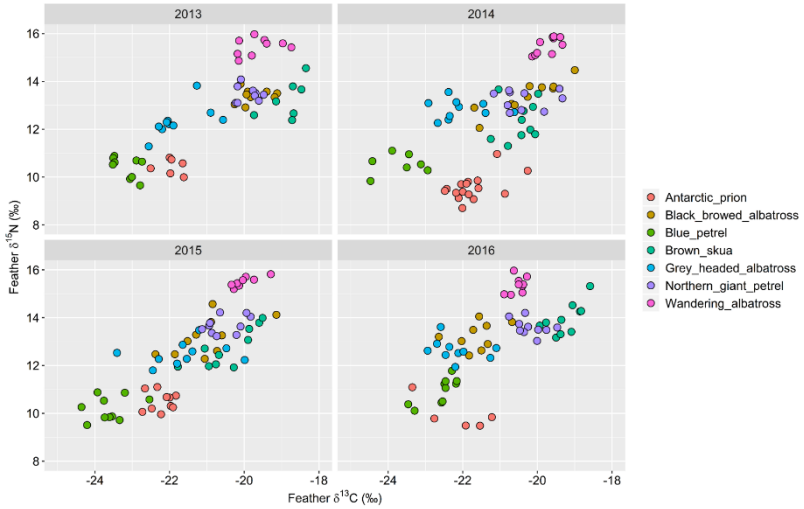
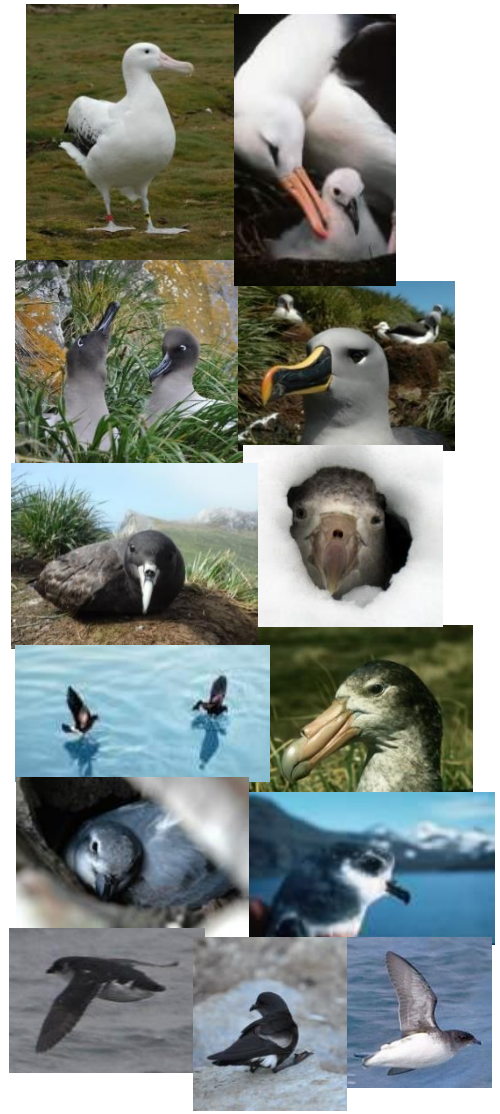
Niche partitioning from SIA





- Model annual variation in chick SI ratios in relation to krill availability, environmental change etc.
- Test correspondence with breeding success



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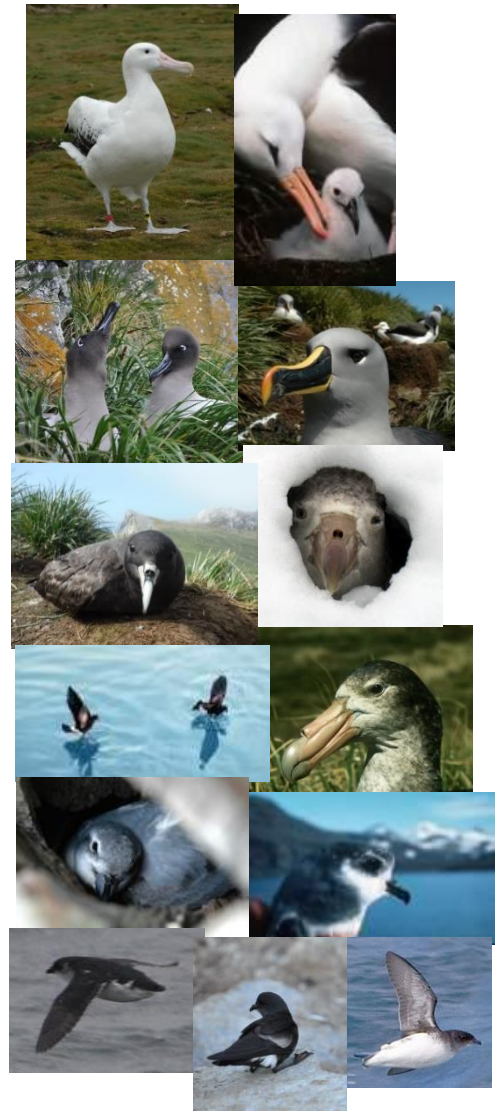
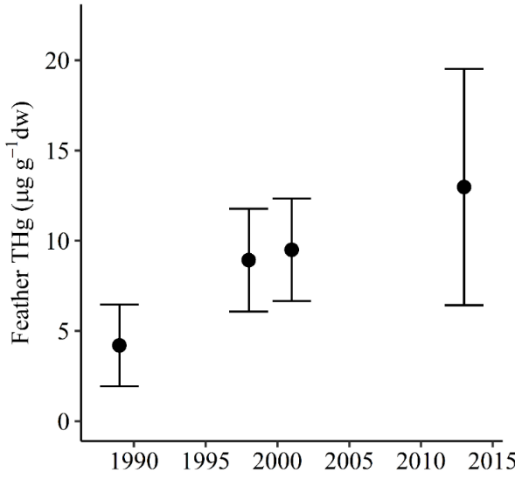
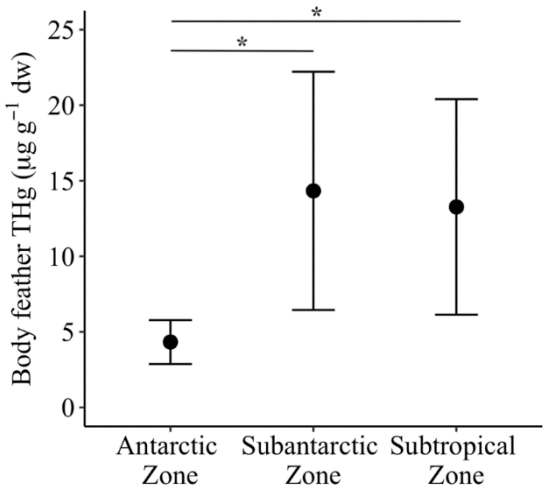
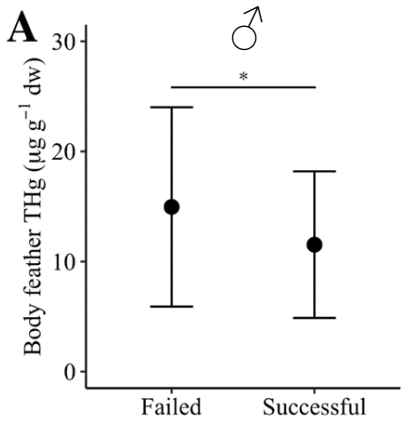
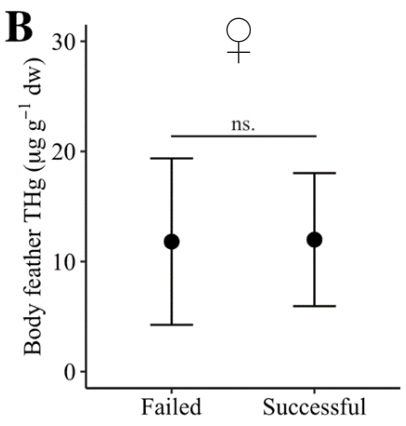


Long-term changes in mercury contamination in relation to nonbreeding distribution & breeding success









- Increase since 1990s in Hg. Highest levels in feathers grown in subantarctic and subtropical waters
- Mercury levels higher in male grey-headed albatrosses that failed

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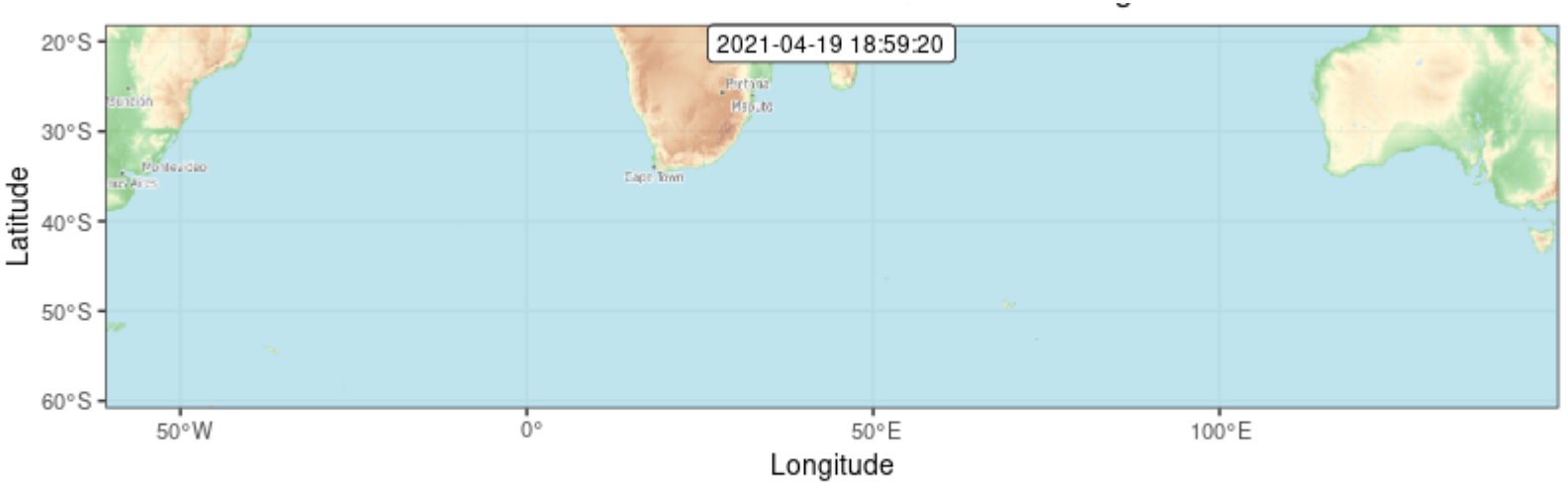
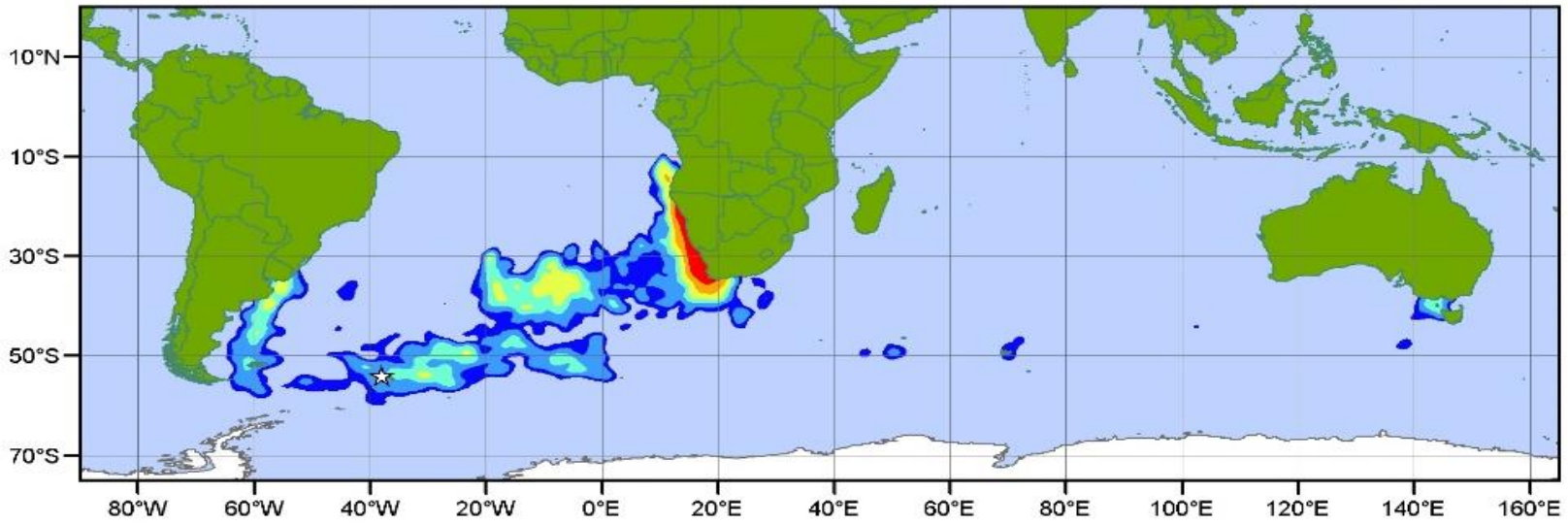
Tracking: compare migration and fisheries overlap of fledglings and adults





Effects of changing wind patterns on foraging of albatrosses

- Adult foraging trips
  - GPS logger
  - Accelerometer
  - Immersion logger
  - 3-axis magnetometer
  - Heart-rate logger

- Chick mass changes
  - Growth rates
  - Meal mass
  - Feeding frequency

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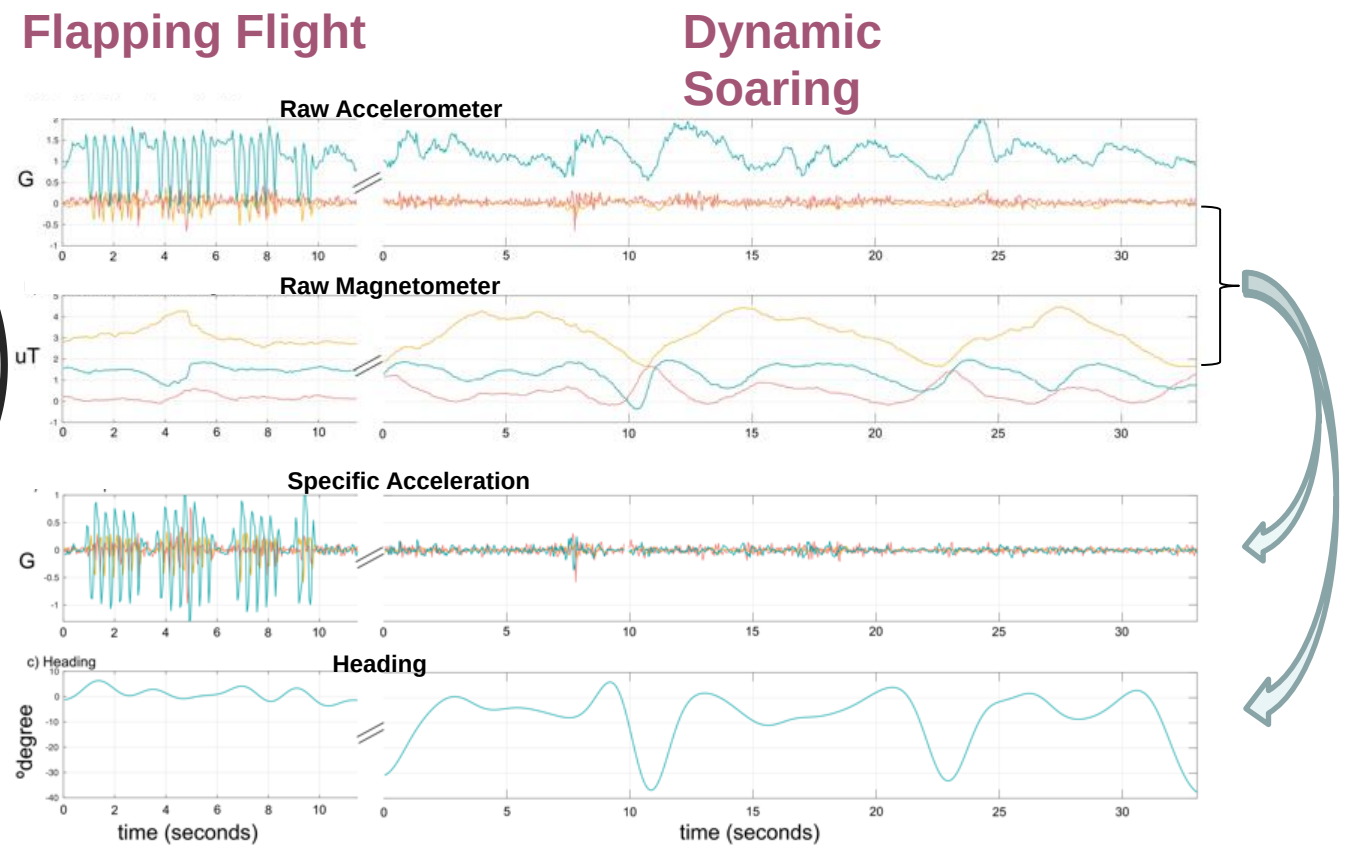
Stony Brook University

NSF

Relate flight mode to energy expenditure

Accelerometer + Magnetometer

Two flight modes as seen in ~ 45 seconds of sensor data



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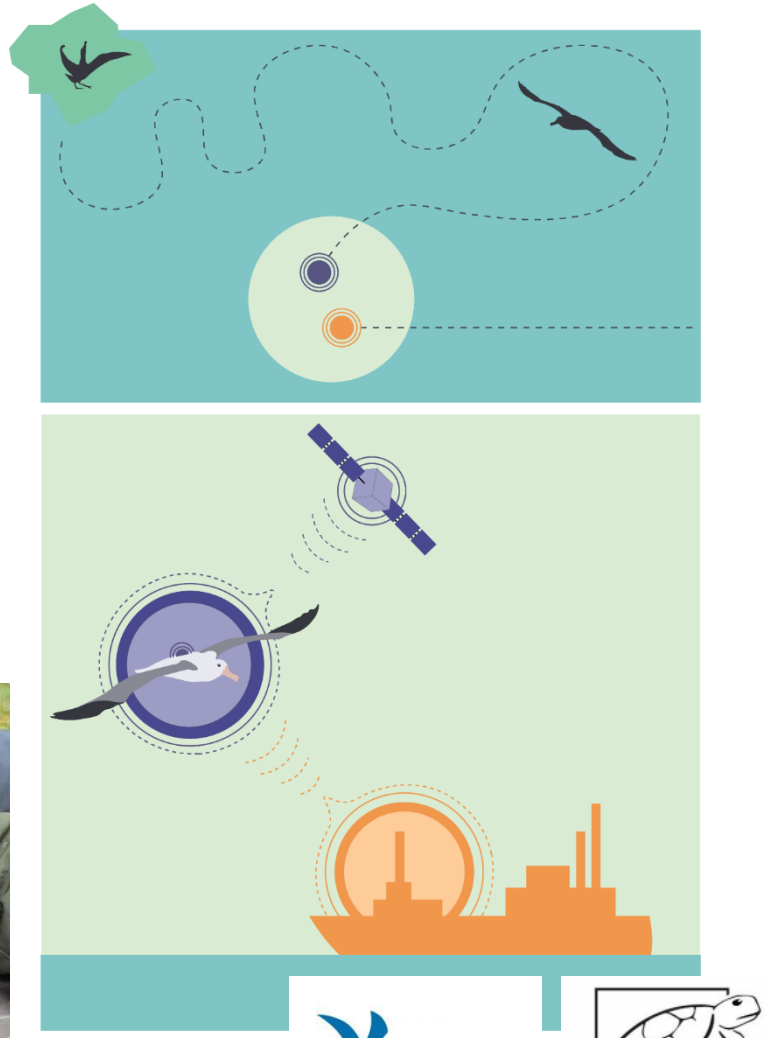
Seabird sentinels: mapping fine-scale bycatch risk using bird-borne radar-GPS loggers

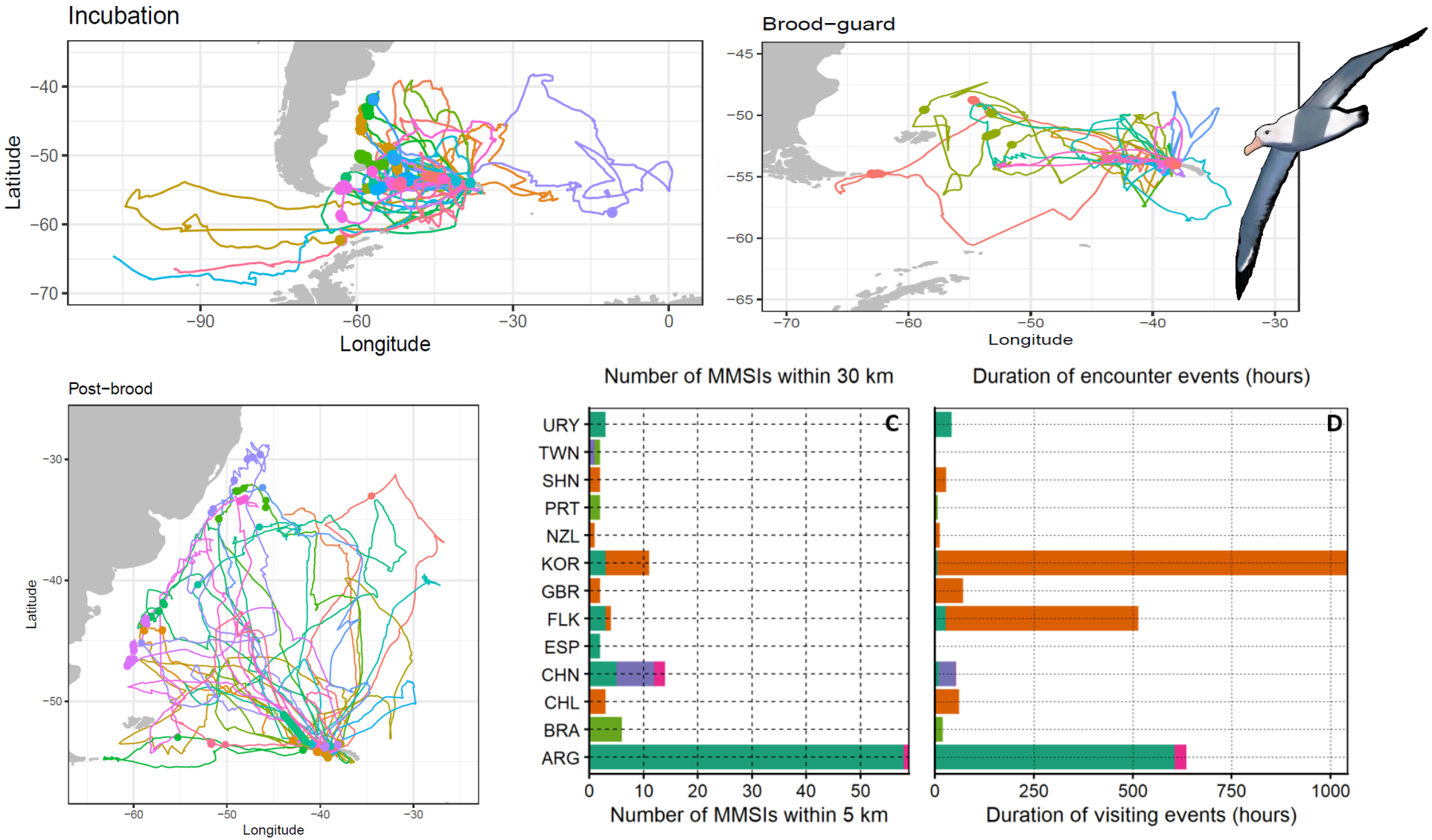
- Understand fine-scale vessel interactions
- Detect legal and undeclared/IUU vessels (radar & GFW AIS data)
- Analyse habitat preference (GPS data)
- Test for signature of vessel association from movements and flight/landing pattern (from immersion loggers)



BirdLife INTERNATIONAL

DARWIN PLUS

Seabird sentinels: mapping bycatch risk



Dots are ship radar detections

Thanks to: Numerous fieldworkers, PhD students, postdocs., national and international collaborators

