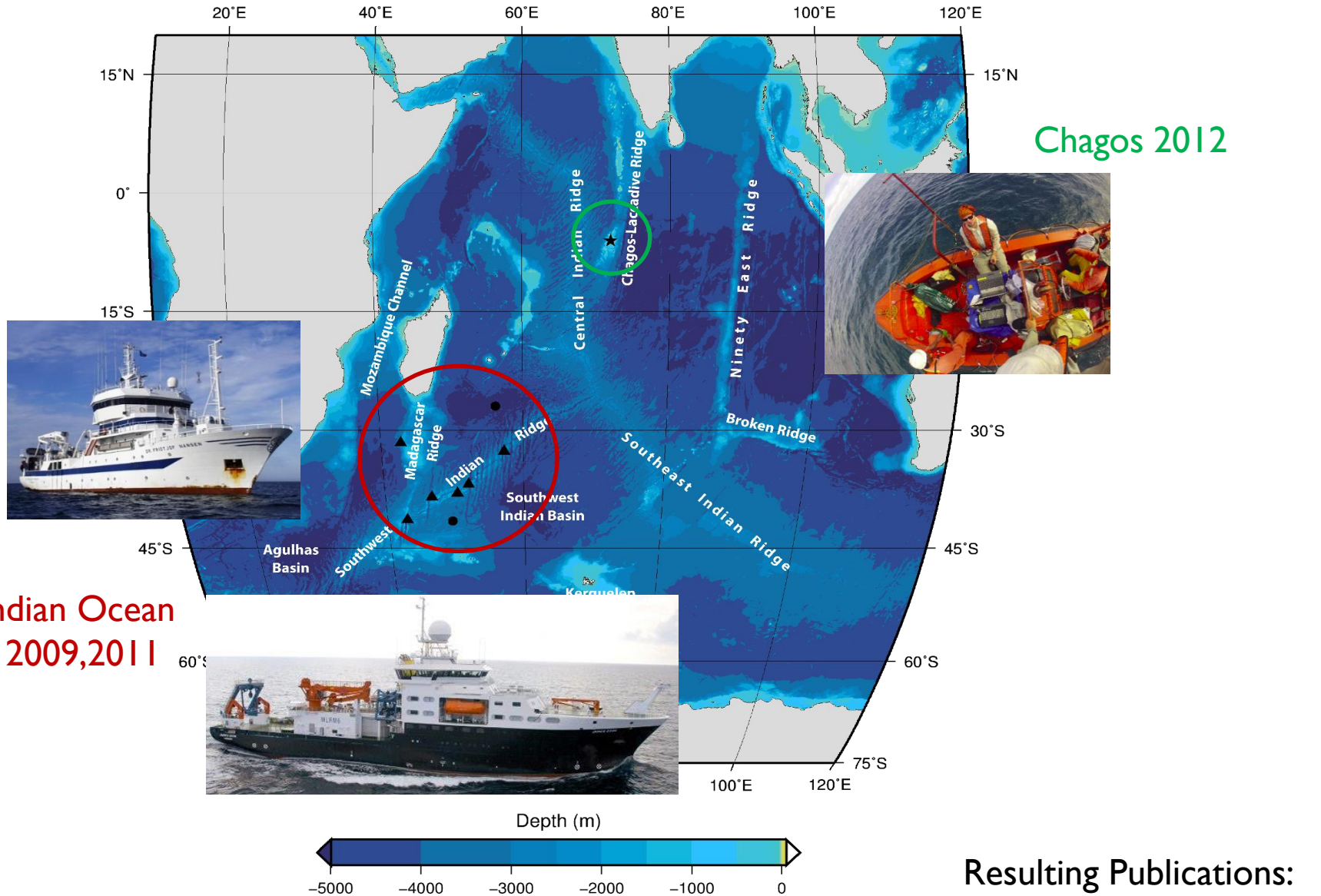2005: Field technician German National Park Service
2006-2008: UG in (Bio)chemistry/zoology
2008-2009: Master's in Environmental Biology

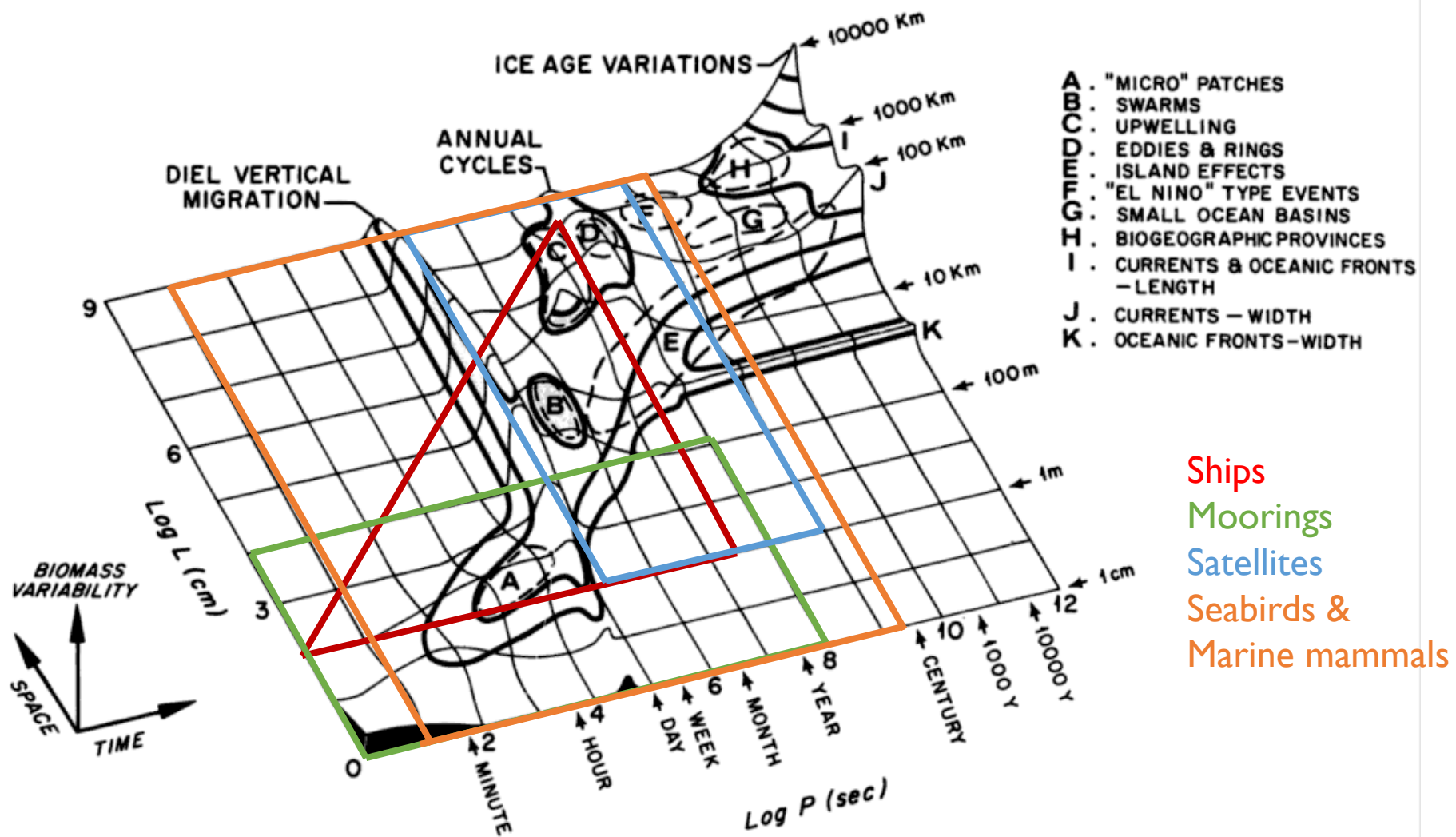# 2009-2013: PhD on pelagic prey fields in the Indian Ocean

Chagos 2012

SW Indian Ocean
Ridge 2009,2011

Resulting Publications:
http://pboesu.github.io/

2013-2014: Analyst/Software developer at British Antarctic Survey

- Development of analysis algorithms for a penguin weighbridge
- ~200,000,000 row data set
- R package development