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Vicky Warwick-Evans

British Antarctic Survey

ESA

Sue G

Judith Brown

Spatial Segregation of Wandering Albatrosses at South Georgia

Victoria Warwick-Evans, Lizzie Pearmain,
Andy Wood, Richard Phillips

Introduction

Globally threatened

Bycatch

Variable rates of decline

At-sea interactions

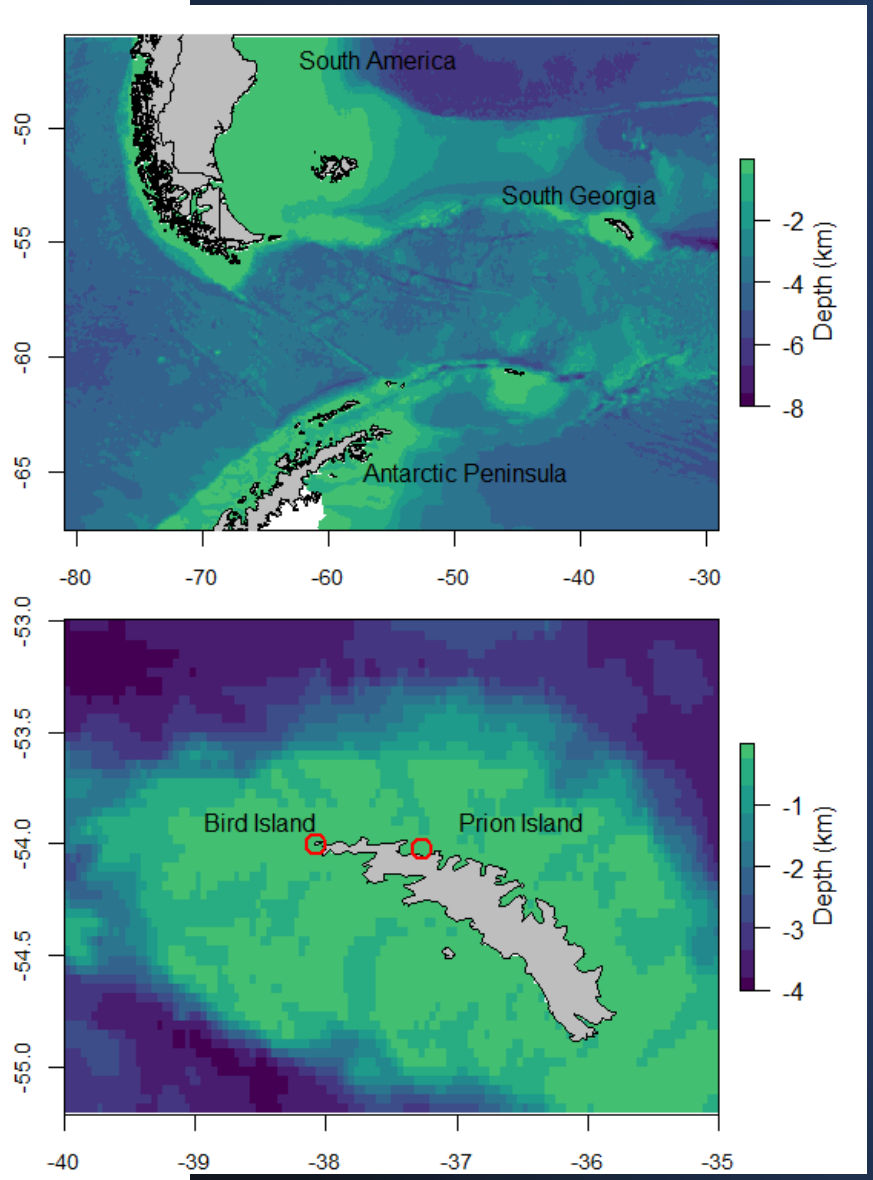
Tracking only from Bird Island

Conservation implications

Methods

Data collection

- Two colonies
- Deploy PTTs and GPSs
- Breeding adults
- Jan - Jul
- Geolocators



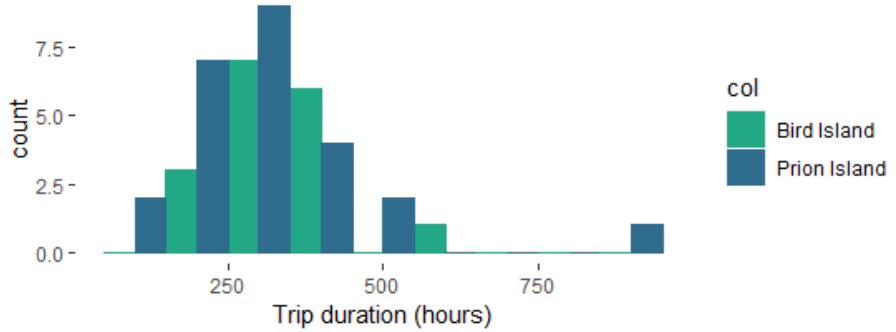
Methods

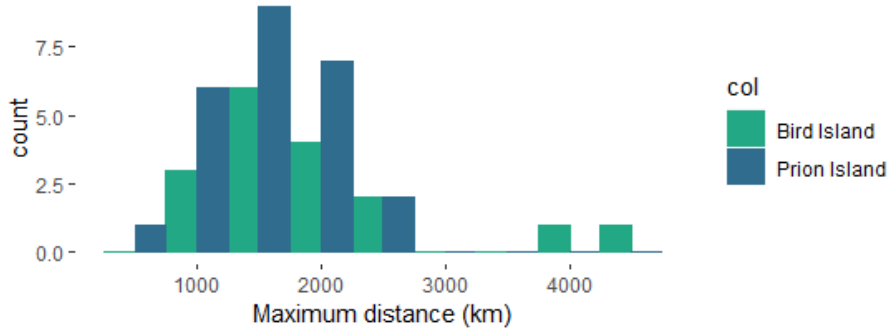
Data processing and analyses

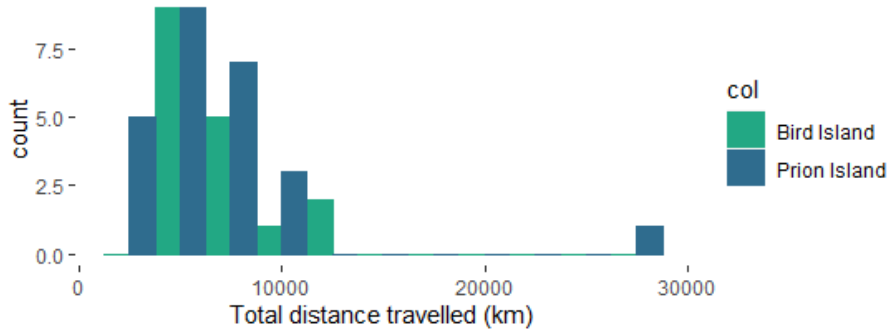
- GPS and PTT 1hr - crawl
- Kernel Density
- Population overlap
- Wind direction at colony departure
- Habitat characteristics
- Overlap with fisheries

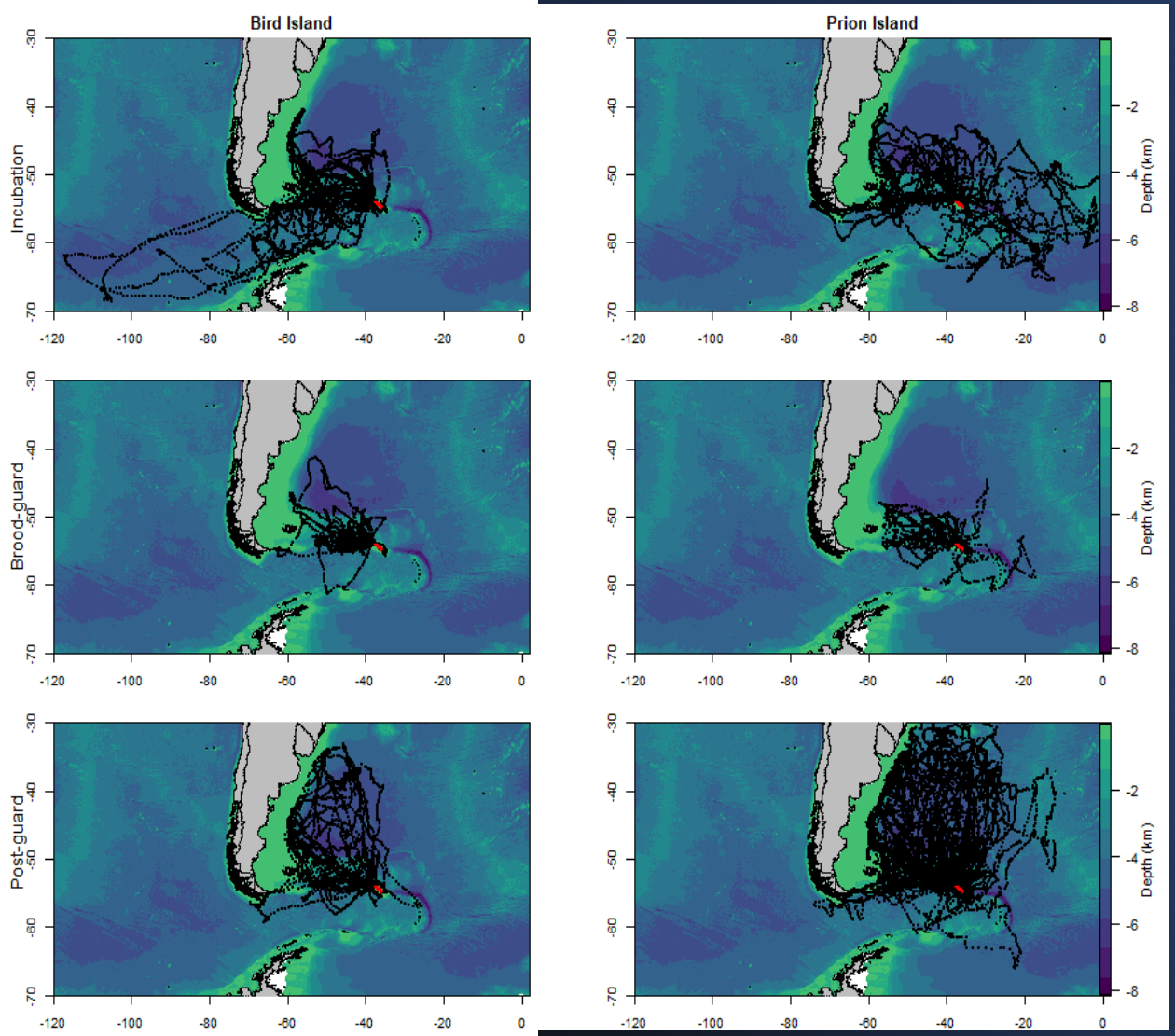
Results tracks

Incubation



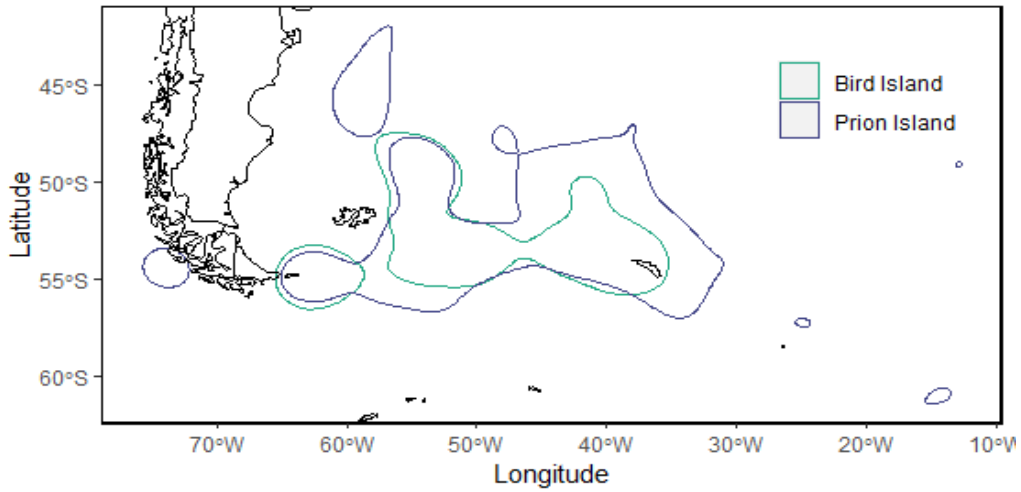




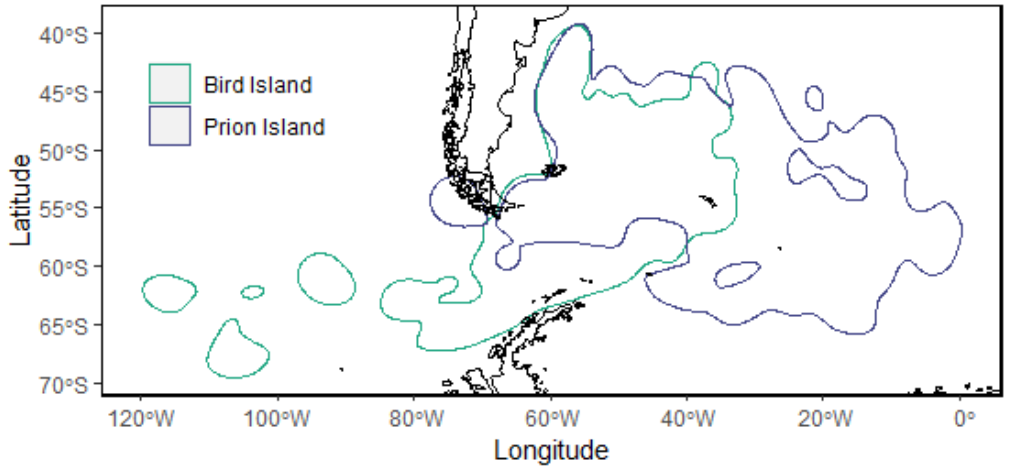


Results kernel density

Core foraging area (50 %)



Home range (95 %)

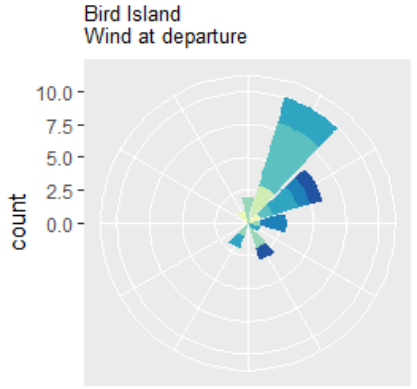


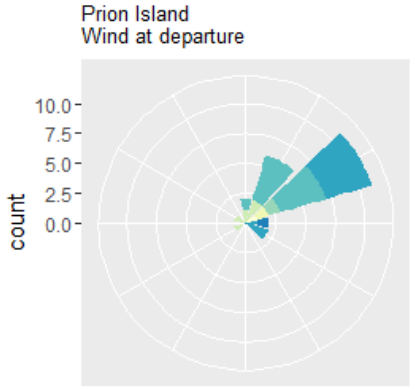
Bhattacharyya affinity			
UD	Sample	Randomised	p
50 %	0.35	0.38 ± 0.03	0.17
95%	0.69	0.77 ± 0.03	0.005

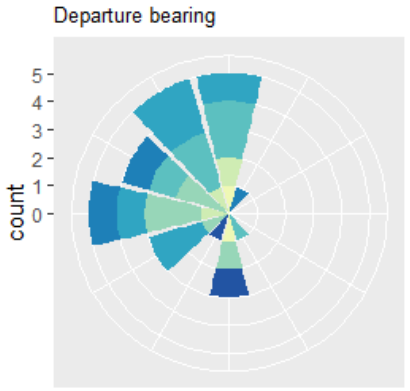
Conclusion

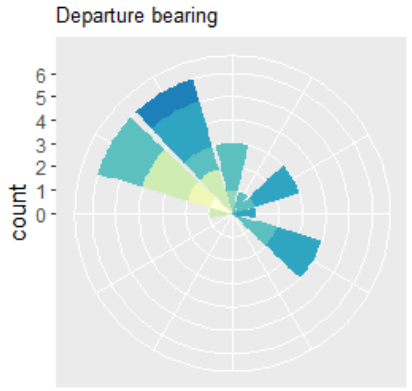
- No difference in the core foraging area
- Significant difference in home range