ICE AGE VARIATIONS — ← 10000 Km
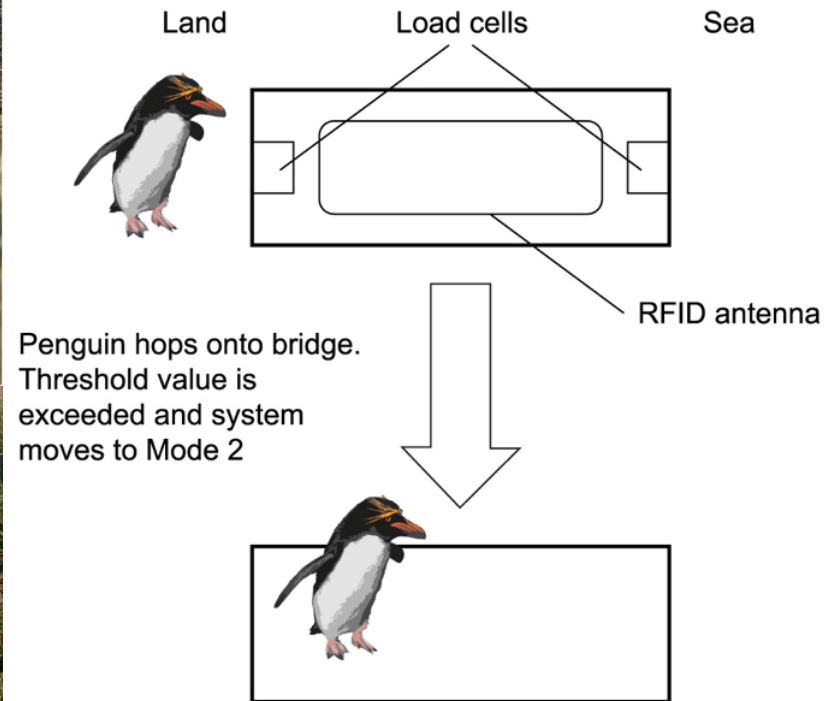← 1000 Km
← 100 Km

ANNUAL CYCLES —

DIEL VERTICAL MIGRATION —

← 10 Km

← 100 m

← 1m

← 1cm

BIOMASS VARIABILITY

SPACE

TIME

Log L (cm)
9
6
3
0

Log P (sec)

MINUTE HOUR DAY WEEK MONTH YEAR CENTURY 1000 Y 10000 Y
2   4   6   8   10   12

A . "MICRO" PATCHES
B . SWARMS
C . UPWELLING
D . EDDIES & RINGS
E . ISLAND EFFECTS
F . "EL NINO" TYPE EVENTS
G . SMALL OCEAN BASINS
H . BIOGEOGRAPHIC PROVINCES
I . CURRENTS & OCEANIC FRONTS — LENGTH
J . CURRENTS — WIDTH
K . OCEANIC FRONTS — WIDTH

Ships
Moorings
Satellites
Seabirds &
Marine mammals

Haury et al 1978, Spatial Pattern in Plankton Communities

Pelagic assemblages are structured by oceanography

Watermasses are volumes w/ relatively homogeneous temperature, salinity
Fronts separate them and form biogeographic boundaries

Djurhuus, Boersch-Supan et al. 2017 Royal Soc Open Science, Rogers et al. 2017 Deep Sea Res II, Laptikovsky, Boersch-Supan et al. 2015 Deep Sea Res II, Letessier et al. 2015 Deep Sea Res II

Take home message - Part 1:

Prey aggregations are associated with static (e.g. seamounts) and dynamic (e.g. fronts) ocean features.

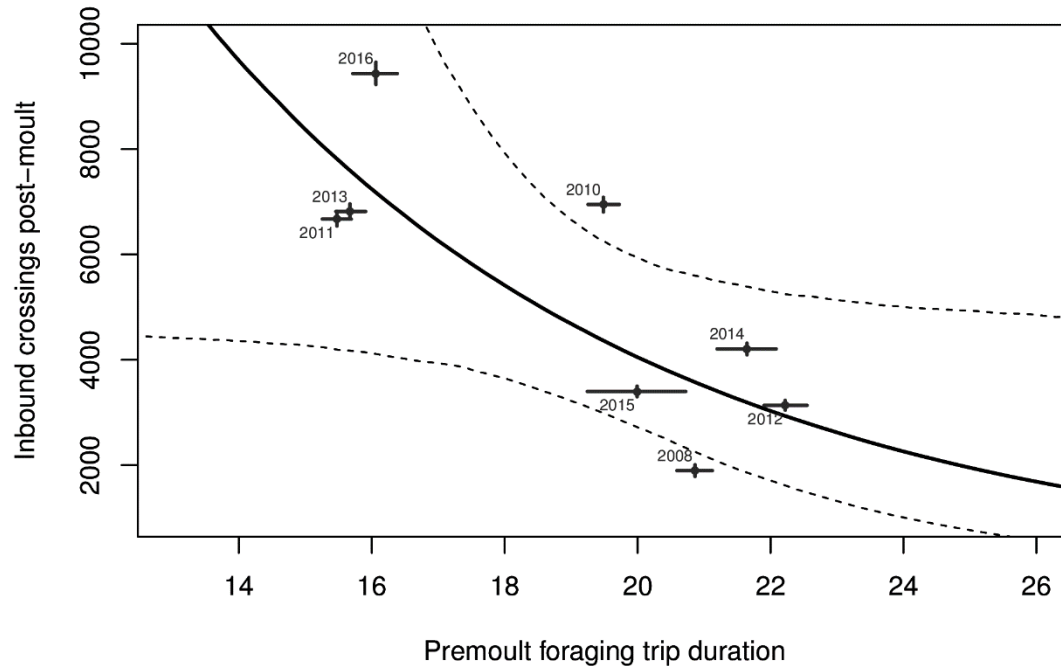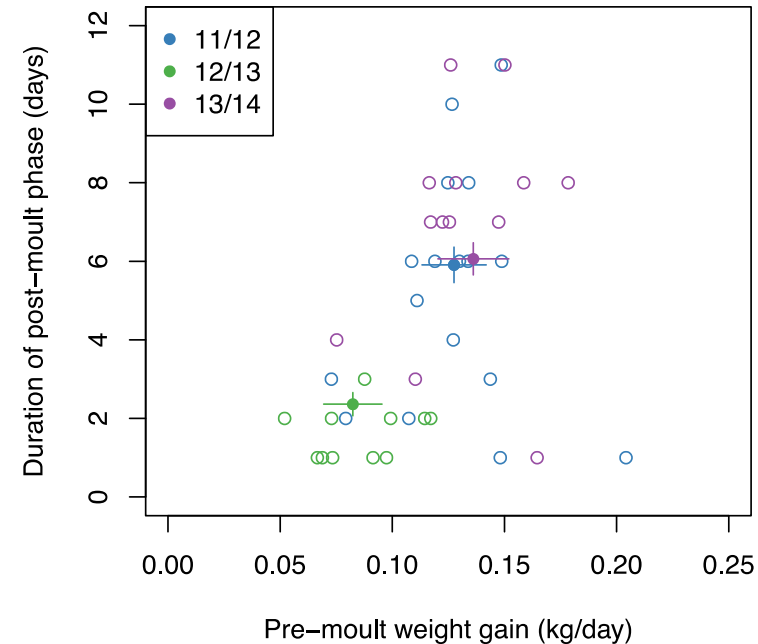**Predators adapt their foraging behaviour across space to efficiently exploit these.**