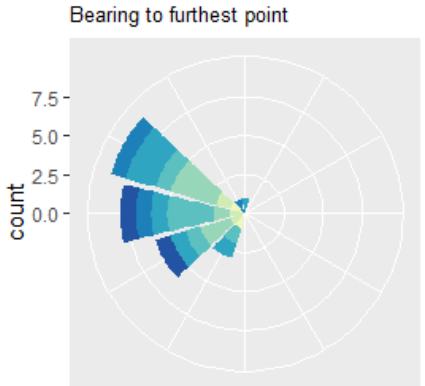
Results wind

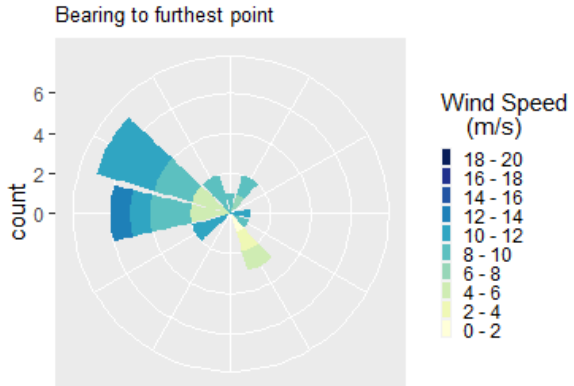


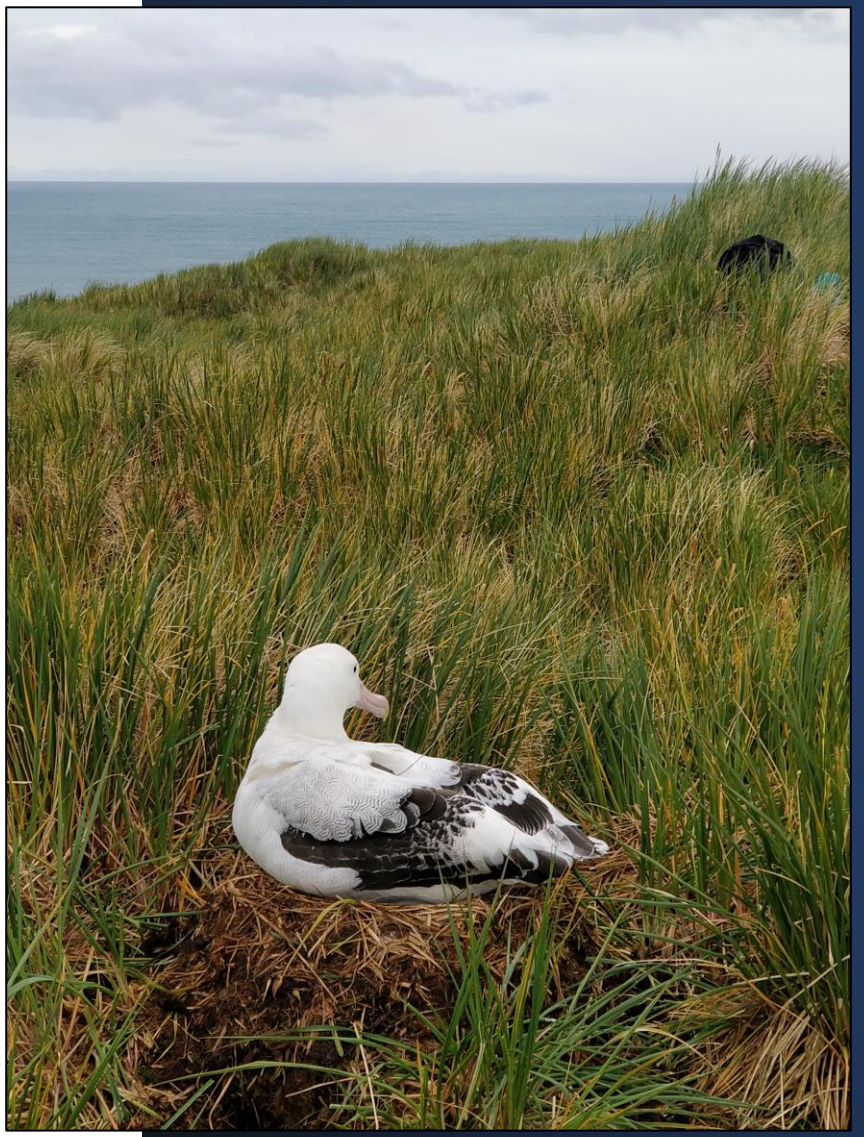




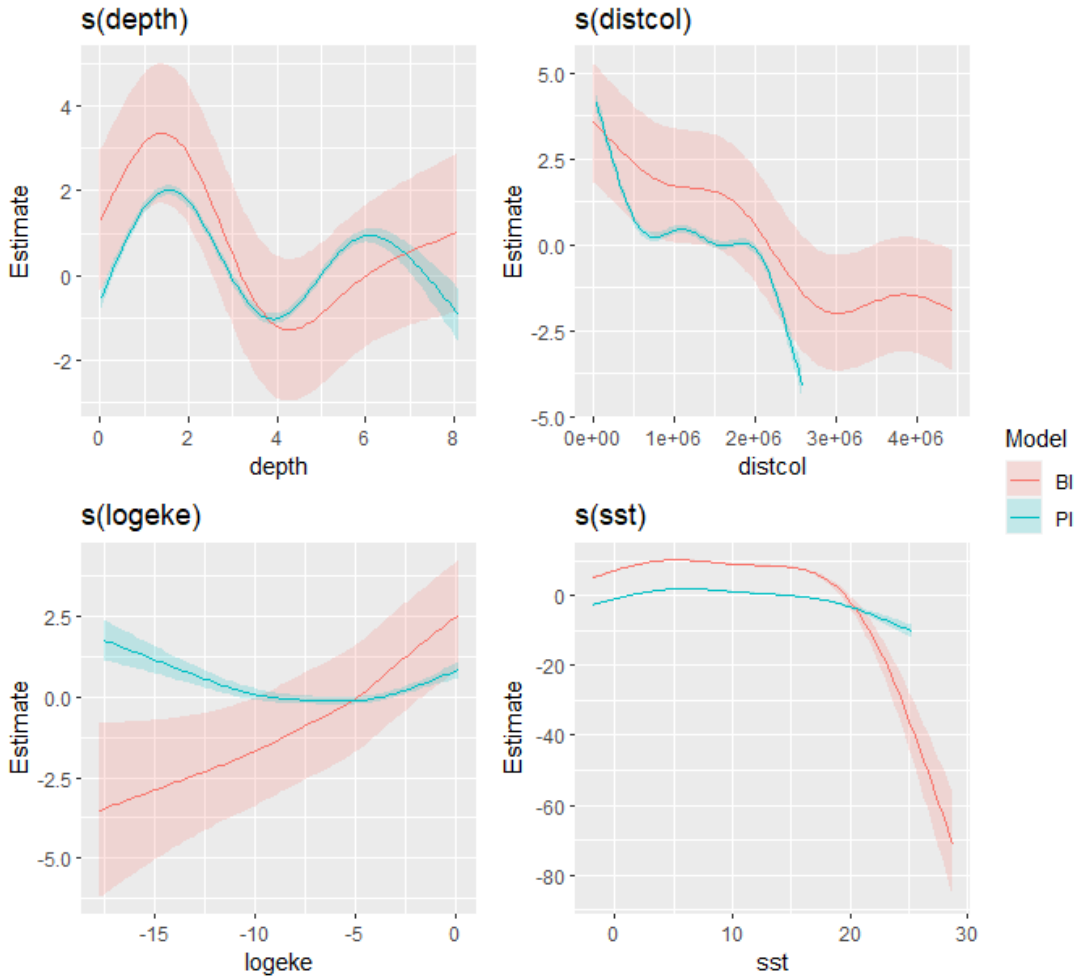


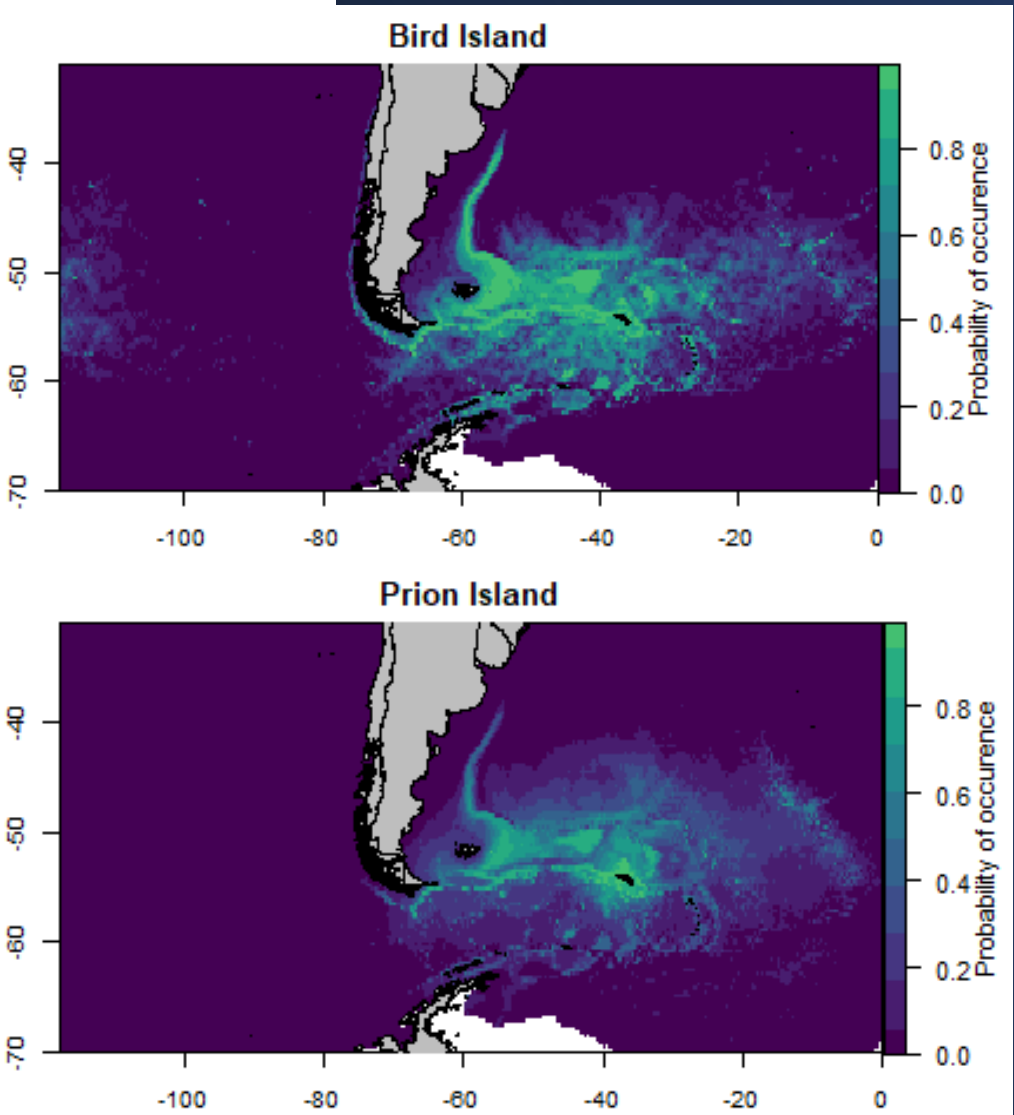




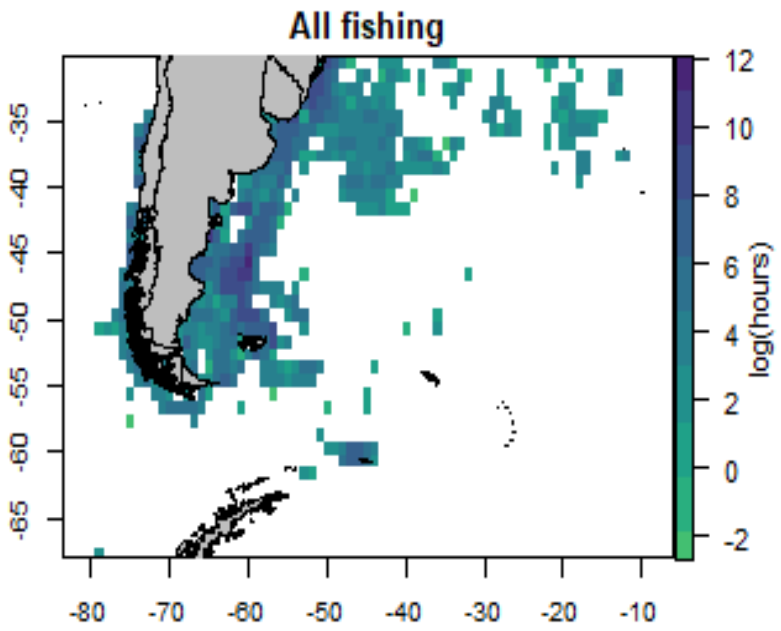


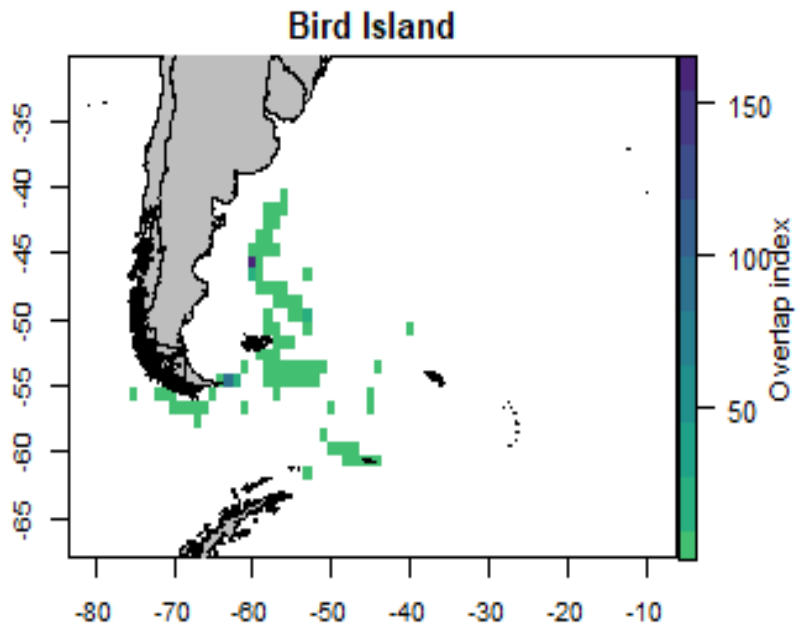
Results habitat models

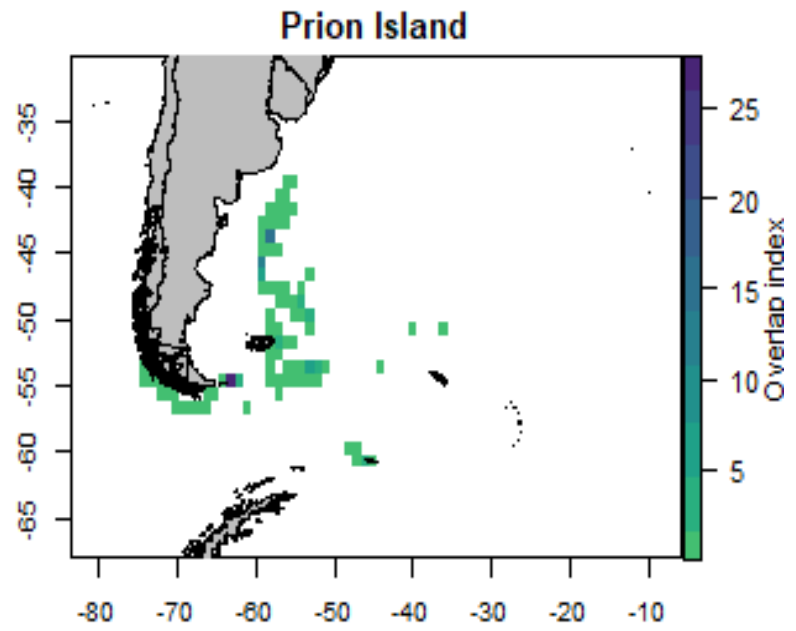




Results Fisheries overlap







Conclusions

- Significant differences in home range
- Unclear what causes population segregation
- Birds breeding at Bird Island have higher overlap with all types of fishery
- Birds from Bird Island more threatened by fishery
- Explains faster rate of population decline at Bird Island than at Prion Island

QUESTIONS?

Tom Hart

Oxford Brookes University

ESA

Sue G

Wolfgang Kaehler

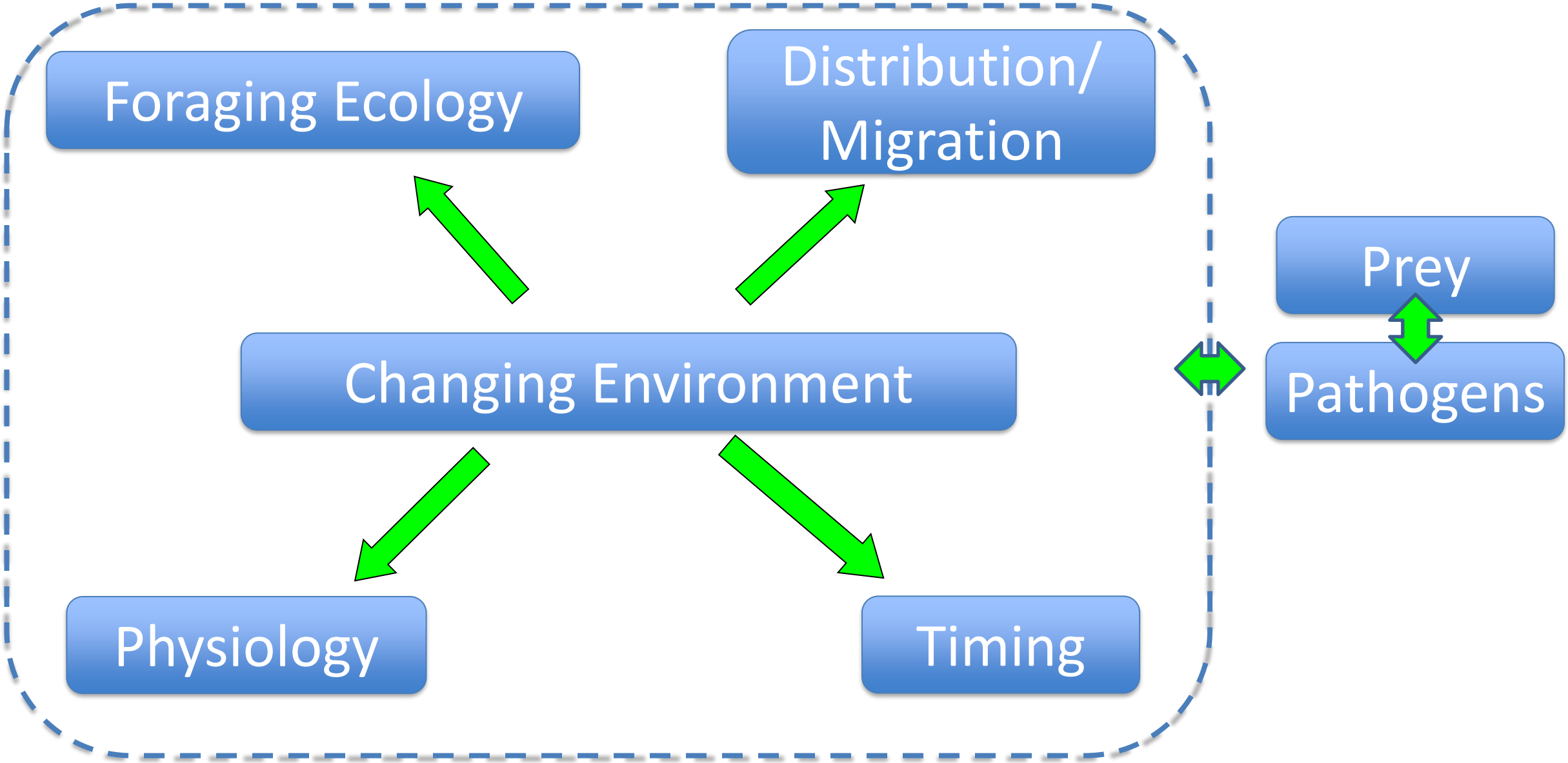
Advances in image monitoring for conservation

Dr Tom Hart

PENGUIN WATCH

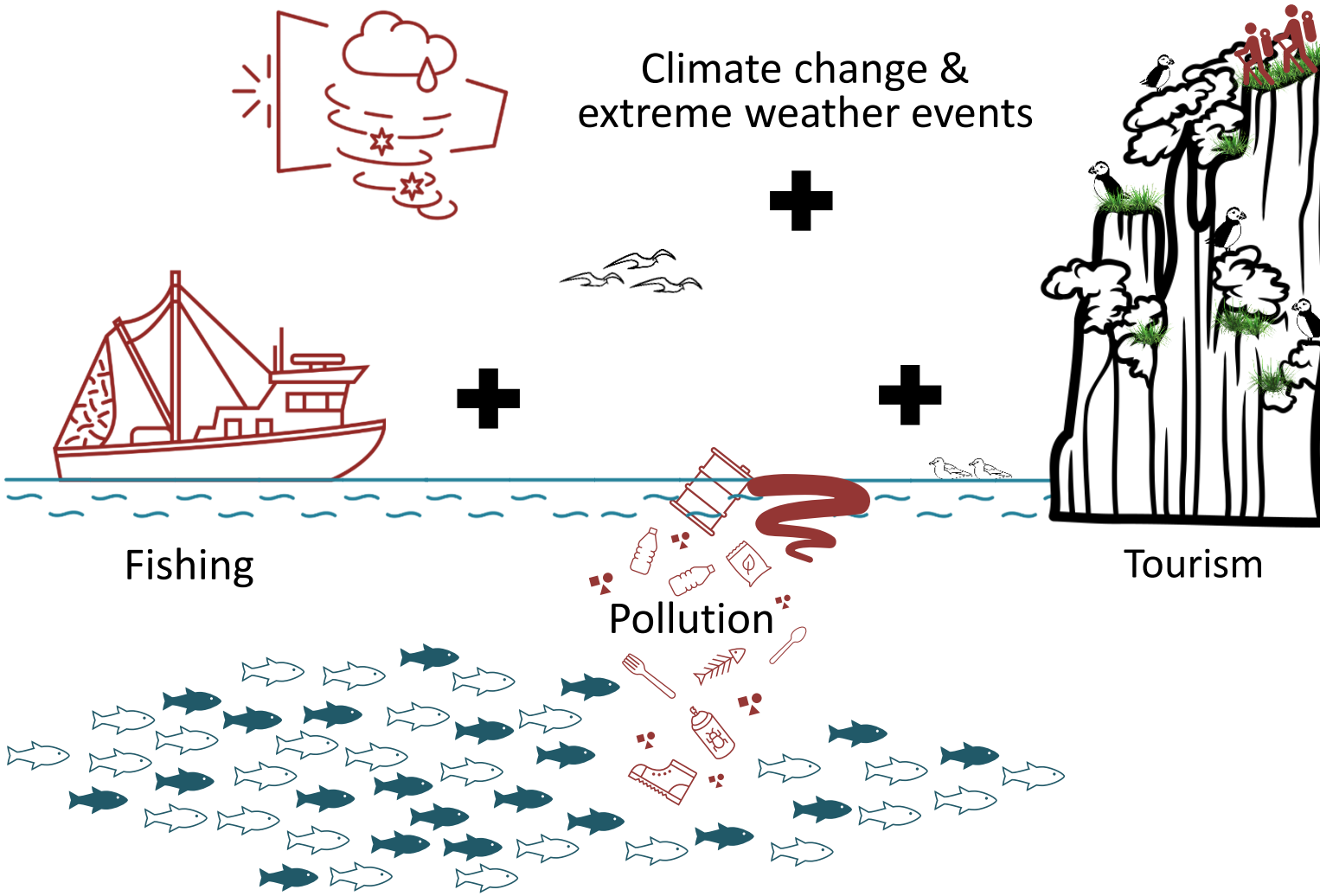
OXFORD BROOKES UNIVERSITY

How do organisms respond to changes in the environment?



Understanding Change

Population change



UNDERSTANDING CONFOUNDING THREATS

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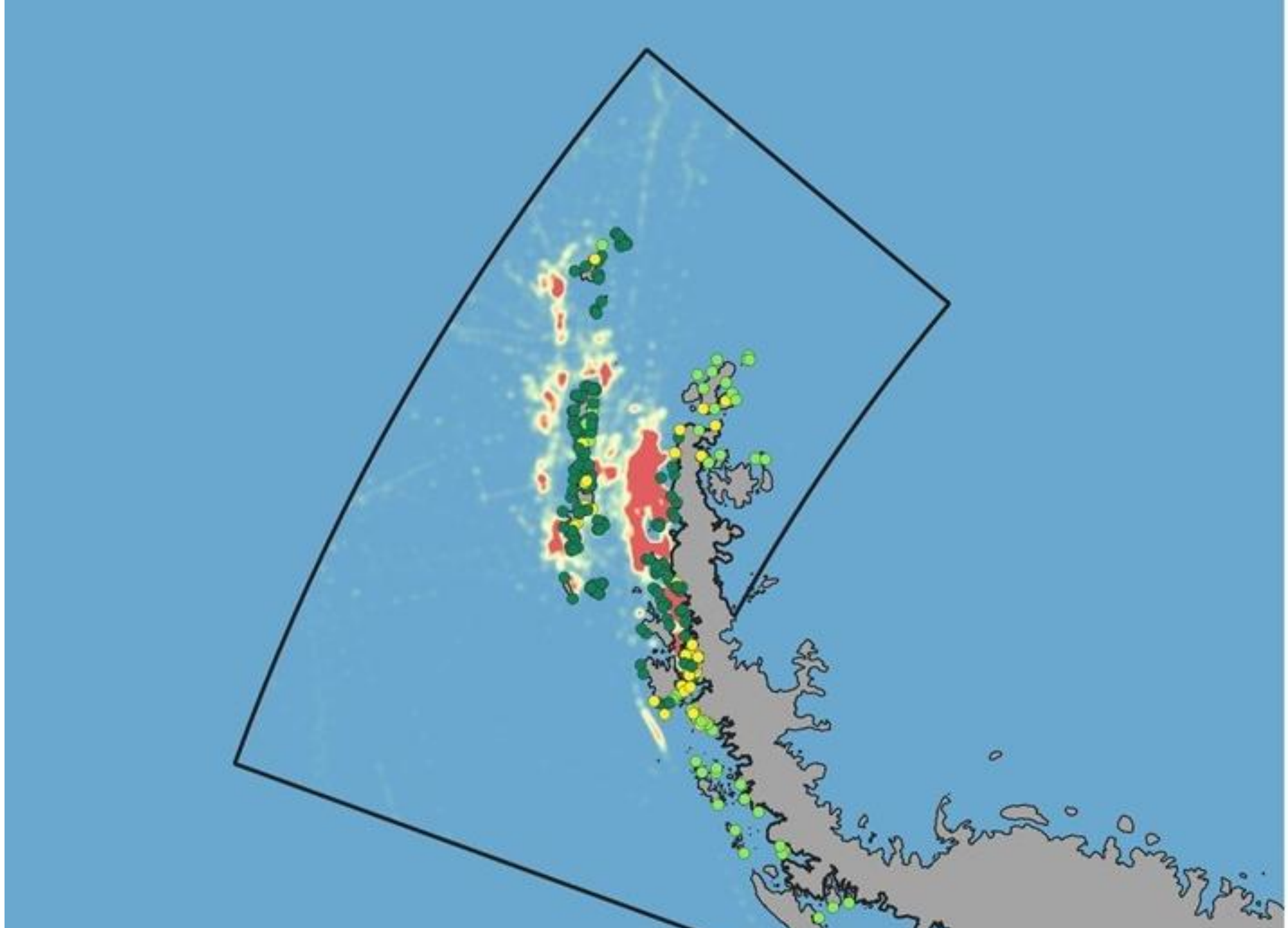
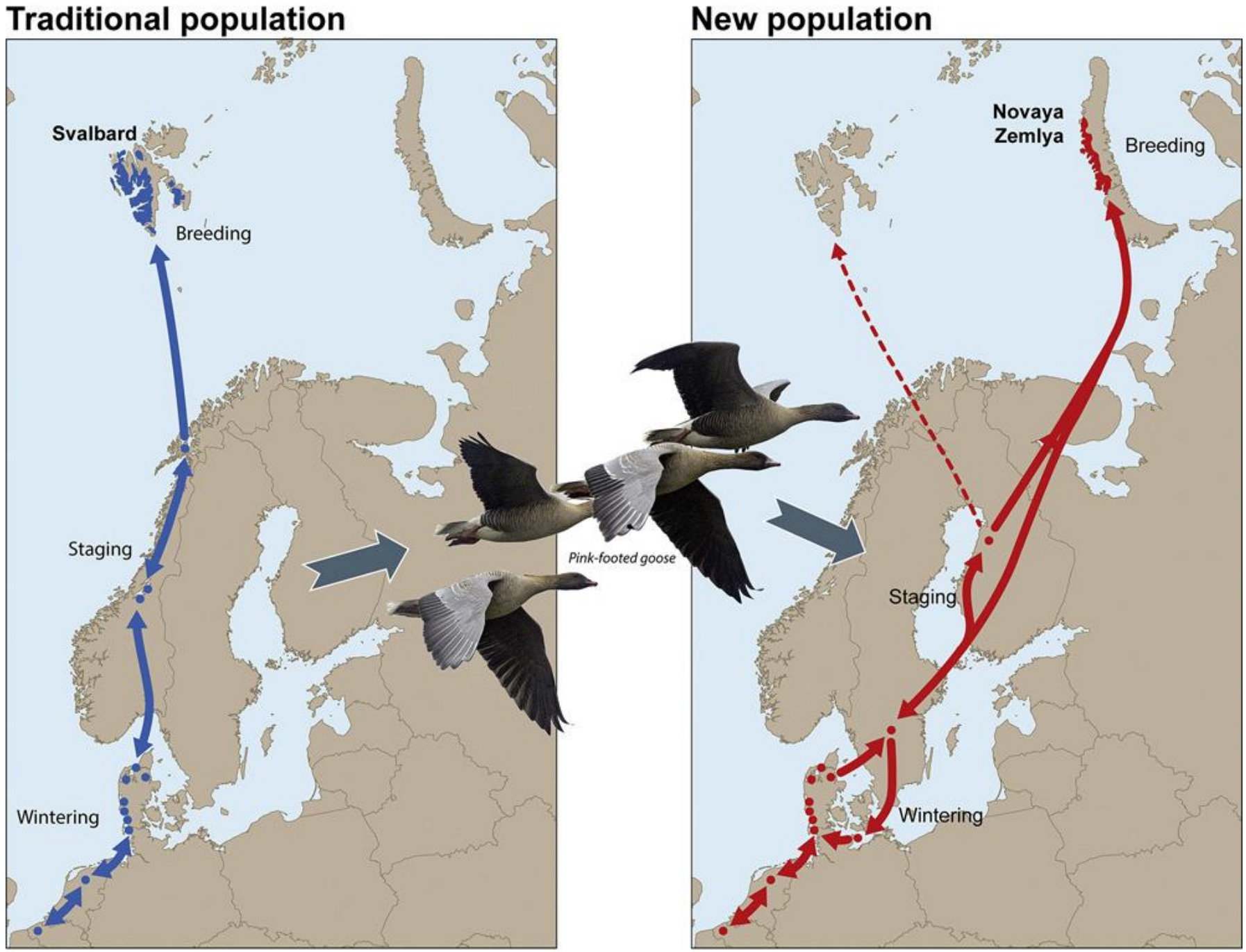
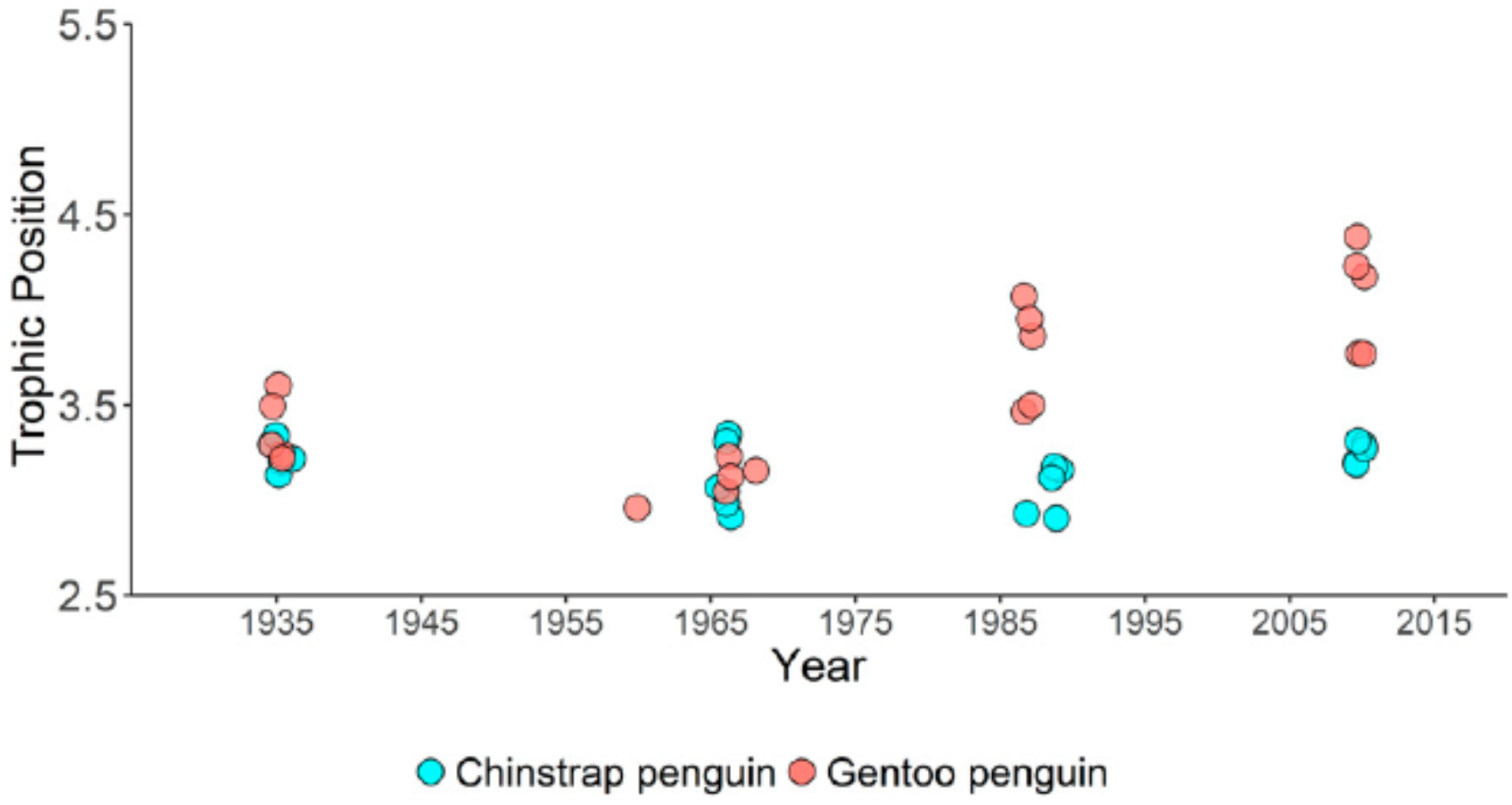
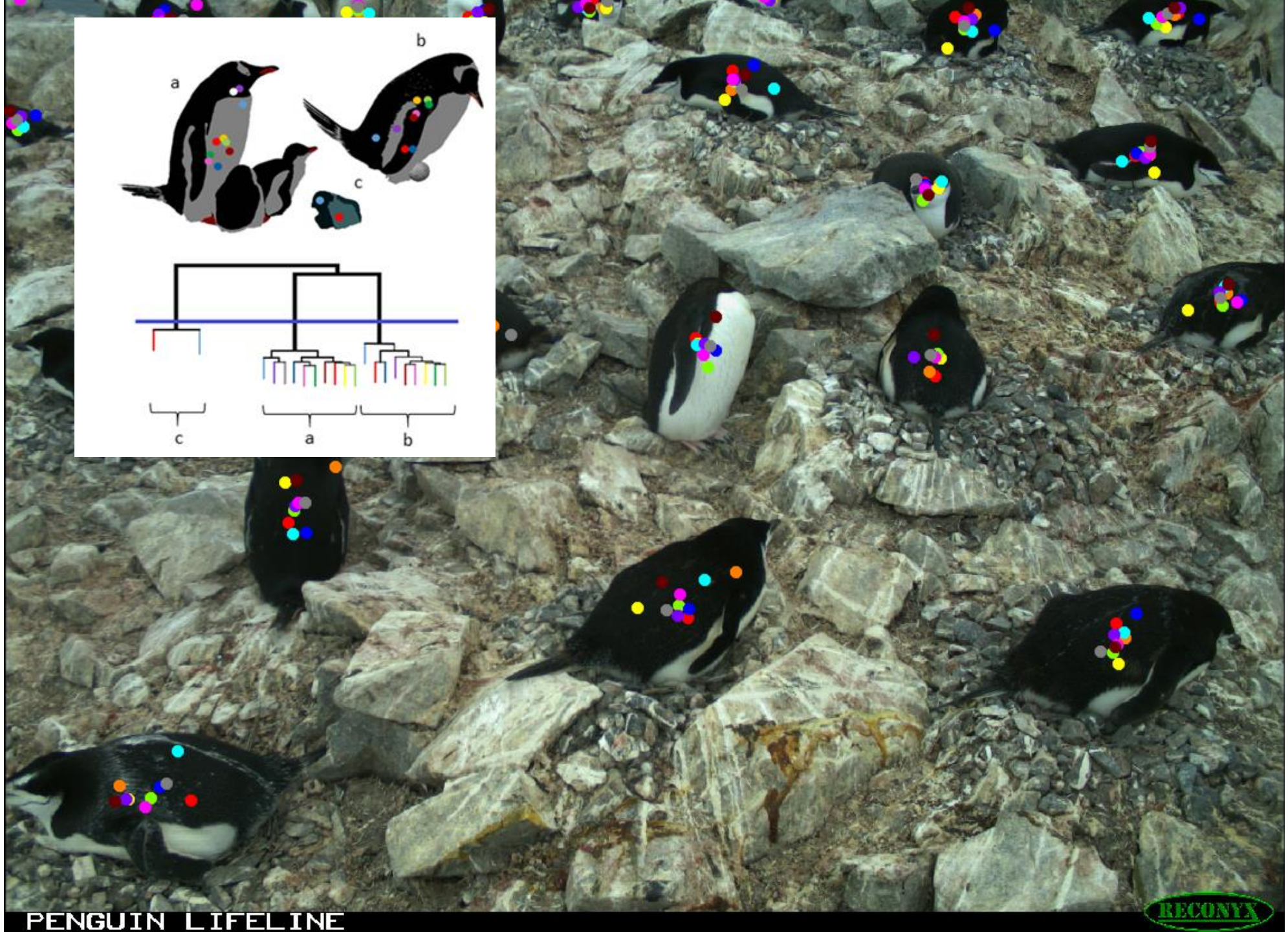