@pboesu

The penguin weighbridge

Land   Load cells   Sea

RFID antenna

Penguin hops onto bridge. Threshold value is exceeded and system moves to Mode 2

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Seasonal movement pattern

Boersch-Supan et al. in prep
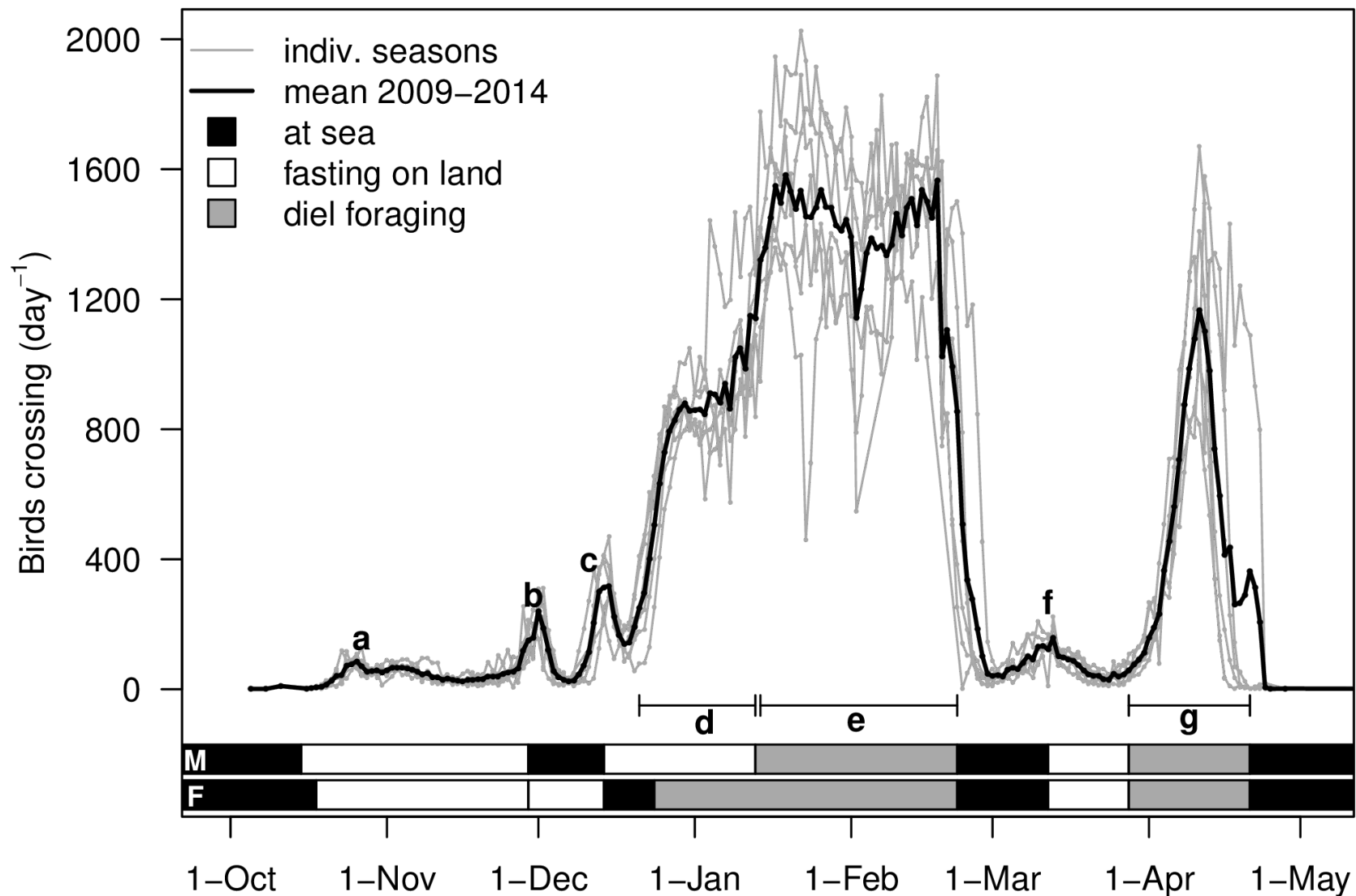
Linking post-moult movement to (unobserved) prey