Traditional population
Svalbard
Breeding
Staging
Wintering
Pink-footed goose
New population
Novaya
Zemlya
Breeding
Staging
Wintering

Divergent trophic responses of sympatric penguin species to historic anthropogenic exploitation and recent climate change

Kelton W. McMahon[a,1], Chantel I. Michelson[b], Tom Hart[c], Matthew D. McCarthy[d], William P. Patterson[e], and Michael J. Polito[b,1,2]

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PENGUIN LIFELINE
RECONYX

Image to align

Target image

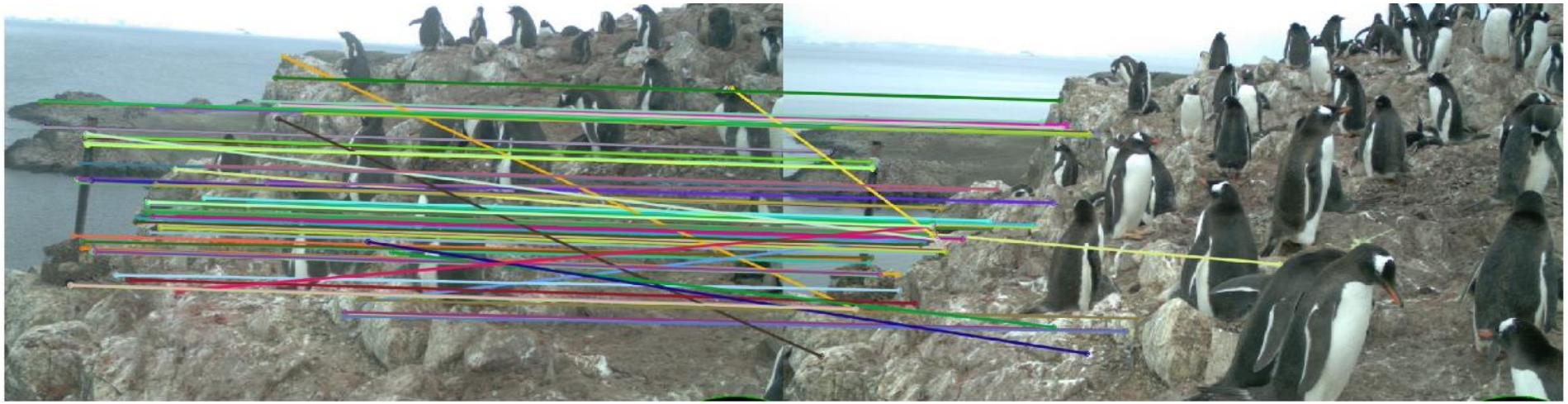
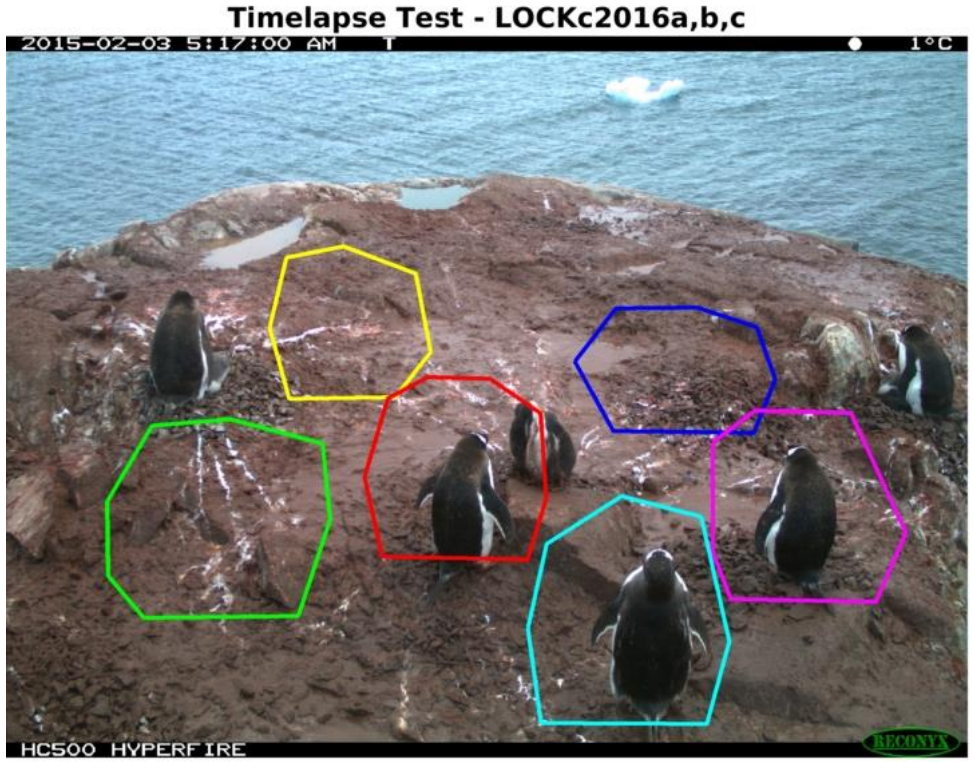
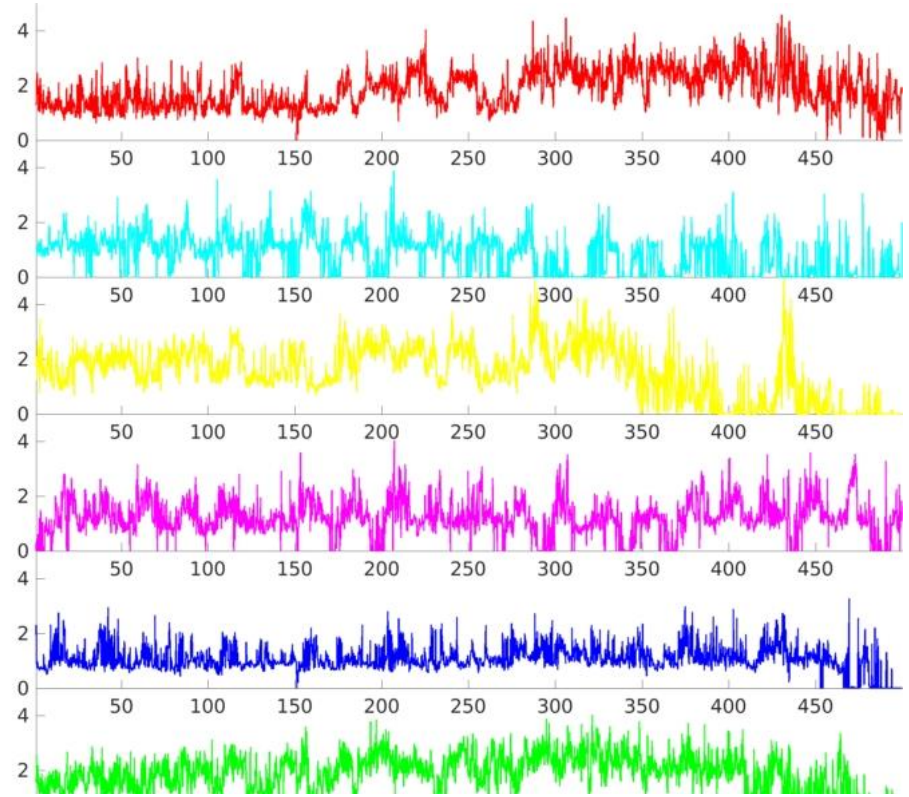


Image to align

Target image





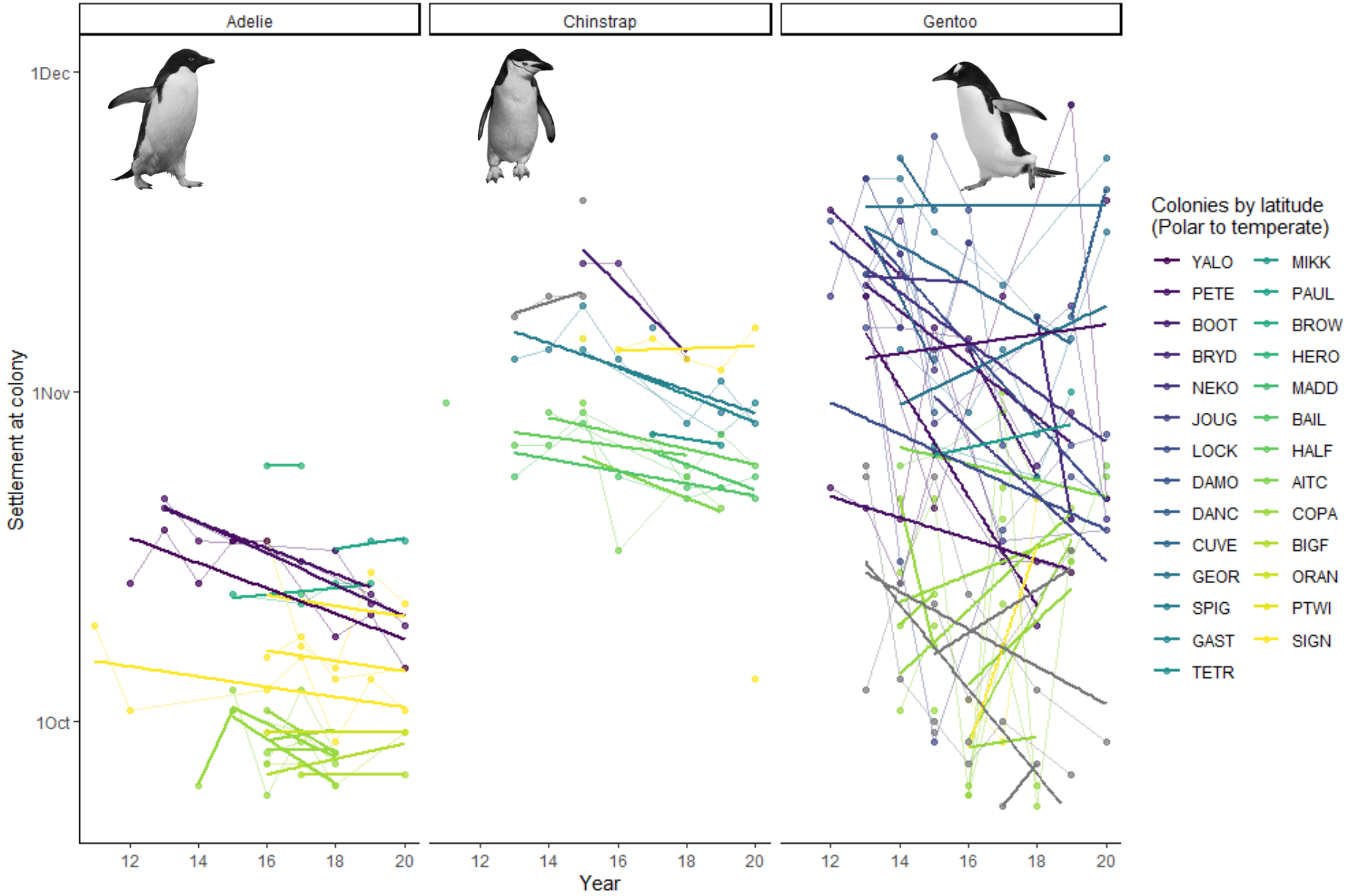
Remote Sensing in Ecology and Conservation
Open Access
ZSL LET'S WORK FOR WILDLIFE

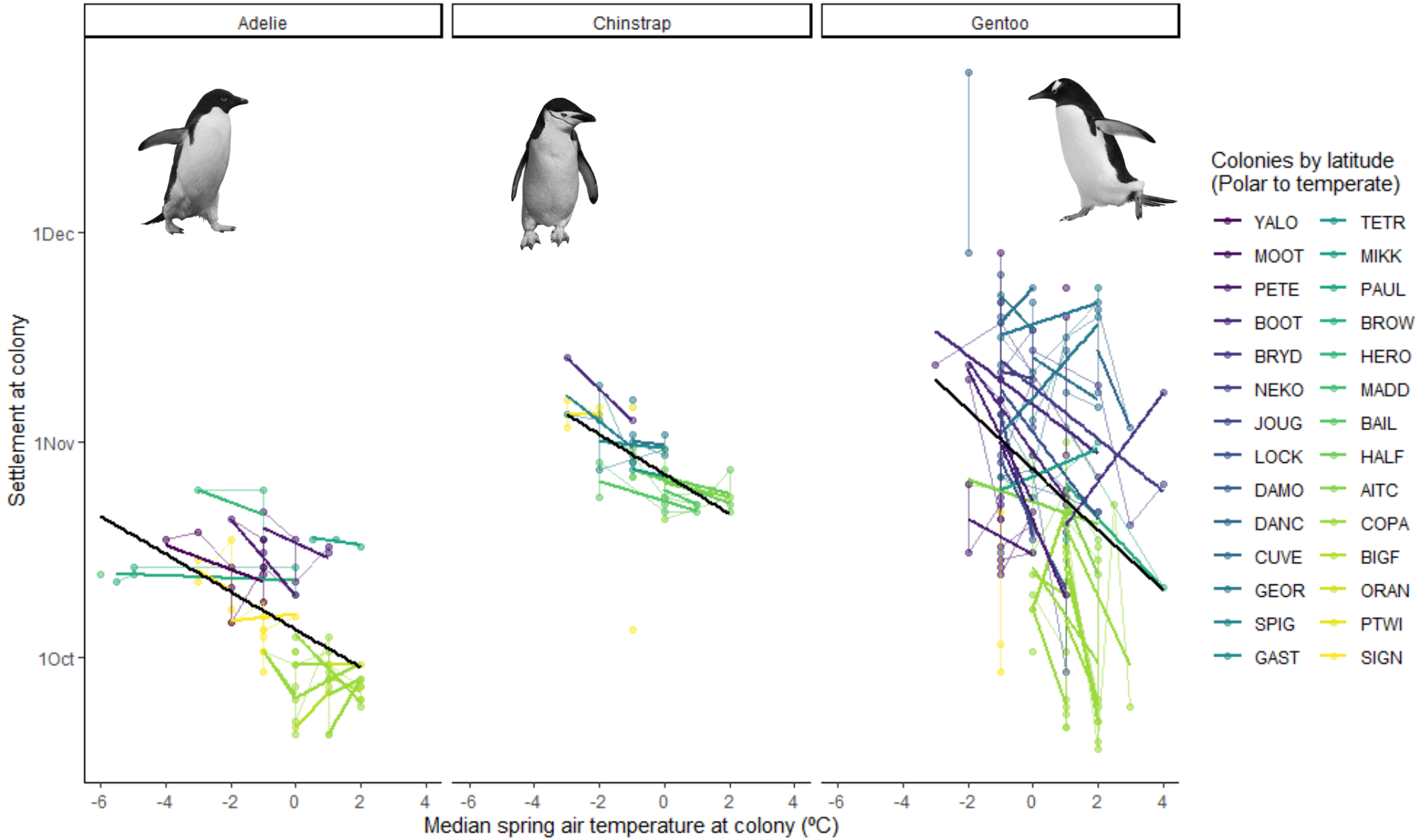
ORIGINAL RESEARCH

Large-scale assessment of intra- and inter-annual breeding success using a remote camera network

Casey Youngflesh[1], Fiona M. Jones[2], Heather J. Lynch[3], Joan Arthur[4], Zuzana Ročkaiová[4], Holly R. Torsey[4] & Tom Hart[2]

[1]Department of Ecology and Evolutionary Biology, University of California, Los Angeles CA, 90095, USA
[2]Department of Zoology, University of Oxford, Oxford OX1 3SZ, UK
[3]Institute for Advanced Computational Science, Stony Brook University, Stony Brook NY, 11794, USA
[4]Zooniverse, Department of Physics, University of Oxford, Oxford OX1 3RH, UK


Adelie
Chinstrap
Gentoo
1Dec
1Nov
1Oct
Settlement at colony
12
14
16
18
20
Year
Colonies by latitude
(Polar to temperate)
YALO
PETE
BOOT
BRYD
NEKO
JOUG
LOCK
DAMO
DANC
CUVE
GEOR
SPIG
GAST
TETR
MIKK
PAUL
BROW
HERO
MADD
BAIL
HALF
AITC
COPA
BIGF
ORAN
PTWI
SIGN


Adelie
Chinstrap
Gentoo
Settlement at colony
1Dec
1Nov
1Oct
-6
-4
-2
0
2
4
Median spring air temperature at colony (ºC)
Colonies by latitude
(Polar to temperate)
YALO
MOOT
PETE
BOOT
BRYD
NEKO
JOUG
LOCK
DAMO
DANC
CUVE
GEOR
SPIG
GAST
TETR
MIKK
PAUL
BROW
HERO
MADD
BAIL
HALF
AITC
COPA
BIGF
ORAN
PTWI
SIGN

RESEARCH ARTICLE

Time-lapse imagery of Adélie penguins reveals differential winter strategies and breeding site occupation

Caitlin Black[1☯¤]*, Colin Southwell[2‡], Louise Emmerson[2‡], Daniel Lunn[3‡], Tom Hart[1☯]

2017-12-01 12:00:00
8°C
1/1
ULTRAFIRE XR6
RECONYX

2018-01-21 120000 10°C 1/1
ULTRAFIRE XR6
RECONYX

2018-03-09 12:00:00
11°C
1/1
ULTRAFIRE XR6
RECONYX

2018-05-11 12:00:00 0°C C 1/1
ULTRAFIRE XR6
RECONYX

2018-06-17 120000
1/1
RECONYX
ULTRAFIRE XR6

2018-07-25 12:00:00 8°C T 1/1
ULTRAFIRE XR6
RECONYX

2018-10-14 12:00:00
1/1
ULTRAFIRE XR6
RECONYX

2018-11-19 12:00:00
15°C
T 1/1
UL RAPIRE XR6
RECONYX

30.1
-8.9
FLIR

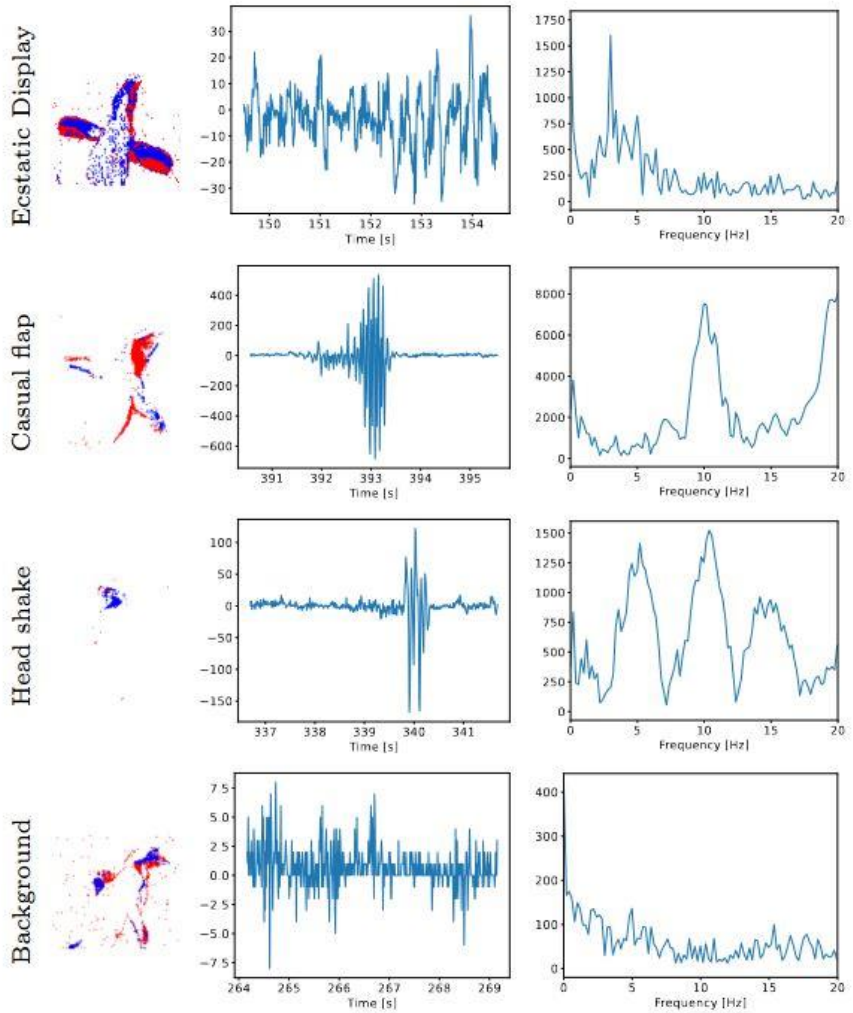
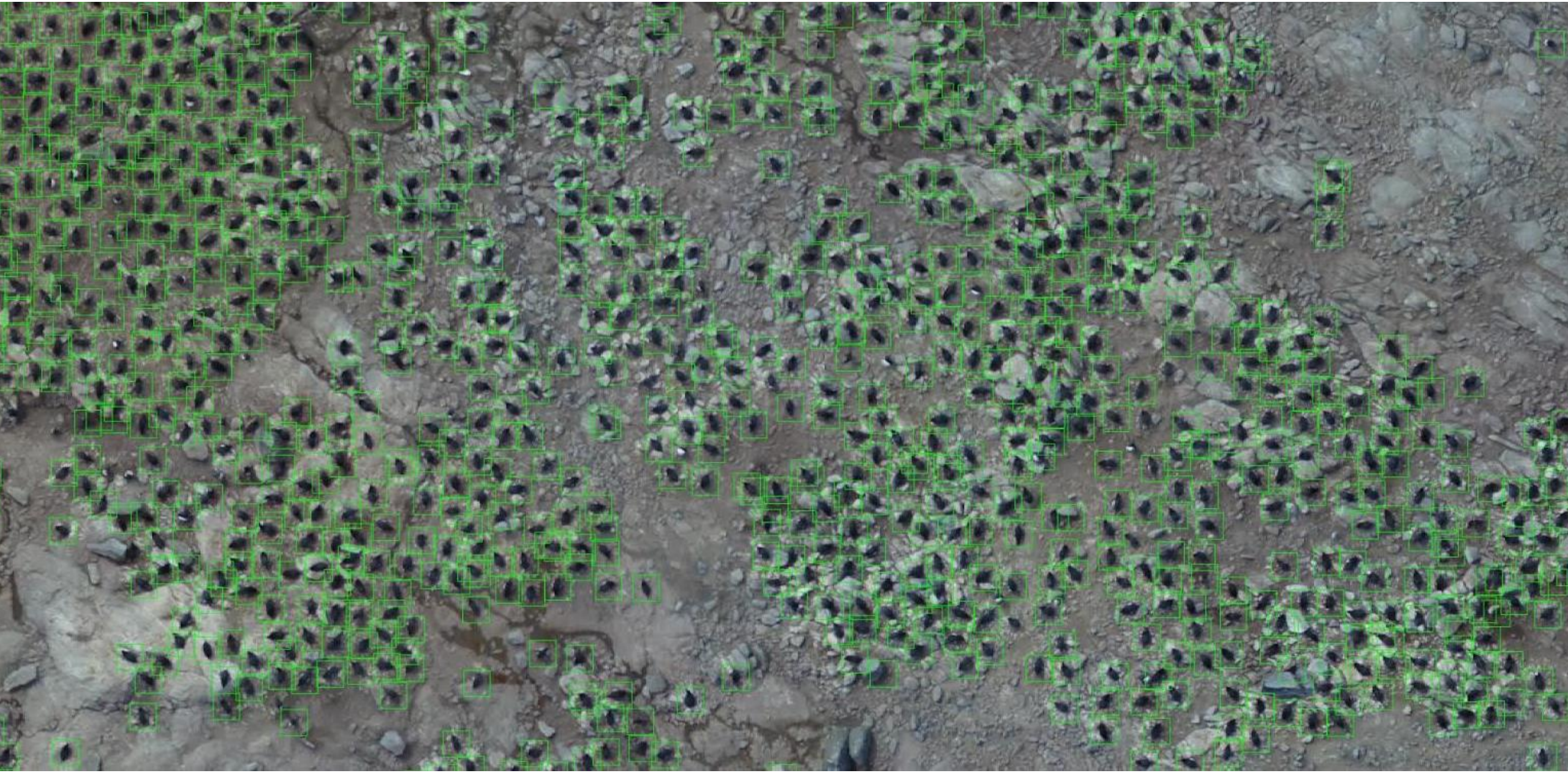
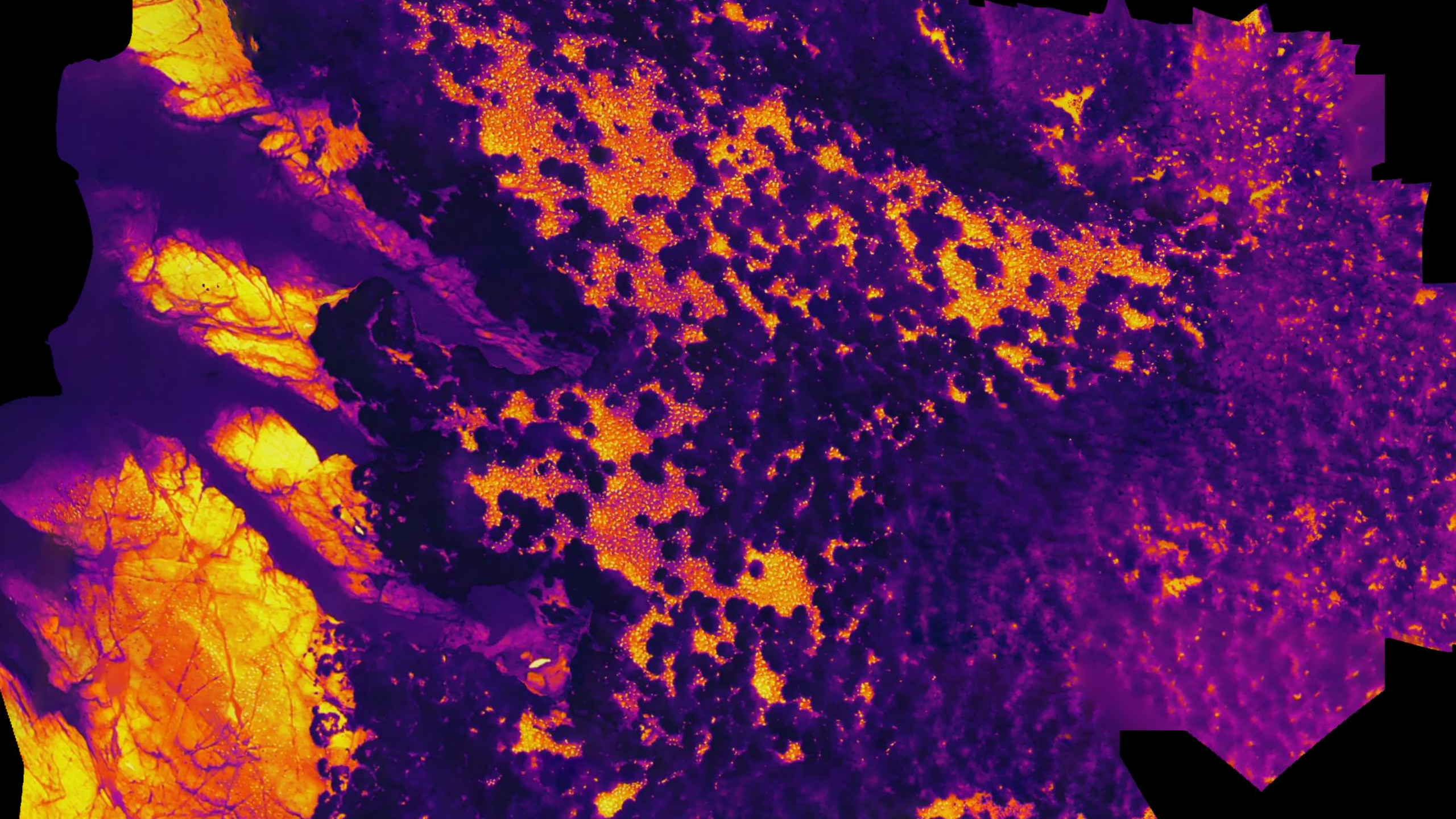
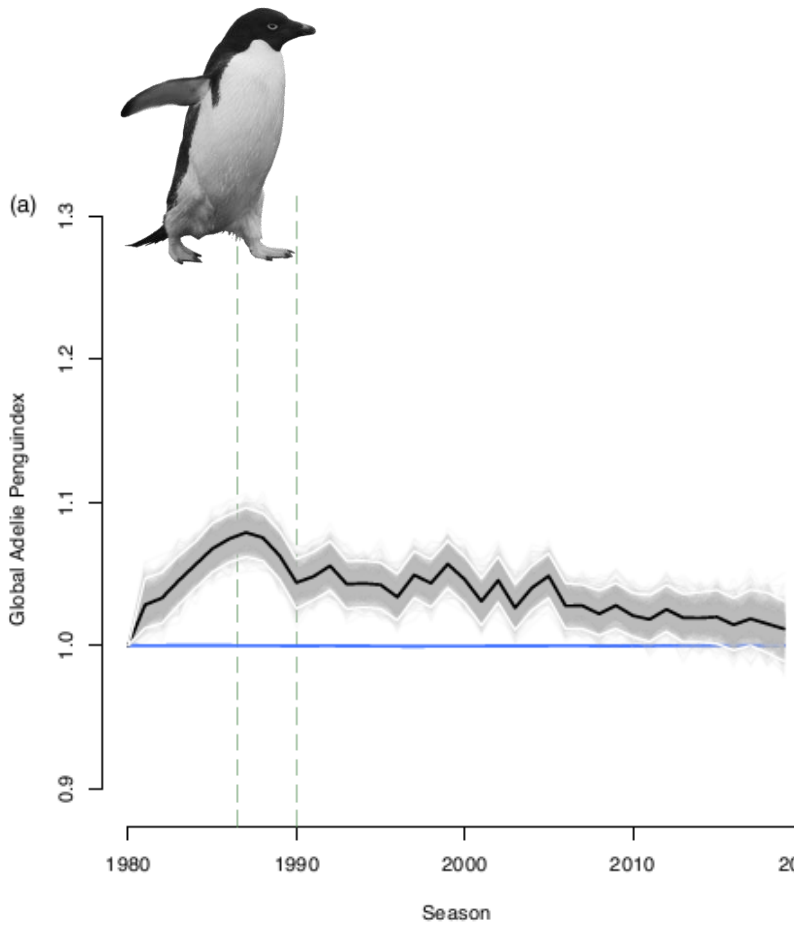
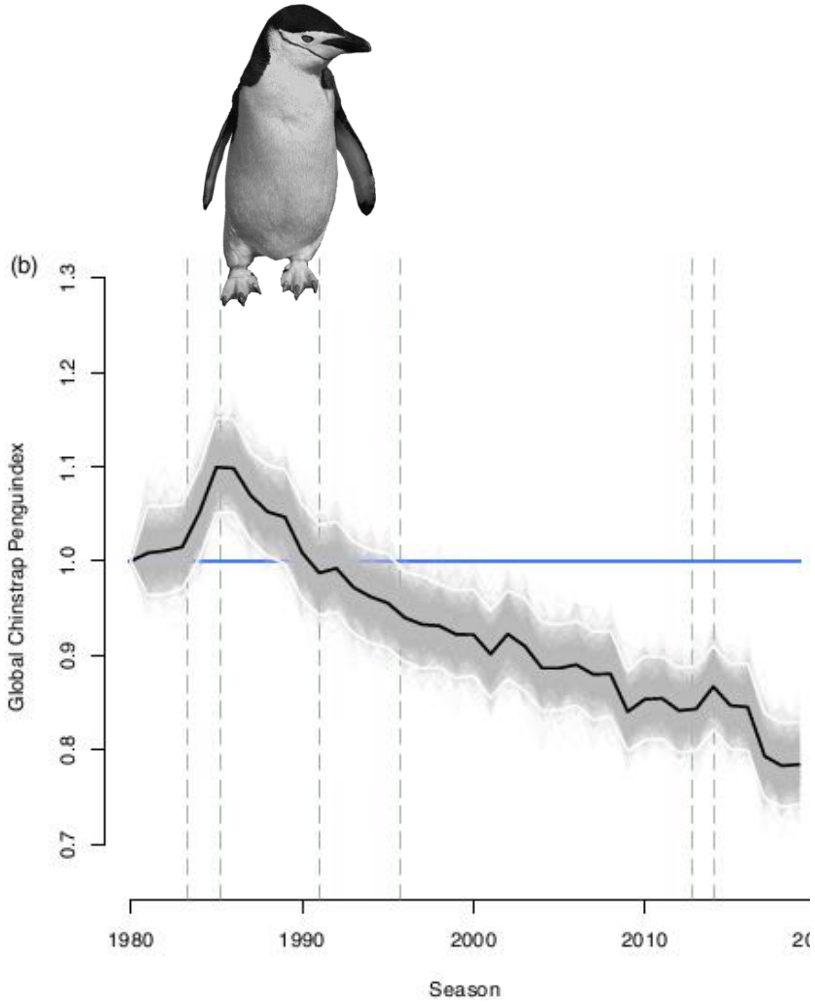


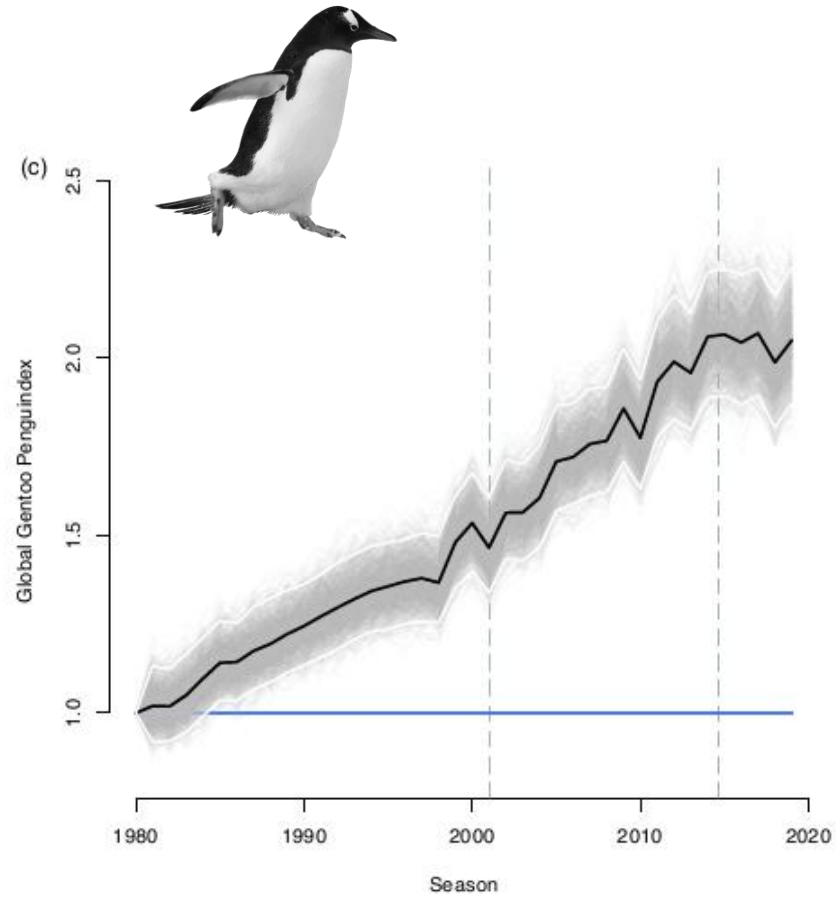
Fig. 6: Examples of different penguin behaviors (rows) and different representations of the signal (columns). Note the large differences in vertical range of the plots across rows, specially in the spectrum plots.





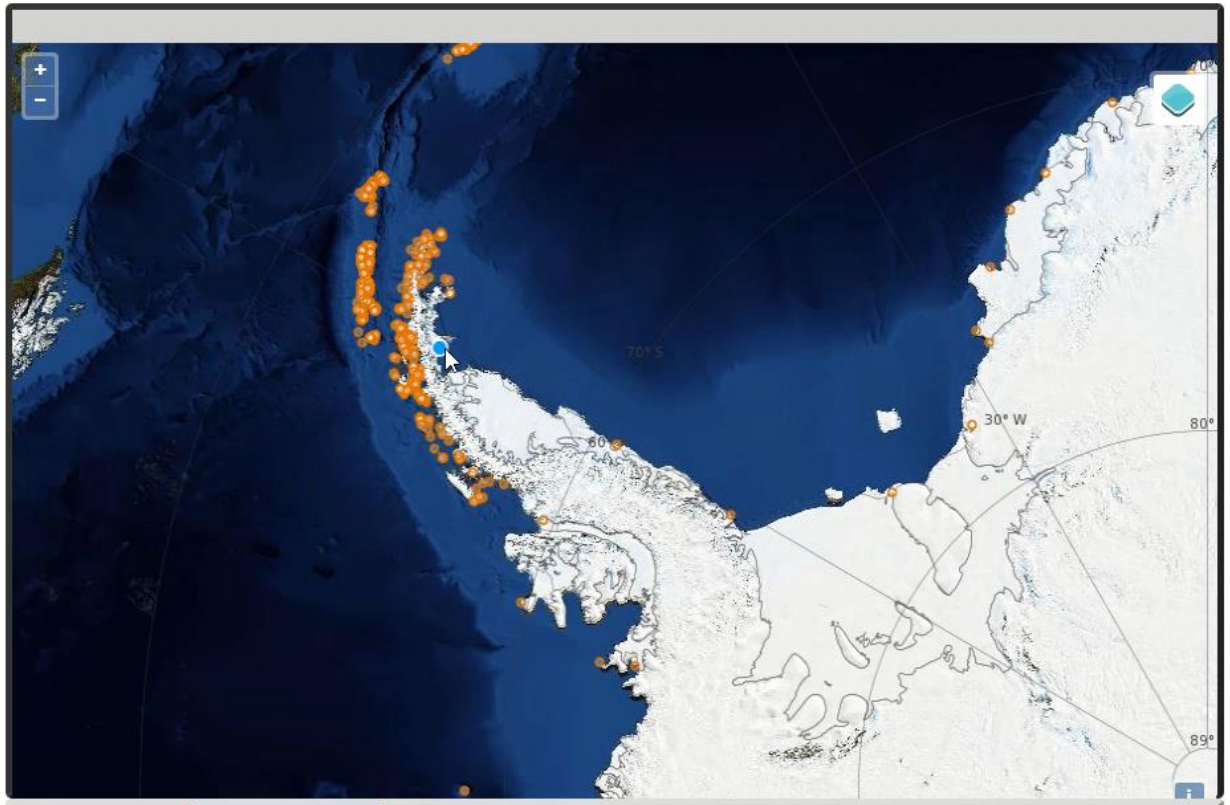

(a)
Global Adelie Penguindex
0.9
1.0
1.1
1.2
1.3
1980
1990
2000
2010
Season


(b)
Global Chinstrap Penguindex
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1980
1990
2000
2010
Season


(c)
Global Gentoo Penguindex
1.0
1.5
2.0
2.5
1980
1990
2000
2010
2020
Season

Mapping Application for Penguin Populations and Projected Dynamics

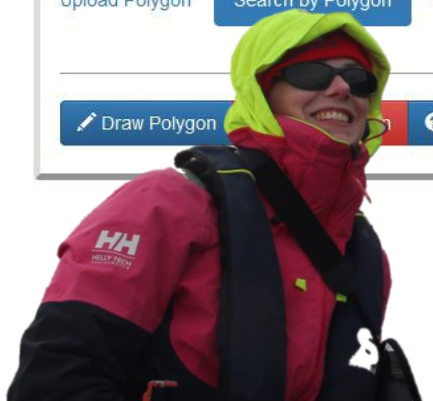
Home | Data portal | Dashboard | About Us | Species | Publications | Contribute | News



Upload Polygon | Search by Polygon | Search by Site | Search by CCAMLR region | Search by Species

Draw Polygon | Tool Help

Please clear the polygon before selecting other sites...



Results

Welcome to MAPPPD, Version 3.0

Last updated: April 2, 2019

For best performance, use Google Chrome

The MAPPPD project aims to deliver **open access** penguin population data for the Antarctic continent, and occupancy probabilities for flying birds around the Antarctic Peninsula.

Check out our **White Paper** describing the MAPPPD application.

Our database currently contains 3743 records of colony counts from 117 sources and 662 sites around the Antarctic.