When pre-moult feeding is good, more birds delay migration for longer
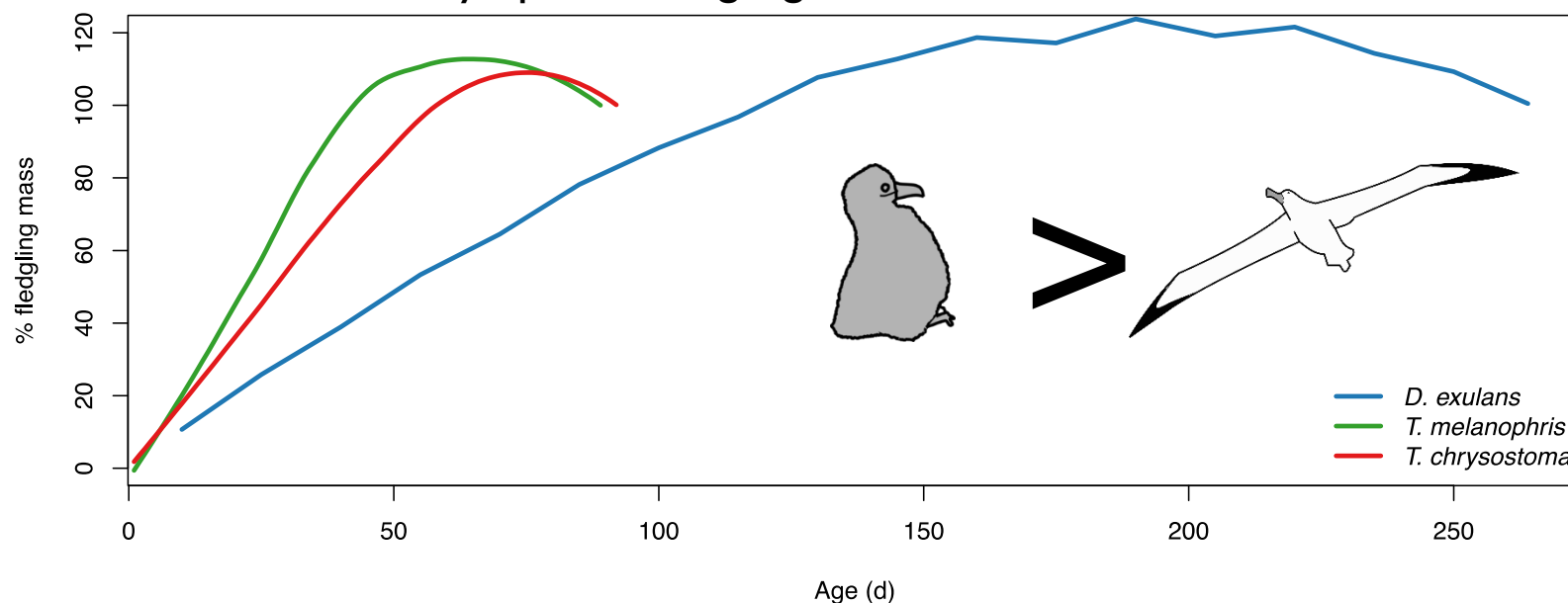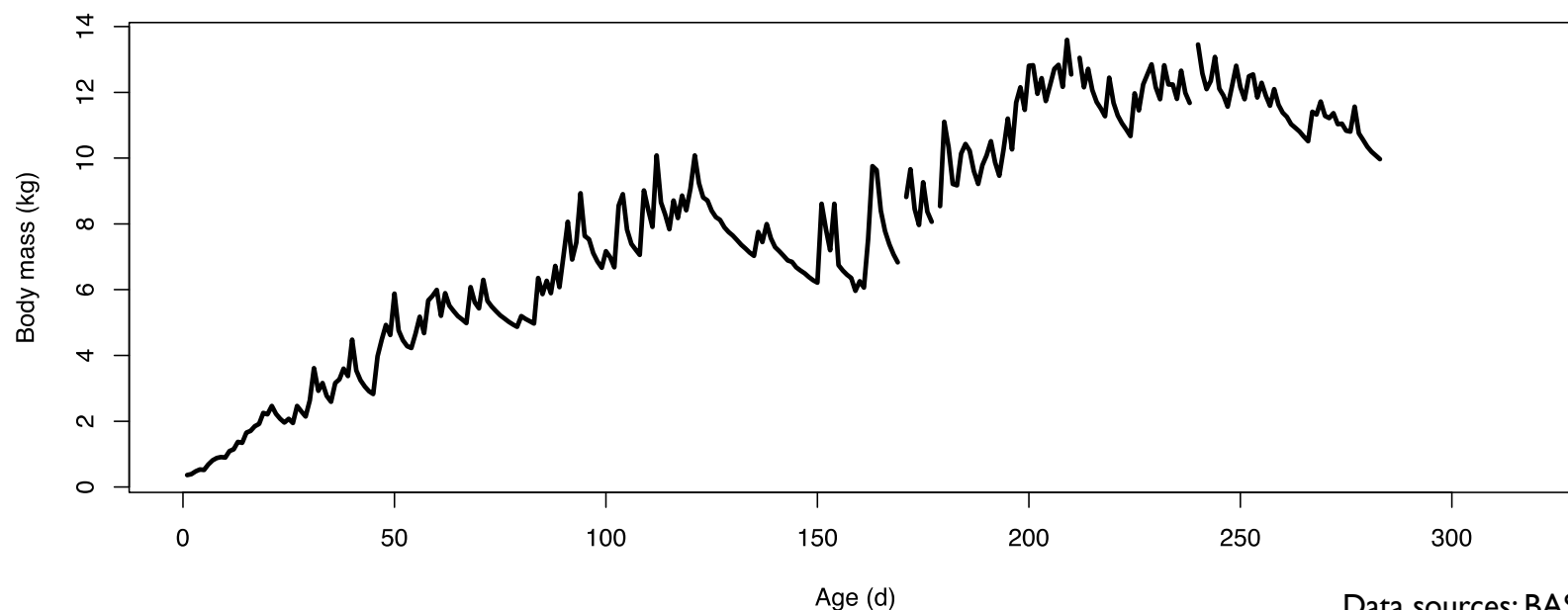
Boersch-Supan et al. in prep

Take home message - Part 2:

Prey availability varies from year to year.

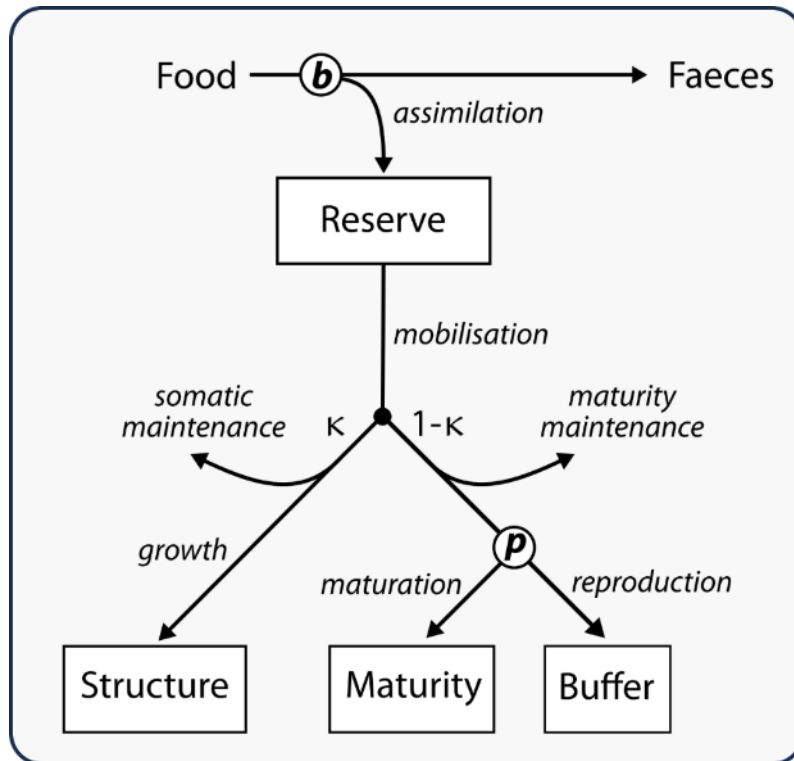Some predators can modulate seasonal foraging and migration strategies in response.

BAS

Individual mass growth

Process model
(mostly) unobservable quantities

Data
Measured quantities

Observation model

Structure + Volume →

Structure →

Food →

Weight
(TBW)

Culmen length

Meal mass
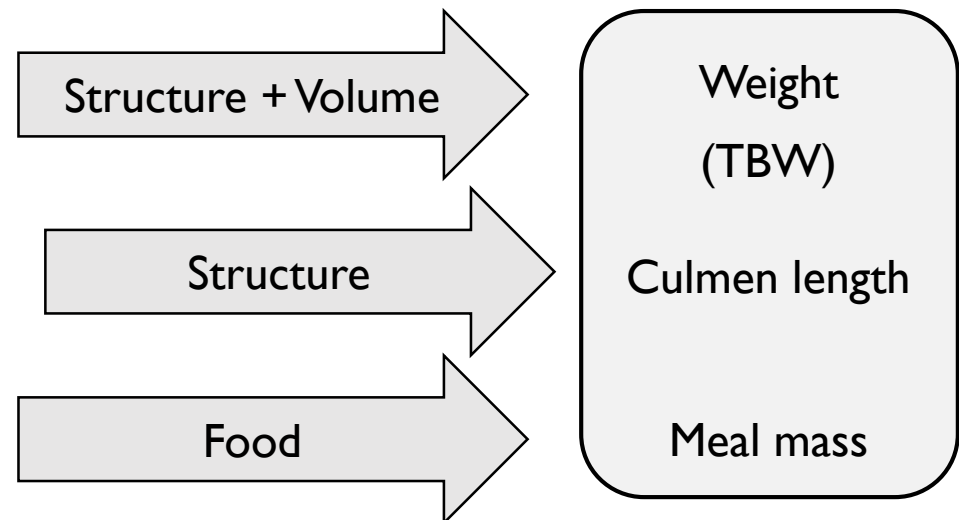
Fitting can be achieved with the "covariation method", a weighted least-squares approach.
We propose a Bayesian approach to better handle uncertainty.

Teixeira et al. 2014, J Sea Res 94:117
Lika et al. 2011 J Sea Res 66:270

Take home message - Part 3:

Mechanistic models can be used to synthesize sparse observations.