Download the full site list

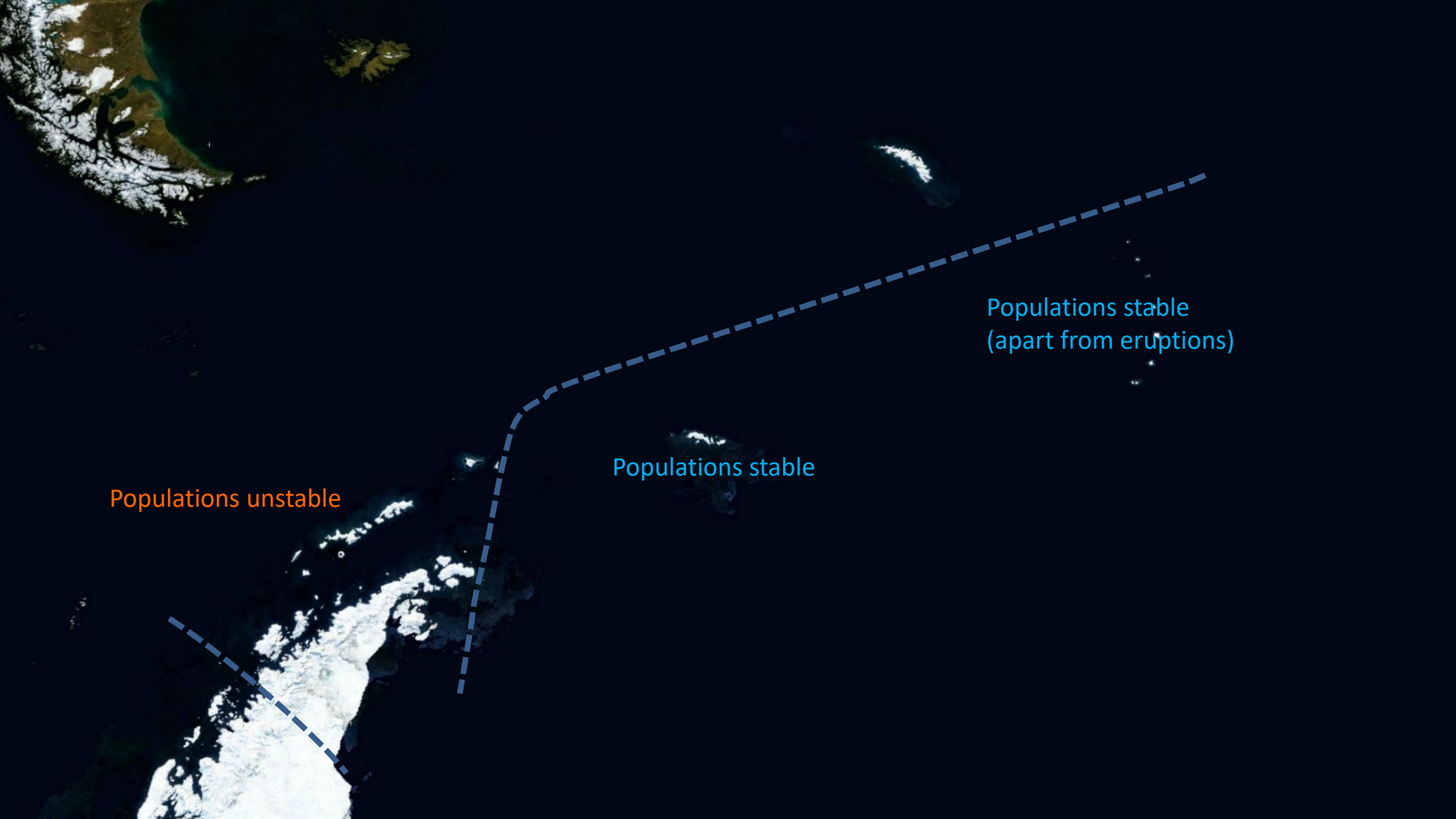
MAPPPD contains counts for these species:

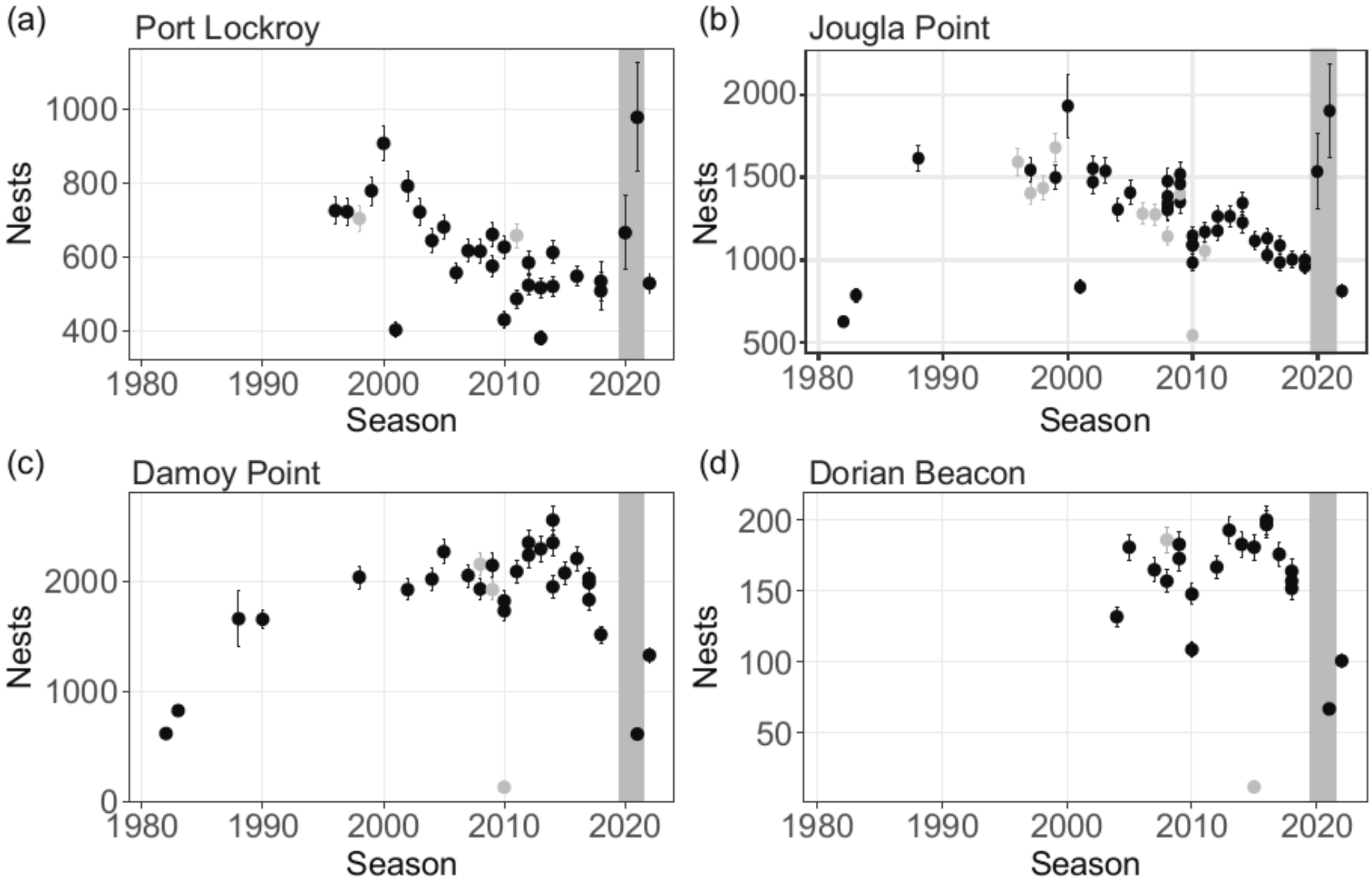
Adélie	1434
Chinstrap	957
Gentoo	1112
Emperor	240

MAPPPD metadata can be viewed ON OUR METADATA PAGE

Explore the data by clicking on one of the search tools below the map to begin.

By accessing MAPPPD you agree to the Terms of Use


Populations stable
(apart from eruptions)
Populations stable
Populations unstable


(a)
Port Lockroy
Nests
1000
800
600
400
1980
1990
2000
2010
2020
Season
(b)
Jougla Point
Nests
2000
1500
1000
500
1980
1990
2000
2010
2020
Season
(c)
Damoy Point
Nests
2000
1000
0
1980
1990
2000
2010
2020
Season
(d)
Dorian Beacon
Nests
200
150
100
50
1980
1990
2000
2010
2020
Season

Take homes

- Still more scope for time lapse monitoring of seabirds, seals.
- Replication is good, but we need reference sites (eg South Coast).
- MAPPPD is adding phenology
- We need a combined platform for imagery, especially aerial survey
- We probably need combined survey effort for penguins, flying seabirds and seals.

PENGUIN WATCH
OXFORD BROOKES UNIVERSITY
UNIVERSITY OF OXFORD
ZOONIVERSE
Stony Brook University
LSU
LOUISIANA STATE UNIVERSITY
Quark Expeditions
CHEESEMANS' ECOLOGY SAFARIS
John Ellerman Foundation
save our seas foundation
oceanites
THE UNIVERSITY OF WESTERN AUSTRALIA
THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH
CONICET
CADIC
WCS
Federation University
ZSL | LET'S WORK FOR WILDLIFE
DARWIN INITIATIVE
the tawaki project
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
FALKLANDS CONSERVATION
WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930
CO-EXIST PROJECTS
#HELPSAVEOURSEAS
WWF
HELLY HANSEN
POSEIDON EXPEDITIONS
Golden Fleece Expedition Cruises
Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Nathan Fenney

British Antarctic Survey

ESA

Sue G

Rod Strachan

Initiating Monitoring Support for the SGSSI-MPA Research and Monitoring Plan

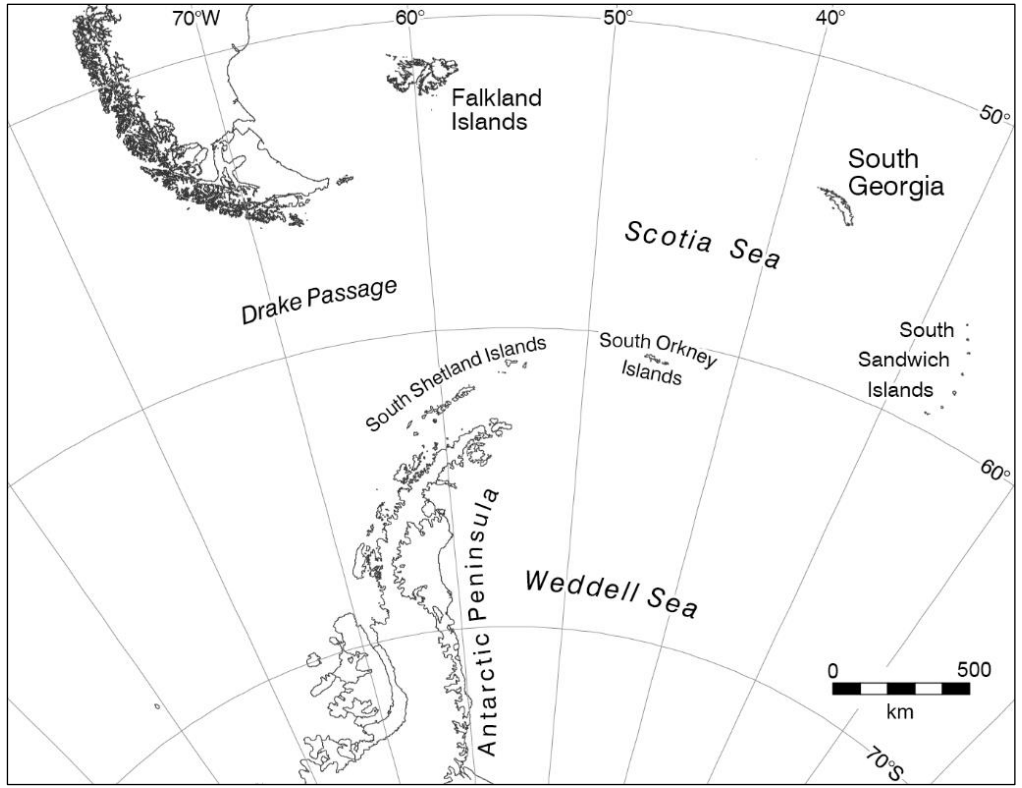
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

DARWIN PLUS

POLAR SCIENCE FOR PLANET EARTH

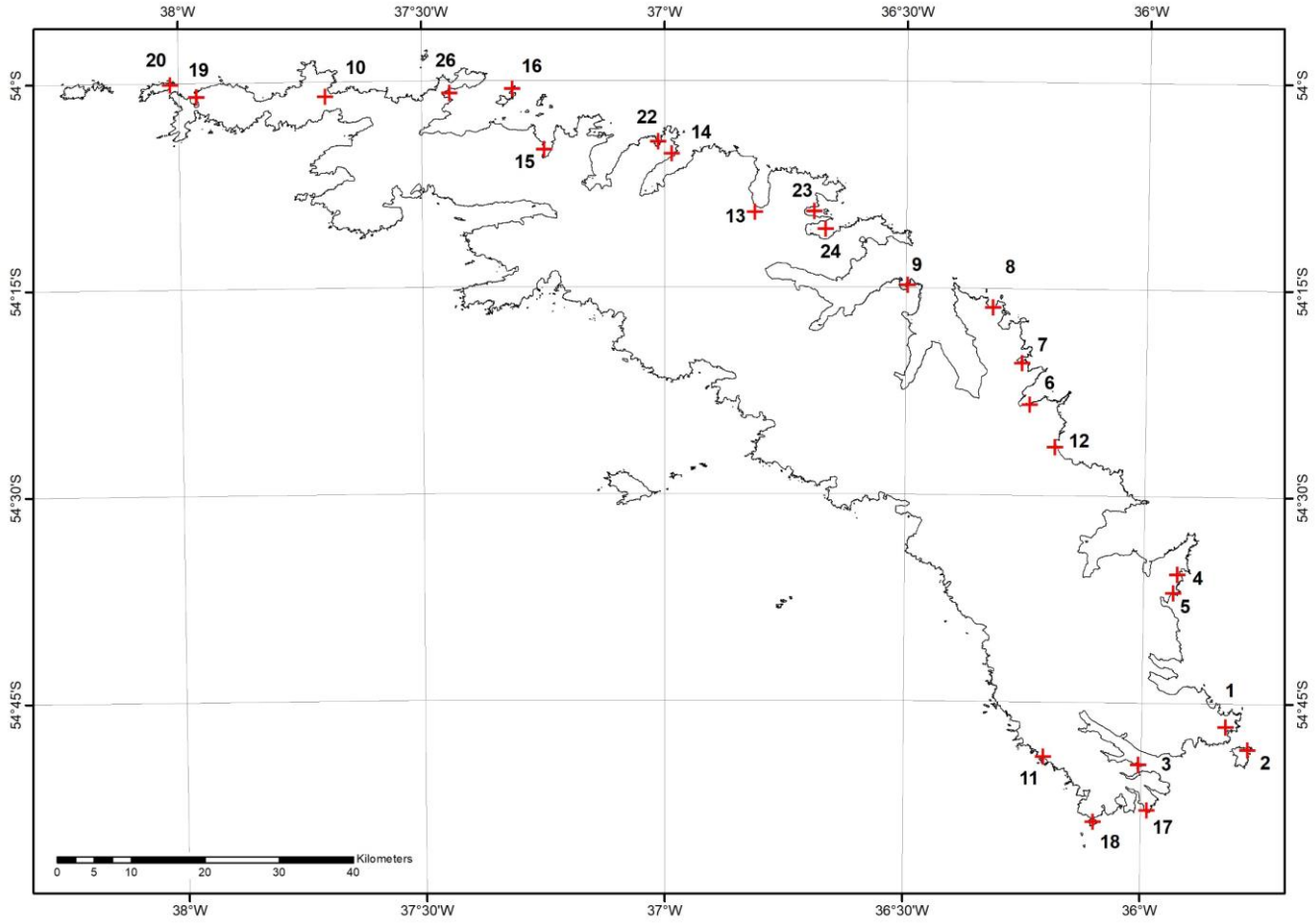
Initiating Monitoring Support for the SGSSI-MPA Research and Monitoring Plan

- South Georgia's environment is currently in a state of flux with the impacts of the krill fishery, rat / deer eradication and wider climate change not fully understood.
- Leverage remotely piloted aircraft systems (RPAS) to undertake a baseline reference survey of key indicator species around South Georgia.
- Develop a methodology by which this can be undertaken on a regular basis in the future.
- Data collected to be submitted into CCAMLR and to help inform GSGSSI's conservation of South Georgia.
- Phil Trathan, Phil Hollyman, Martin Collins, Adrian Fox, Jamie Coleman and Nathan Fenney.



Initiating Monitoring Support for the SGSSI-MPA Research and Monitoring Plan

- 26 target sites across three periods (December 2021, January 2022 and October 2022).
- Target species:
  - Elephant seals
  - Fur seals
  - Wandering albatross
  - King penguins
  - Gentoo penguins
  - Macaroni penguins
  - Chinstrap penguins
- Fixed-wing SenseFly eBee X RPAS platform.

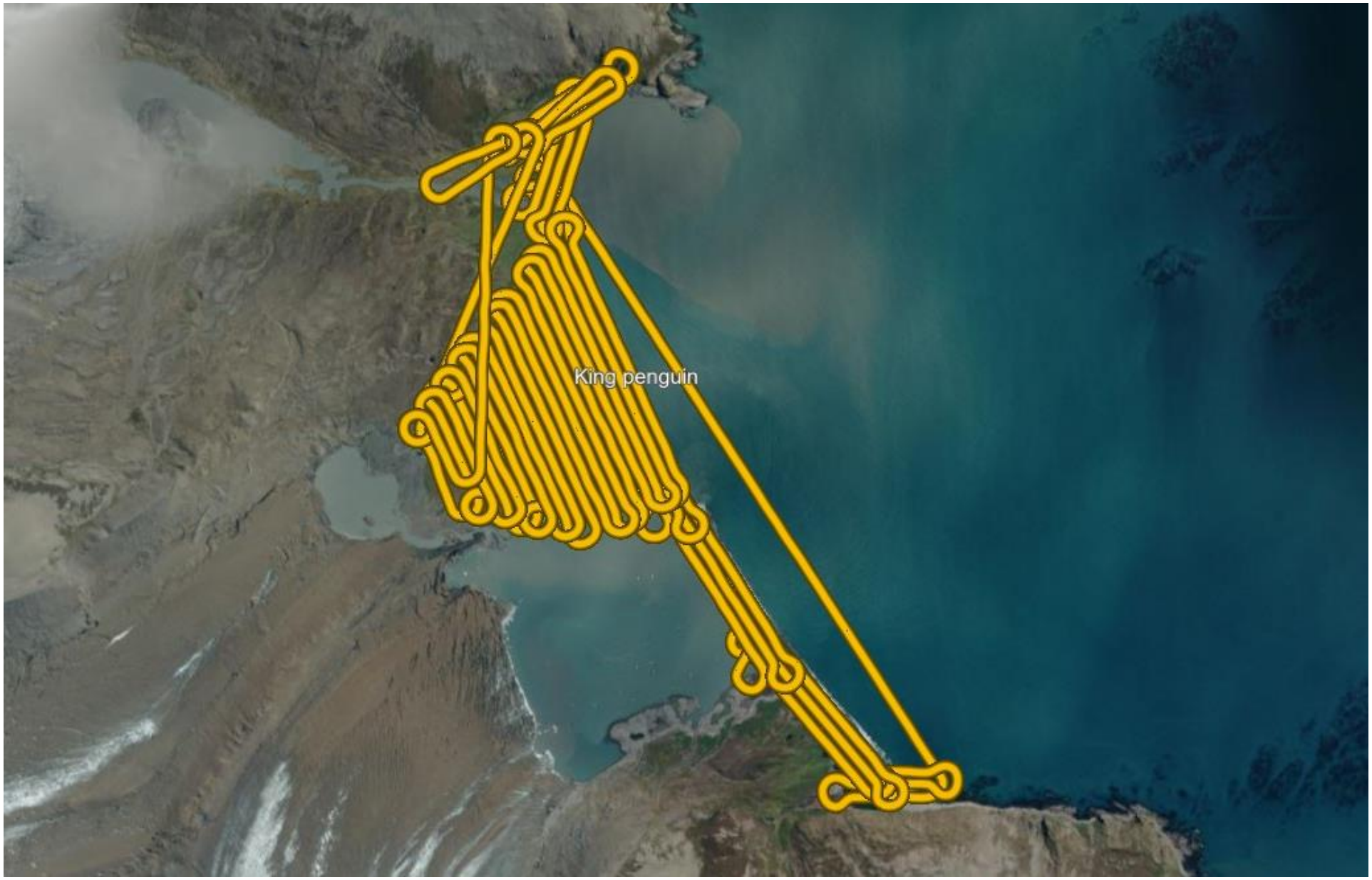


Target field sites for Darwin Plus 109 project.

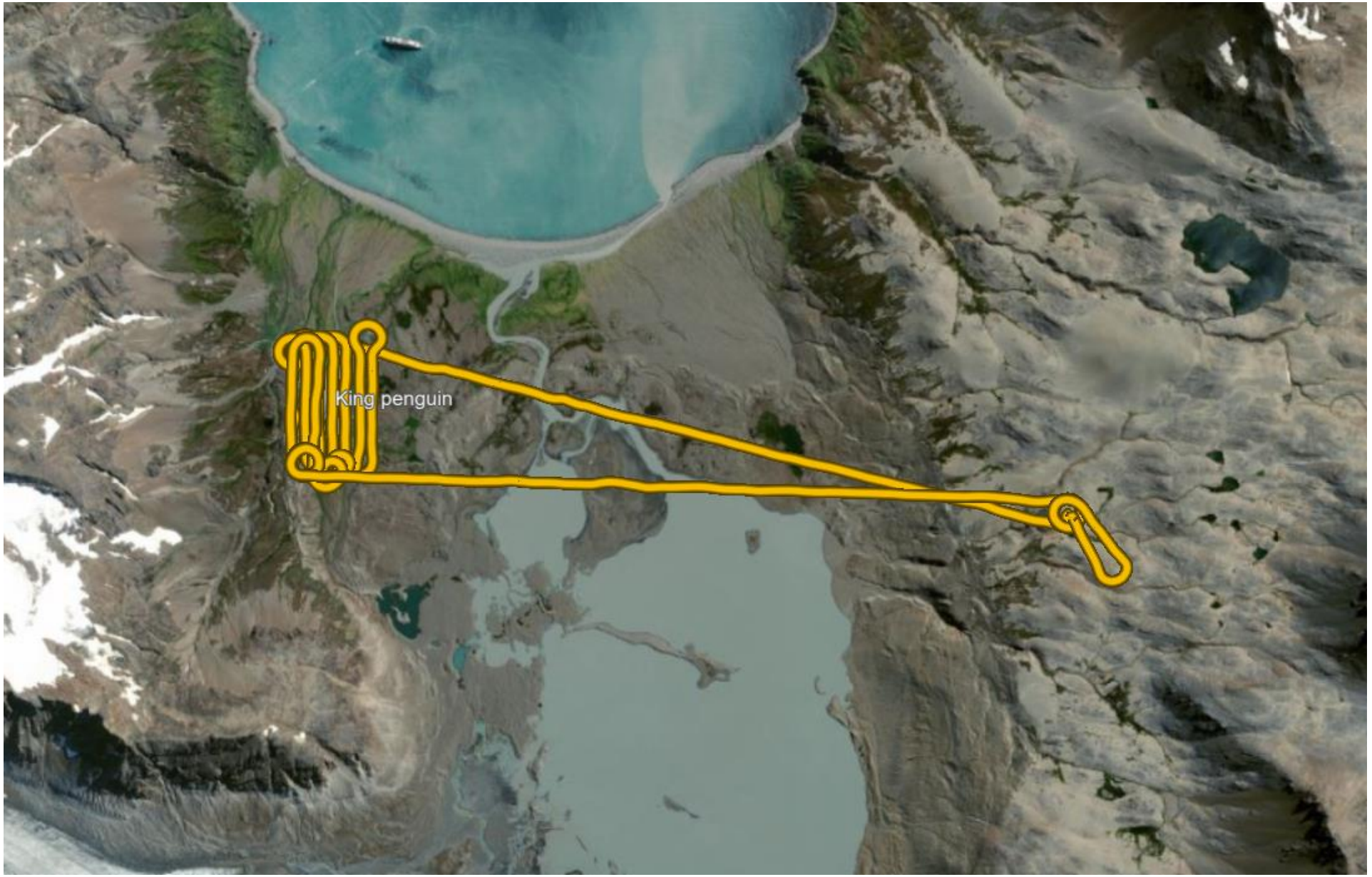
SenseFly eBee X system, Hound Bay / Photo: Jamie Coleman

Hestersletten test flights / Photo: Jamie Coleman

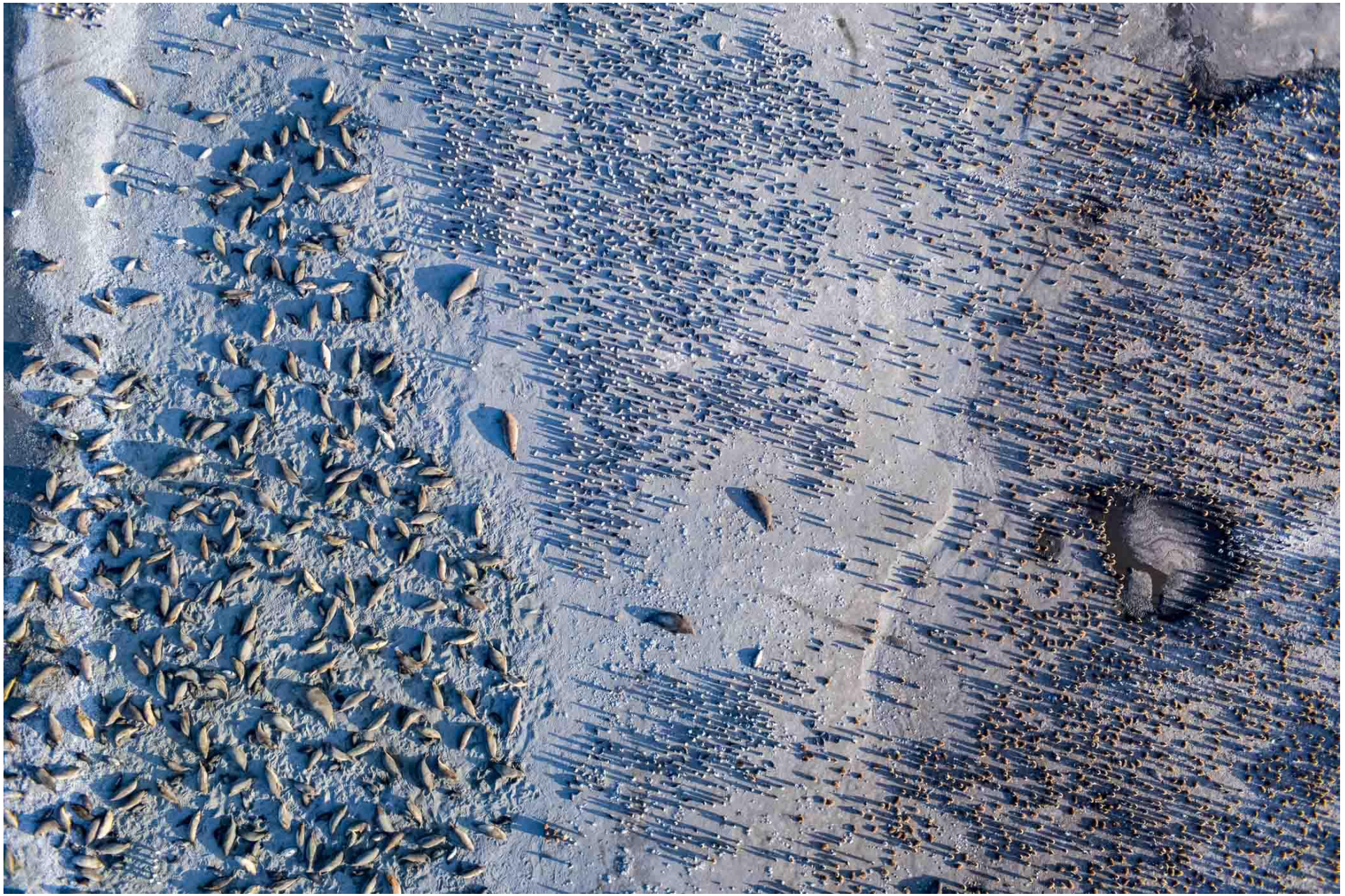
SenseFly eMotion / Imagery: Microsoft



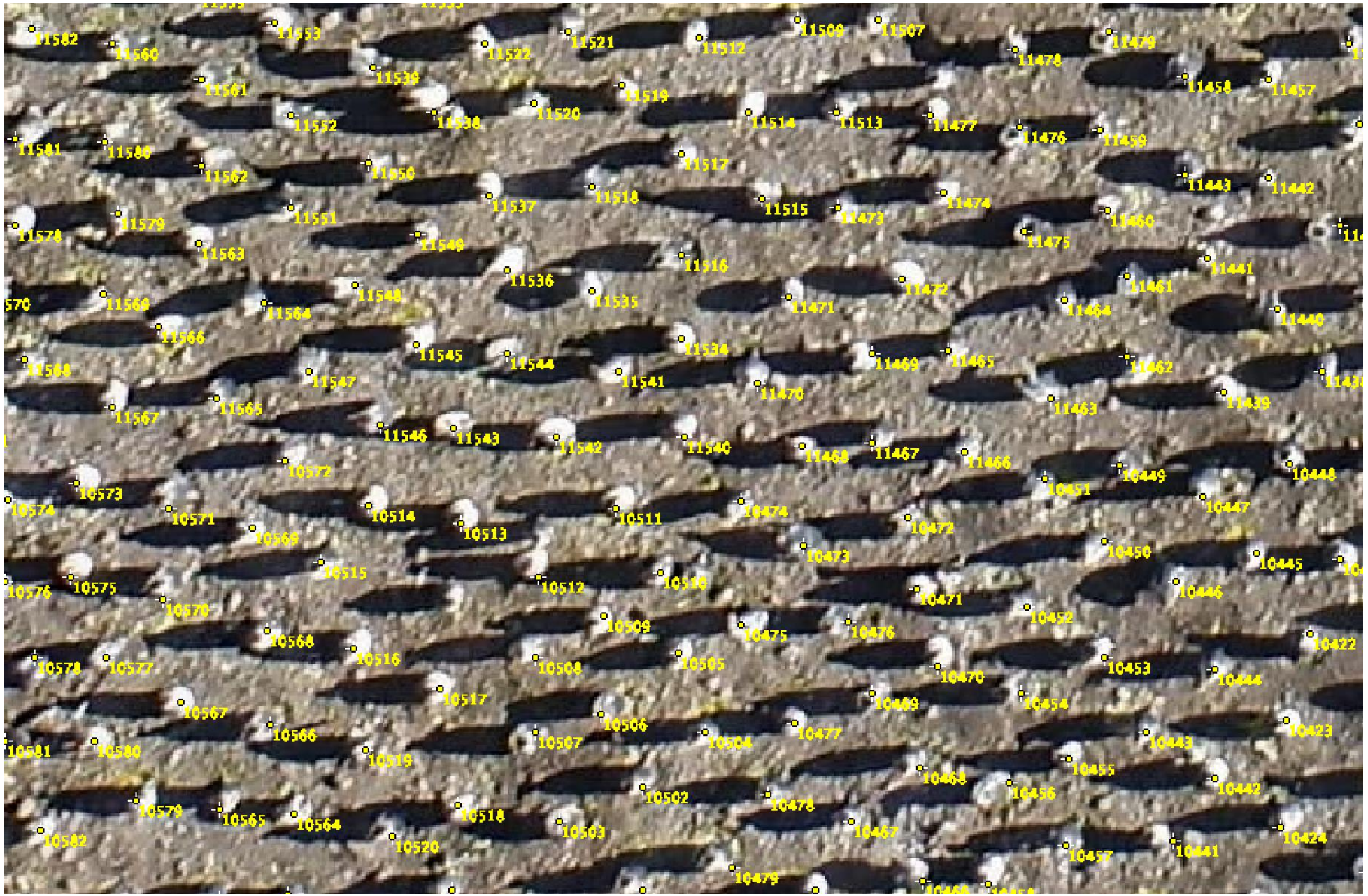
SenseFly eBee X flight path, St Andrews Bay, SenseFly eMotion / Imagery: Microsoft



SenseFly eBee X flight path, Fortuna Bay, SenseFly eMotion / Imagery: Microsoft



RGB image, Elephant seals and king penguins, St Andrews Bay



King penguins, Sea Leopard Fjord

Thanks to KEP, GSGSSI and the Pharos SG! Any Questions?

SenseFly eBee X over Grytviken / Photo: Jamie Coleman

Stephanie Martin

British Antarctic Survey

Baleen whale recovery and habitat use in South Georgia waters

Jen Jackson & Stephanie Martin

DARWIN INITIATIVE

BEST VOLUNTARY SCHEME FOR BIODIVERSITY AND ECOSYSTEM SERVICES IN TERRITORIES OF EUROPEAN OVERSEAS

friends of South Georgia ISLAND SGHT

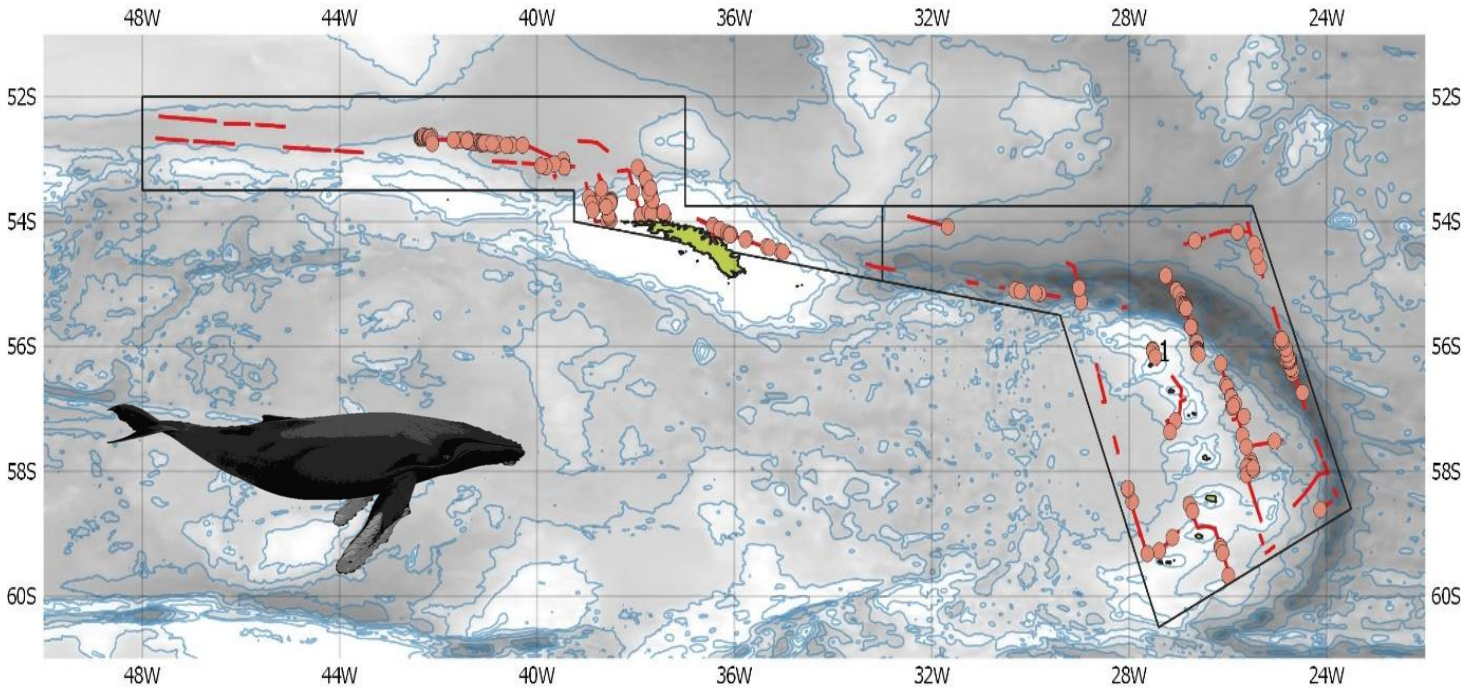
DO IT FOR YOUR PLANET

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Image: John Dickens

Humpback whales nearly recovered from whaling in Scotia Arc



Humpback whale abundance: >24,000 whales

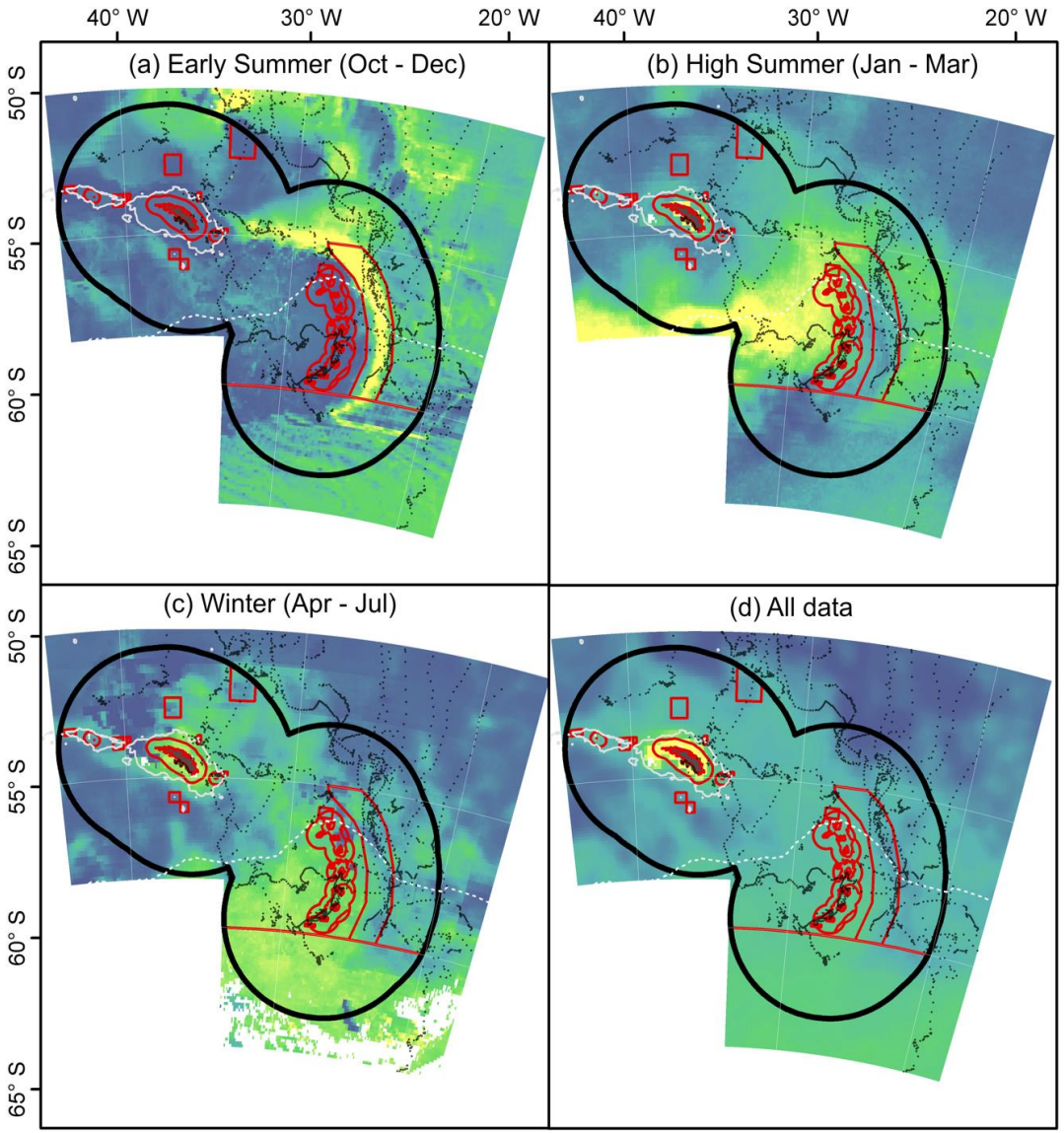
Very close to pre-whaling abundance estimates

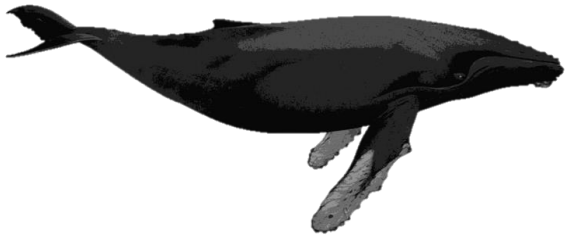
Full recovery from exploitation?

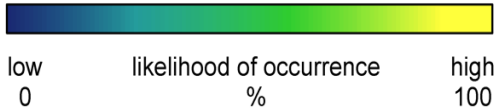
Region	Humpback abundance	95% Confidence Interval	Baleen whale abundance	95% Confidence Interval
South Georgia	**12,103**	7,145 - 20,499	**30,905**	22,361 – 42,713
South Georgia + South Sandwich Islands	**23,759**	13,010 – 43,663	**43,824**	33,509 – 59,077
Scotia Arc	**24,543**	14,863 – 40,528		

Baines et al. 2021 *Marine Ecology Progress Series* 676: 77-94 https://doi.org/10.3354/meps13849

Identifying Scotia Arc humpback whale hotspots by tracking whales



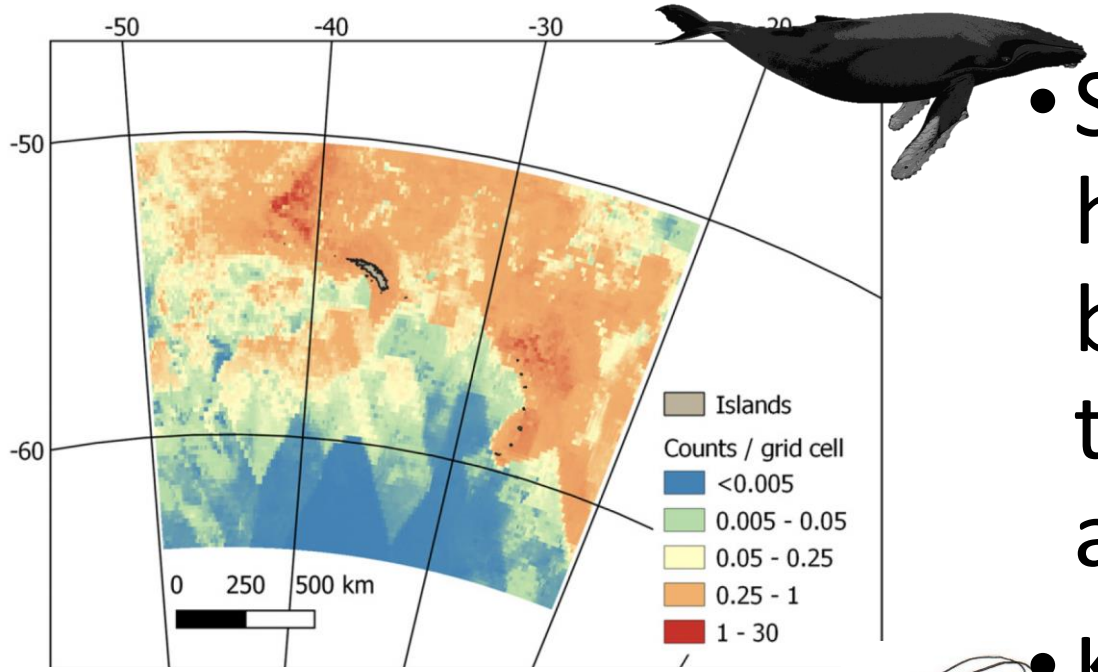


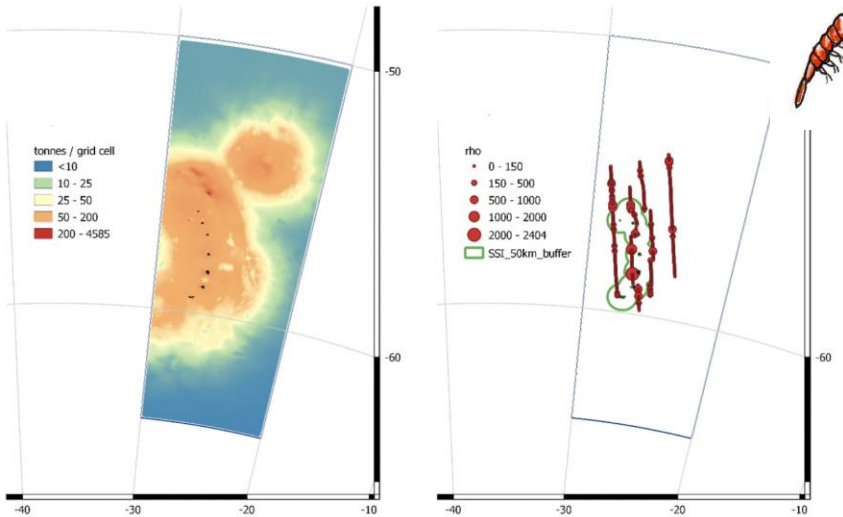


- 16 whales tracked
- Satellite tracks and observations indicate a predominantly coastal distribution at South Georgia and the South Sandwich Isl
- Whale movements broadly towards South Georgia in summer, then easterly during autumn

Bamford et al. (2022) DSR II 198:105074

Habitat and prey preferences of Scotia Arc humpbacks





- Strongest predictive model of humpback density combines krill biomass with sea surface temperature, shelf break distance and current velocity at 1° grid scale
- Krill densities of **>150gm^{-2}** positively correlated with humpback density
- Total estimated annual krill consumption by baleen whales in SG & SSI = **4.8-7.2 million tonnes**

Baines et al. (2022) *DSR I* 189: 103867 https://doi.org/10.1016/j.dsr.2022.103867

Historical catches: SRW use multiple feeding areas

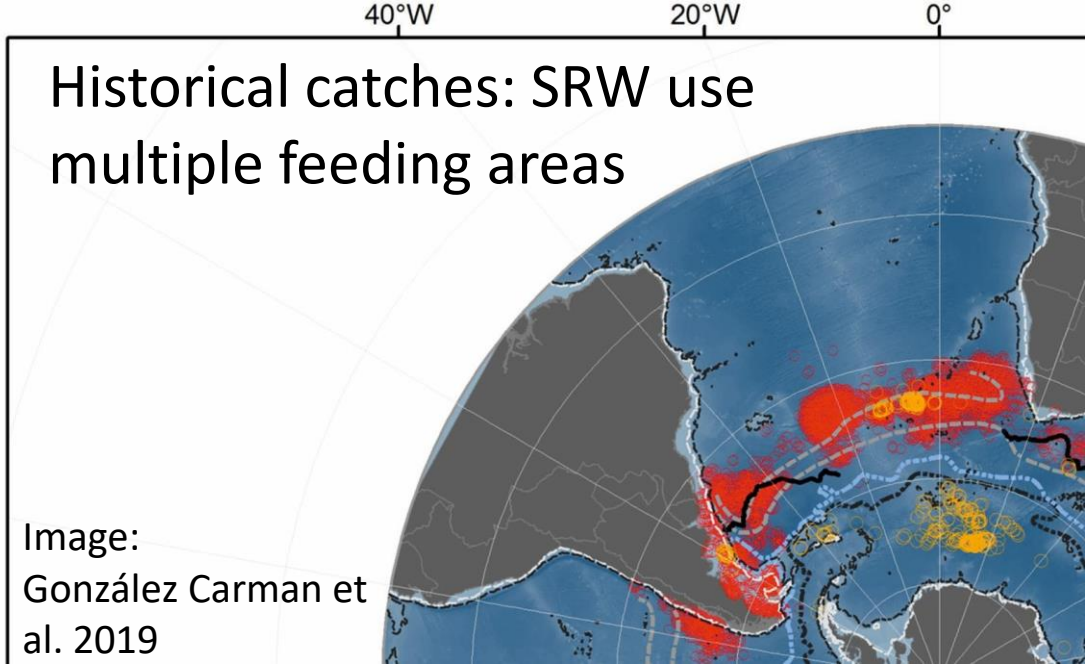
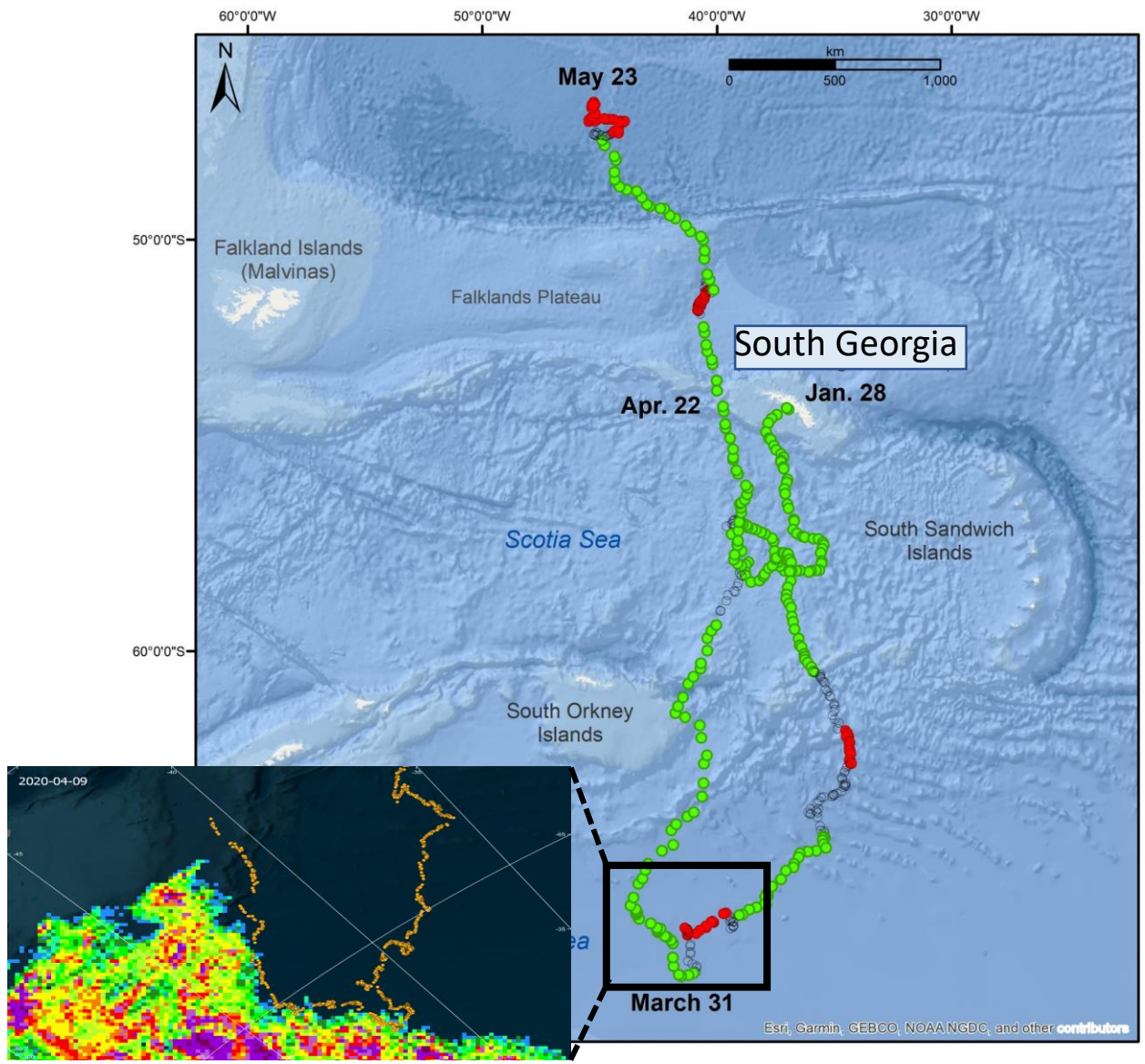