And as simulation devices to forecast impacts of climate change and food availability on seabird growth & survival.
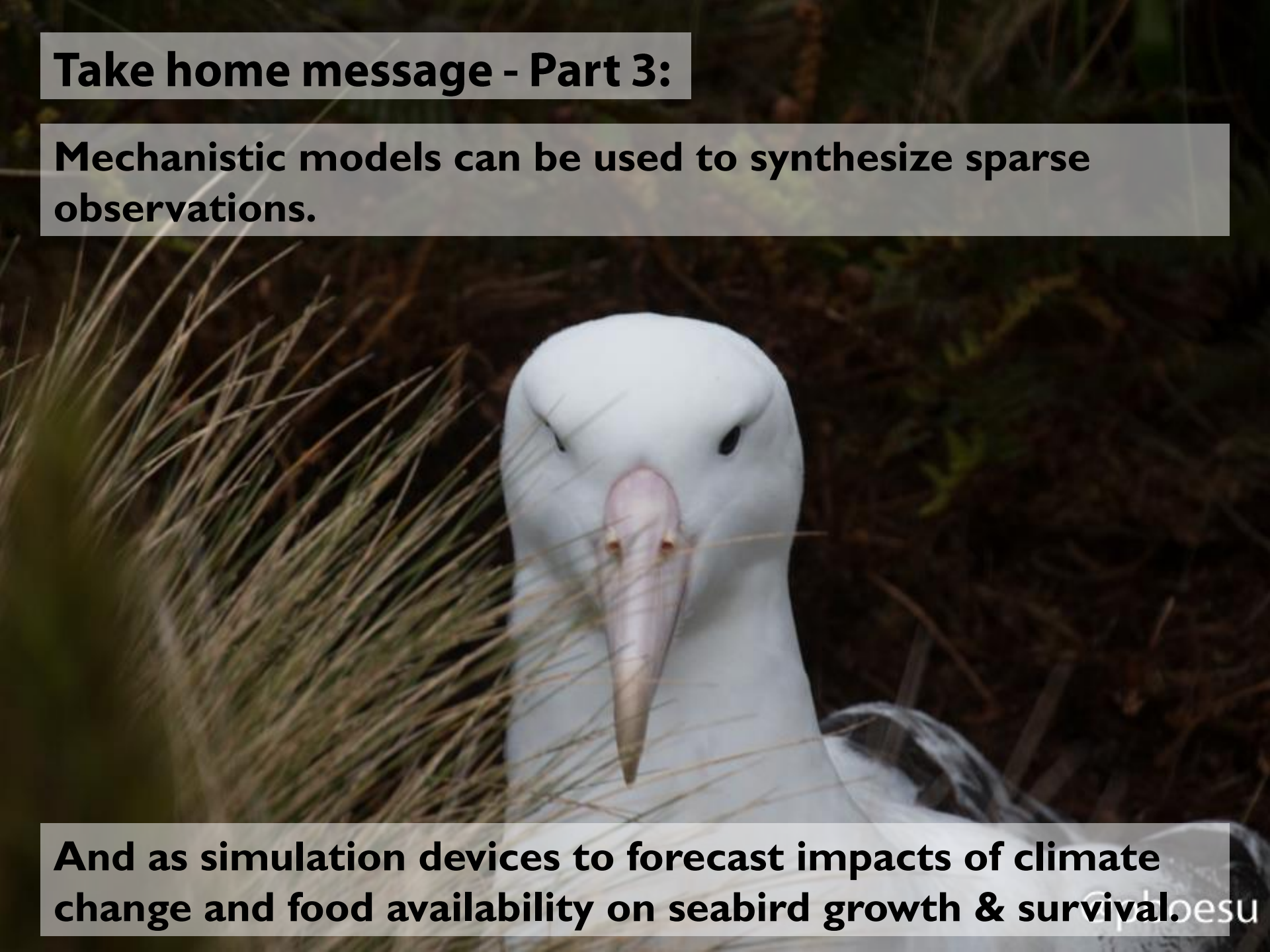
- The ocean is big and dynamic

- Ocean wanderers are well adapted to this

- Ocean wanderers are hard to observe

- With technology we can catch glimpses of them & their prey

- With models and stats we can put the pieces together
    - But different species – different pieces, e.g.
        - adult mass easier for penguins than albatross, seals
        - chick mass easier for albatross than penguins, seals
        - seals can take larger sensor payloads than seabirds
        - etc.

- So ultimately we need good models and appropriate inference methods for them to make the most out of the data we can get

- **Interdisciplinary work is fun, but also challenging!**

+ Many opportunities for collaboration options

+ Diverse systems

   + Hydrothermal vents, marine microbes, invasive predators on islands, amphibian diseases, soil biogeochemistry

± Following multiple bodies of literature

- Navigating subject-specific workflows/publishing/hiring traditions

- Method/software development often seen as service rather than research product; "middle author syndrome"