Image:
González Carman et al. 2019

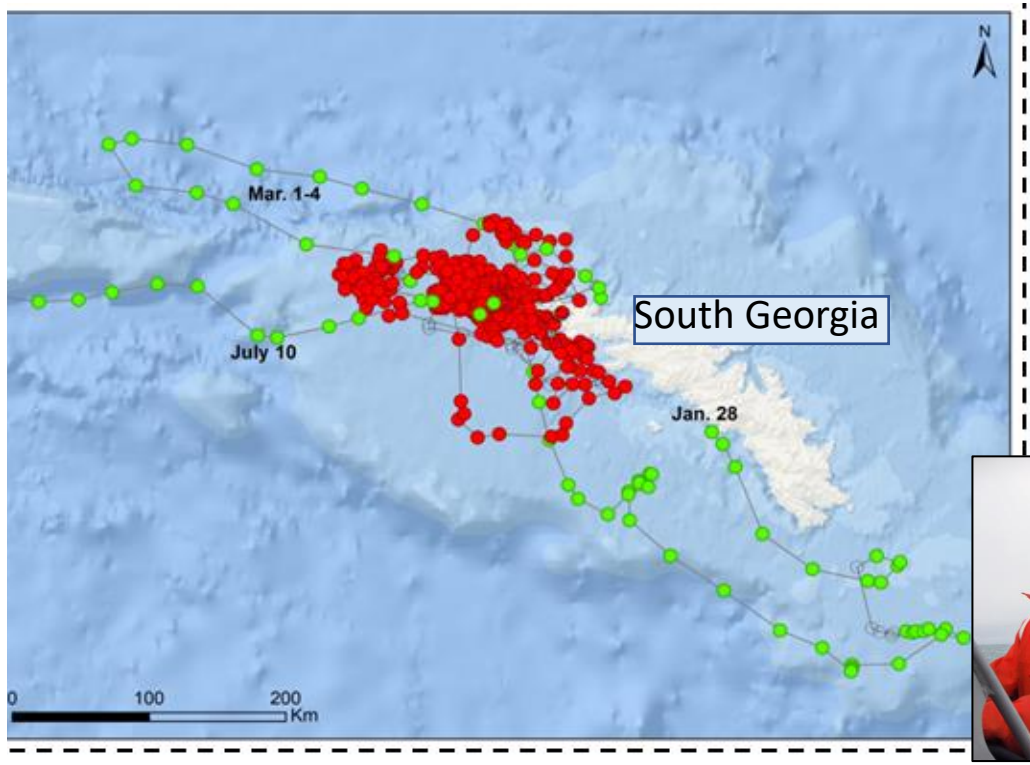
Occurrence at South Georgia varies between years

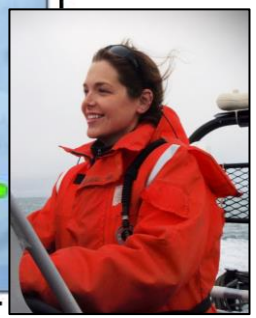
Where do southern right whales feed?



Sea ice edge

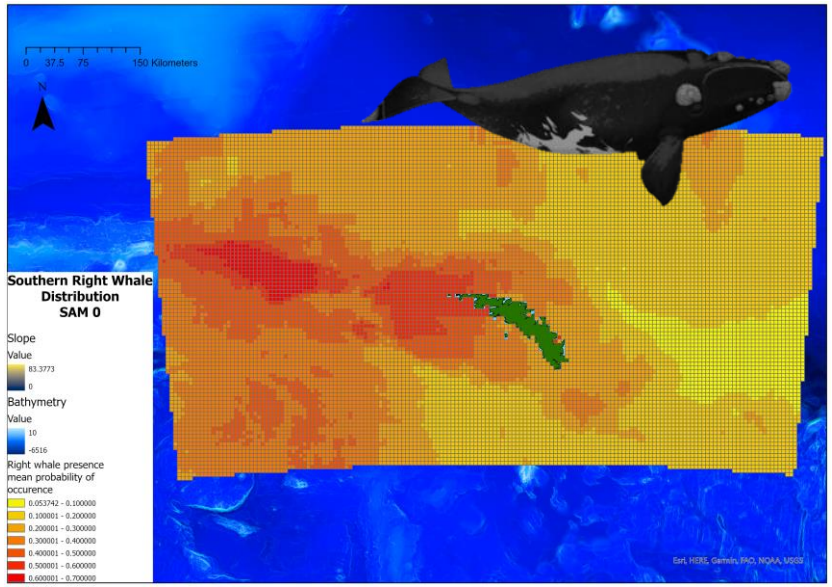
- South Georgia temporary feeding area within broader feeding range for some individuals
- Other individuals may feed locally for many months, including winter

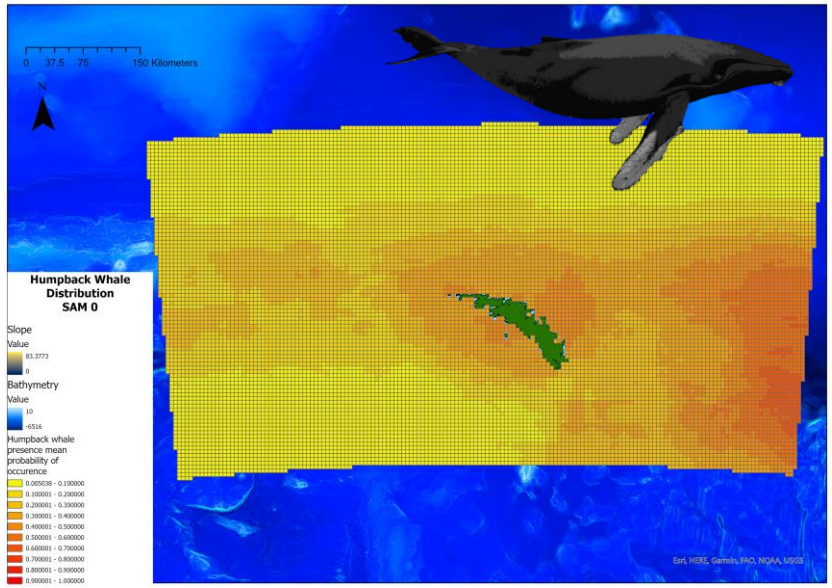




Kennedy et al. (in review) *Marine Mammal Science*

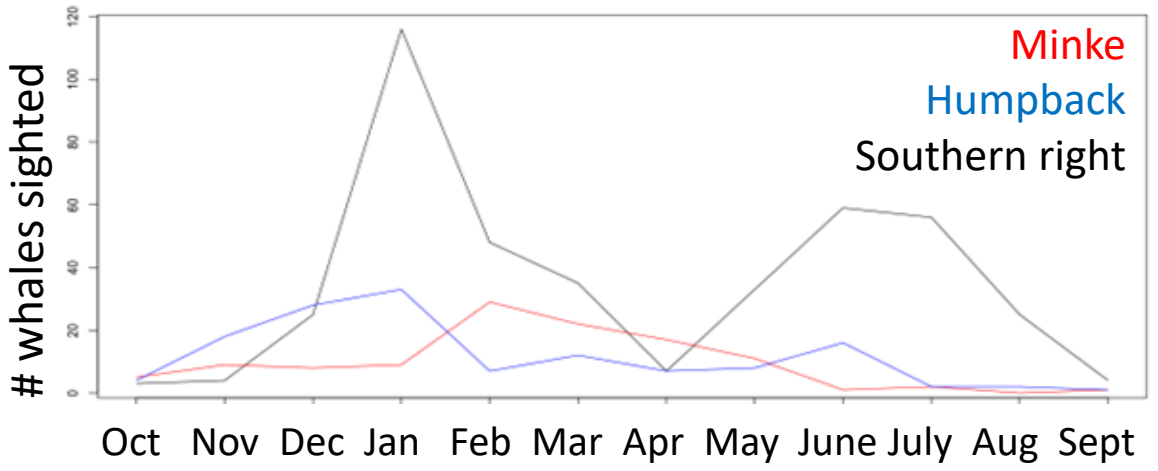
Habitat preferences of right whales





Whale density predictions at SAM0

- Southern right whale observations and satellite tracking suggest right whales regularly feed west of South Georgia
- Opportunistic Bird Island observations agree
- Linking sighting reports to the Southern Annular Mode suggests contrasting right and humpback distributions at South Georgia



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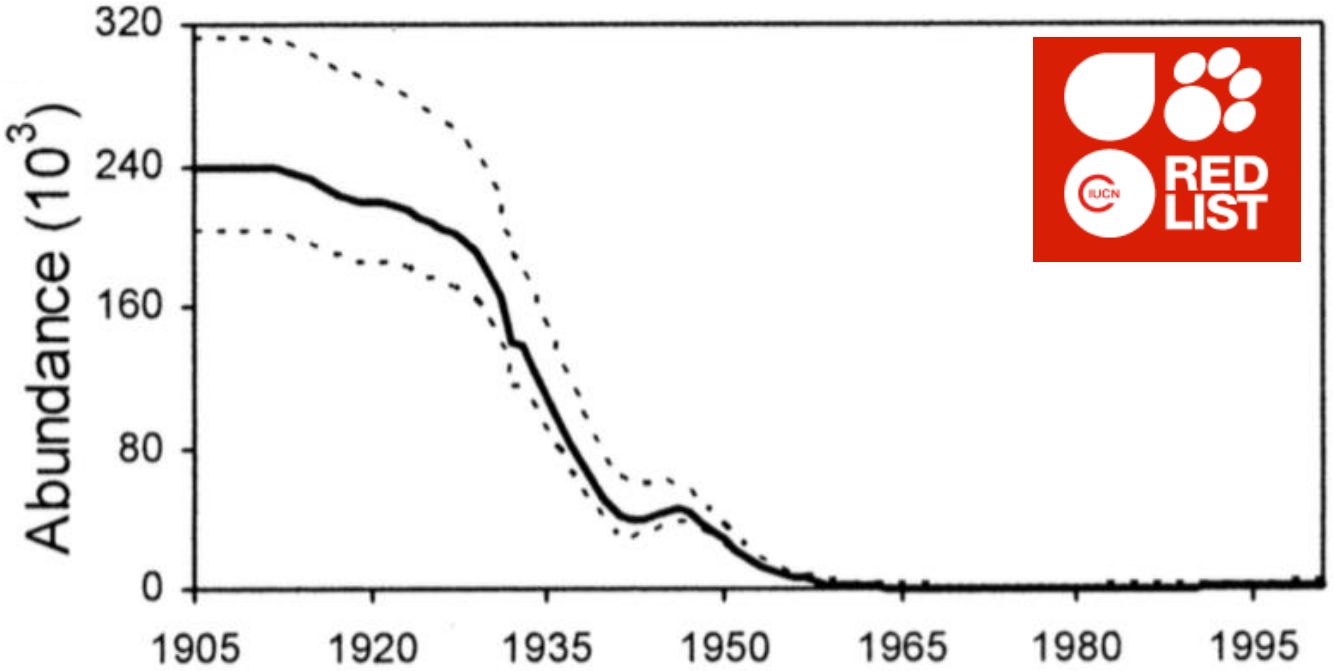
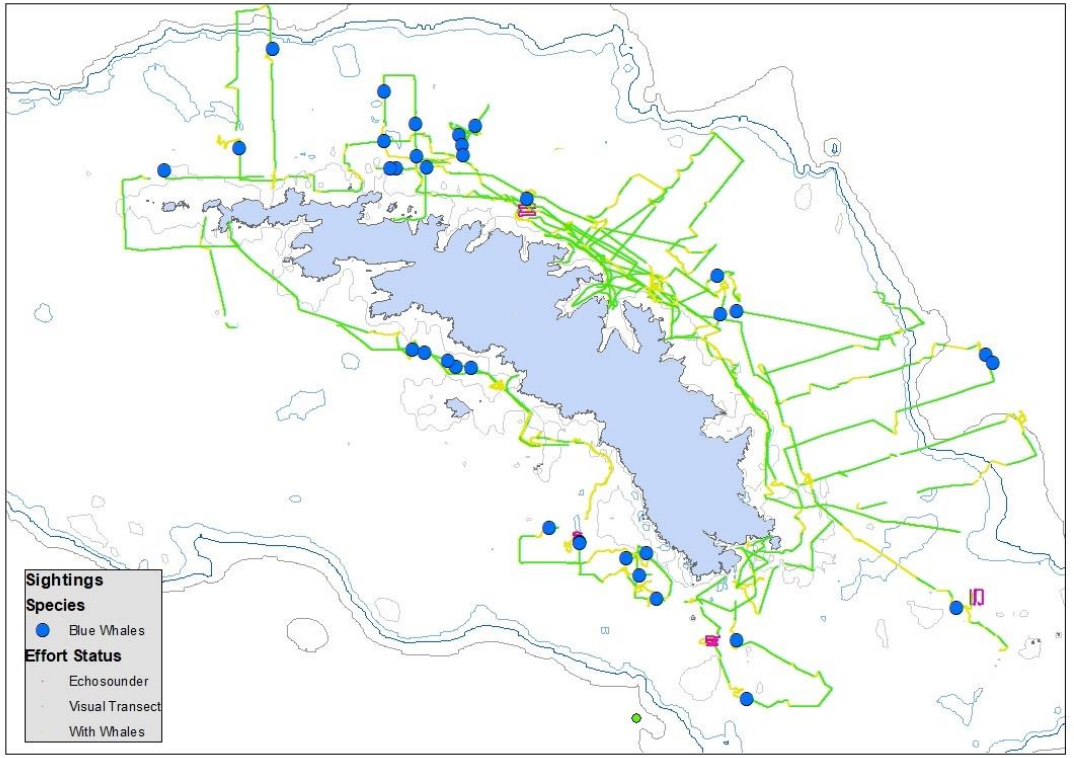
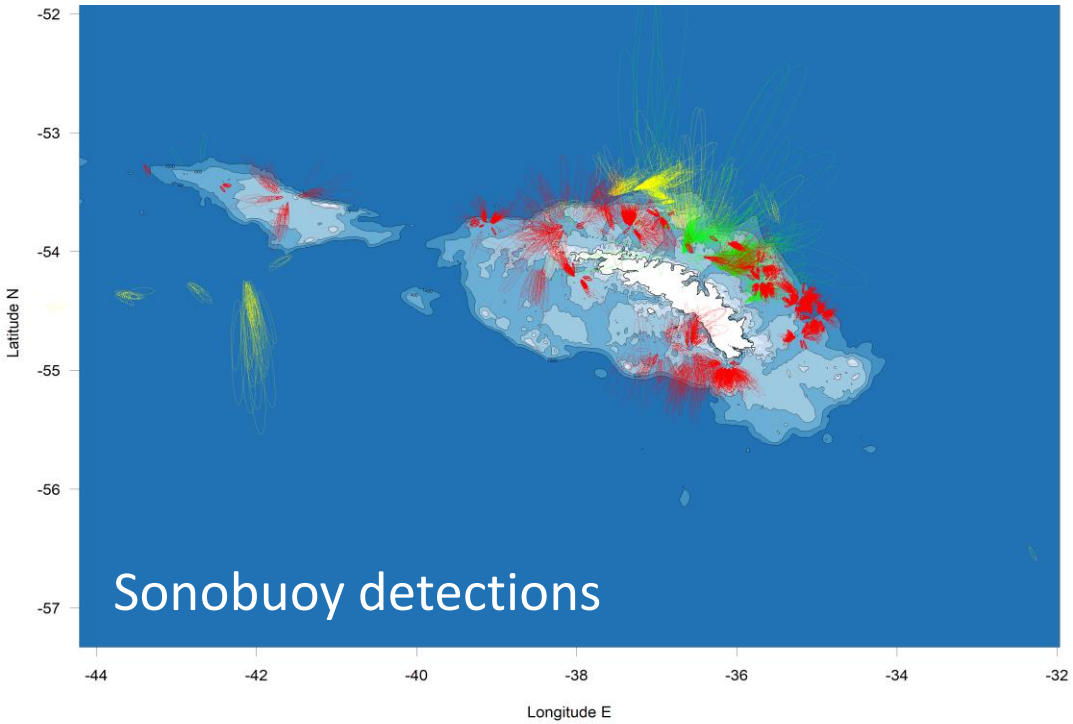
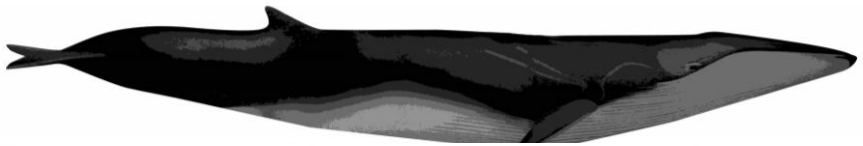


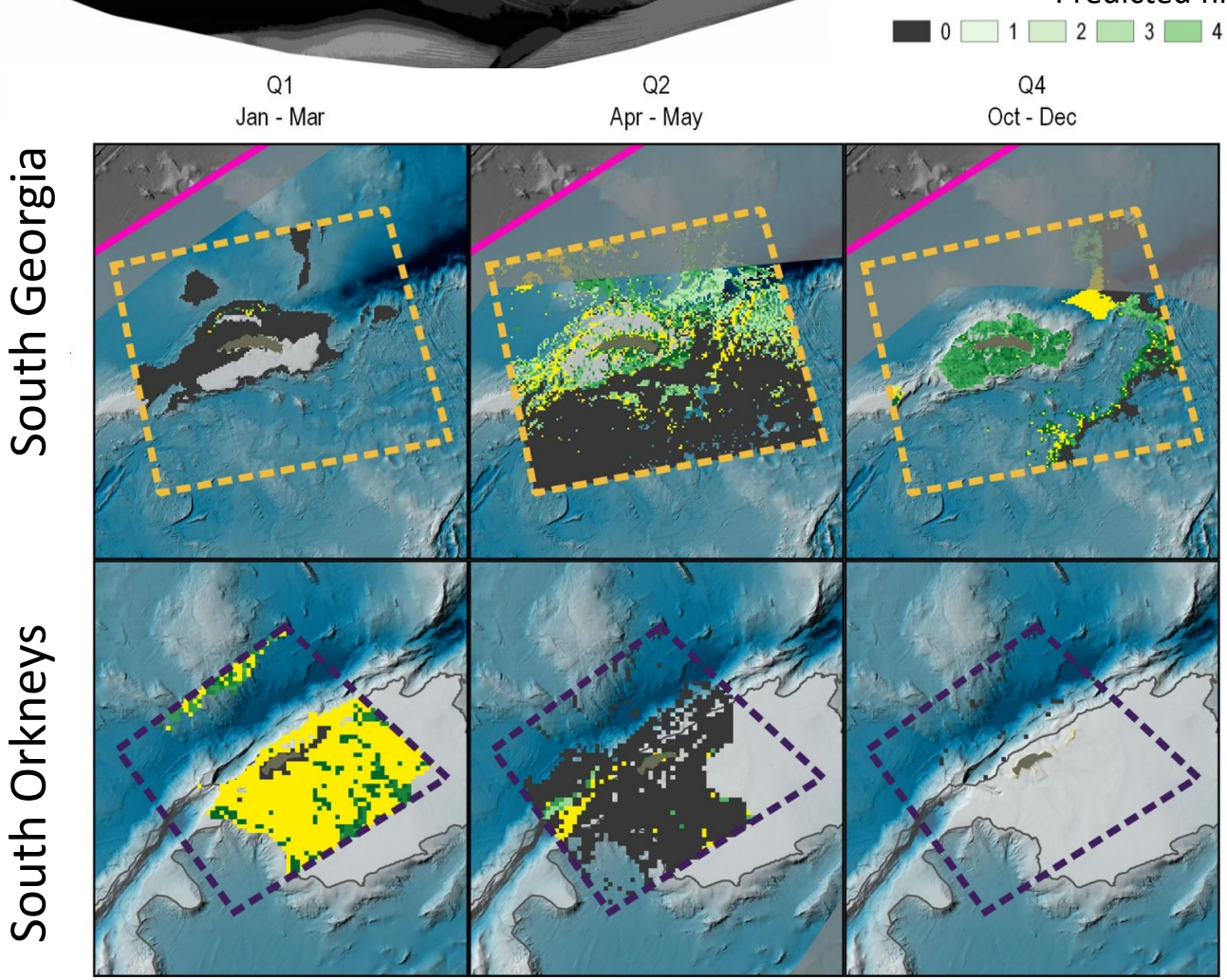




Calderan et al. (2020) *Endangered Species Research*
https://doi.org/10.3354/esr01077

Fin whale distribution in the Scotia Arc



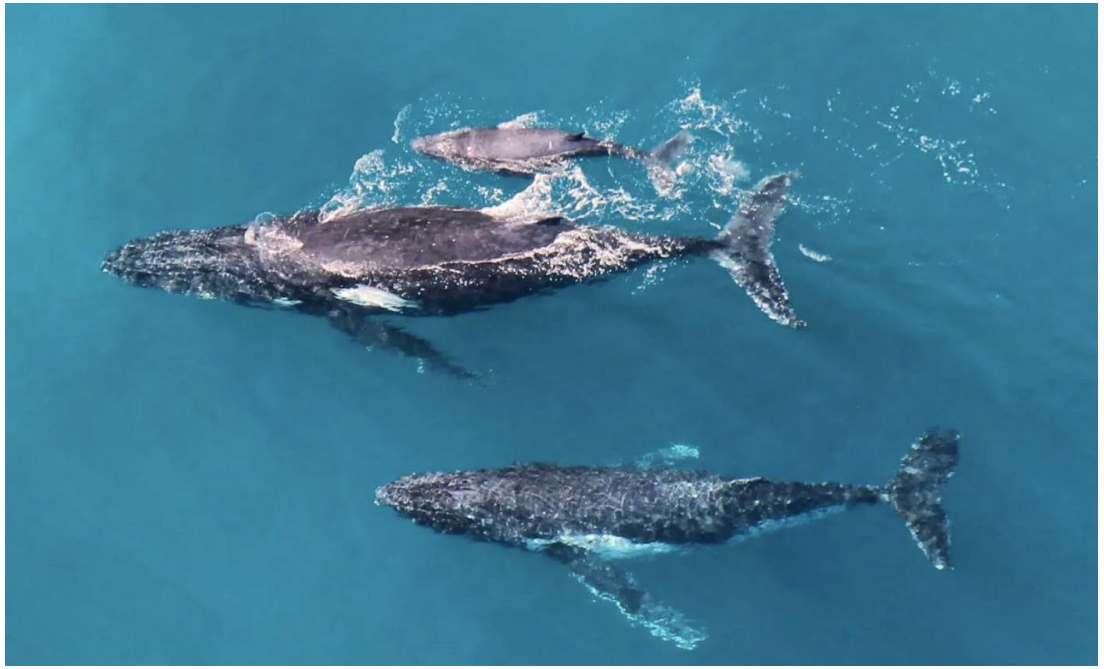


- >87,000 fin whales caught at South Georgia

BUT

- Highest summer fin whale densities in South Orkneys
- Low densities at South Georgia in summer
- Distribution shift further south?

Viquerat et al. (2022) *Frontiers in Marine Science* https://doi.org/10.3389/fmars.2022.1040512



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Sue G

Rod Long