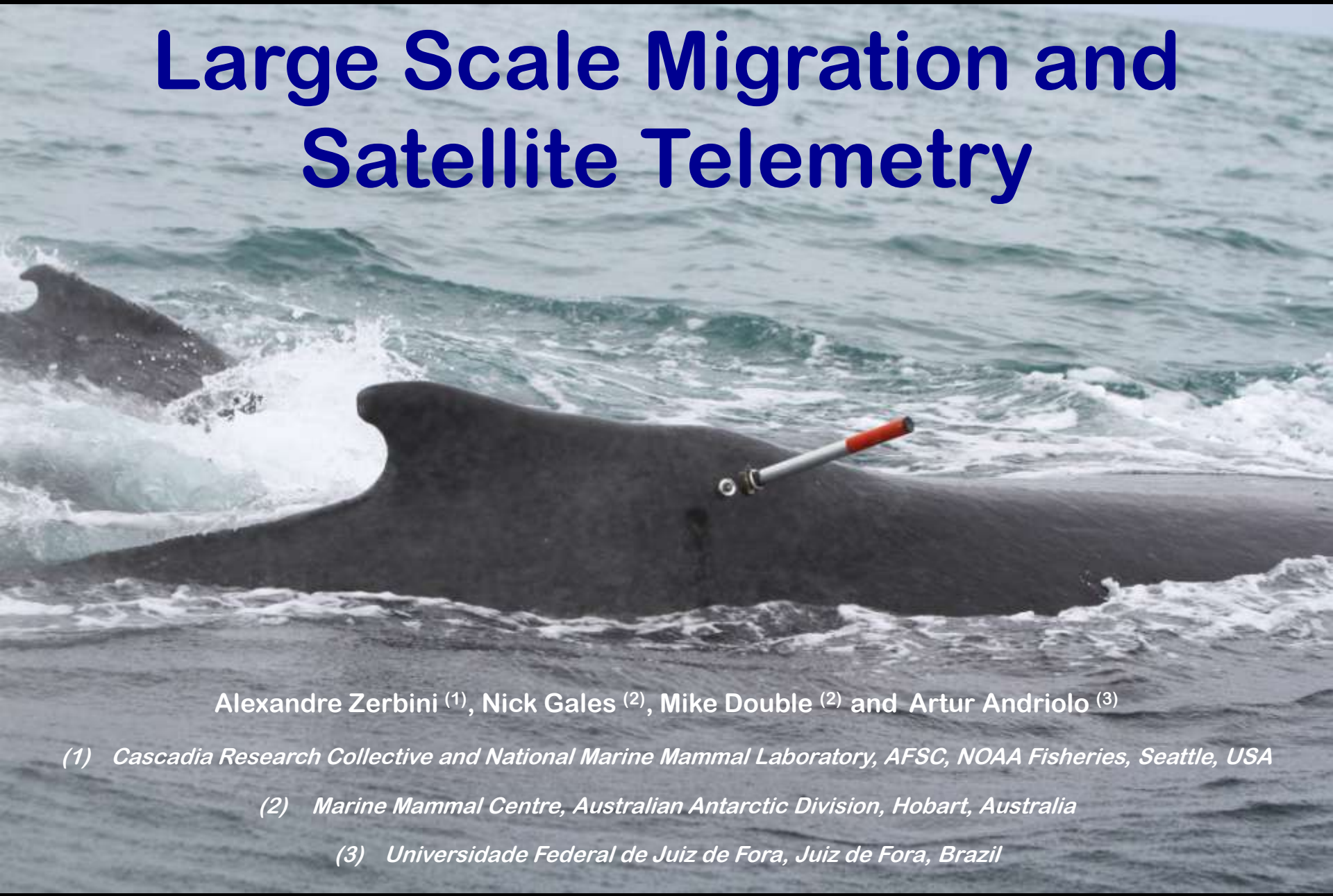
Large Scale Migration and Satellite Telemetry



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GREENPEACE

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Outline

- Large whales: long range seasonal migrants
- Brief history of methods to study whale migration
- Satellite telemetry: what it is and how it works
- Examples of studies with Southern Hemisphere humpback whales

Whale migration

- Seasonal movement of individuals between different geographic location

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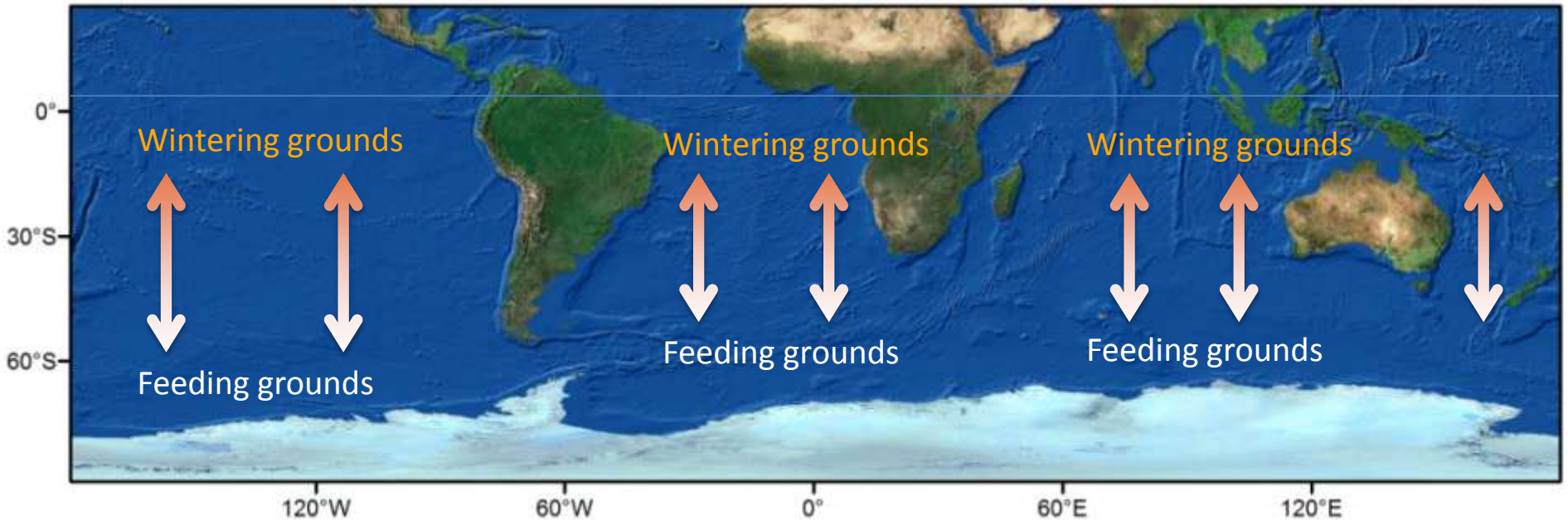
- Typical: summer/cold-water feeding to winter/warm-water mating/calving grounds (but species-specific)



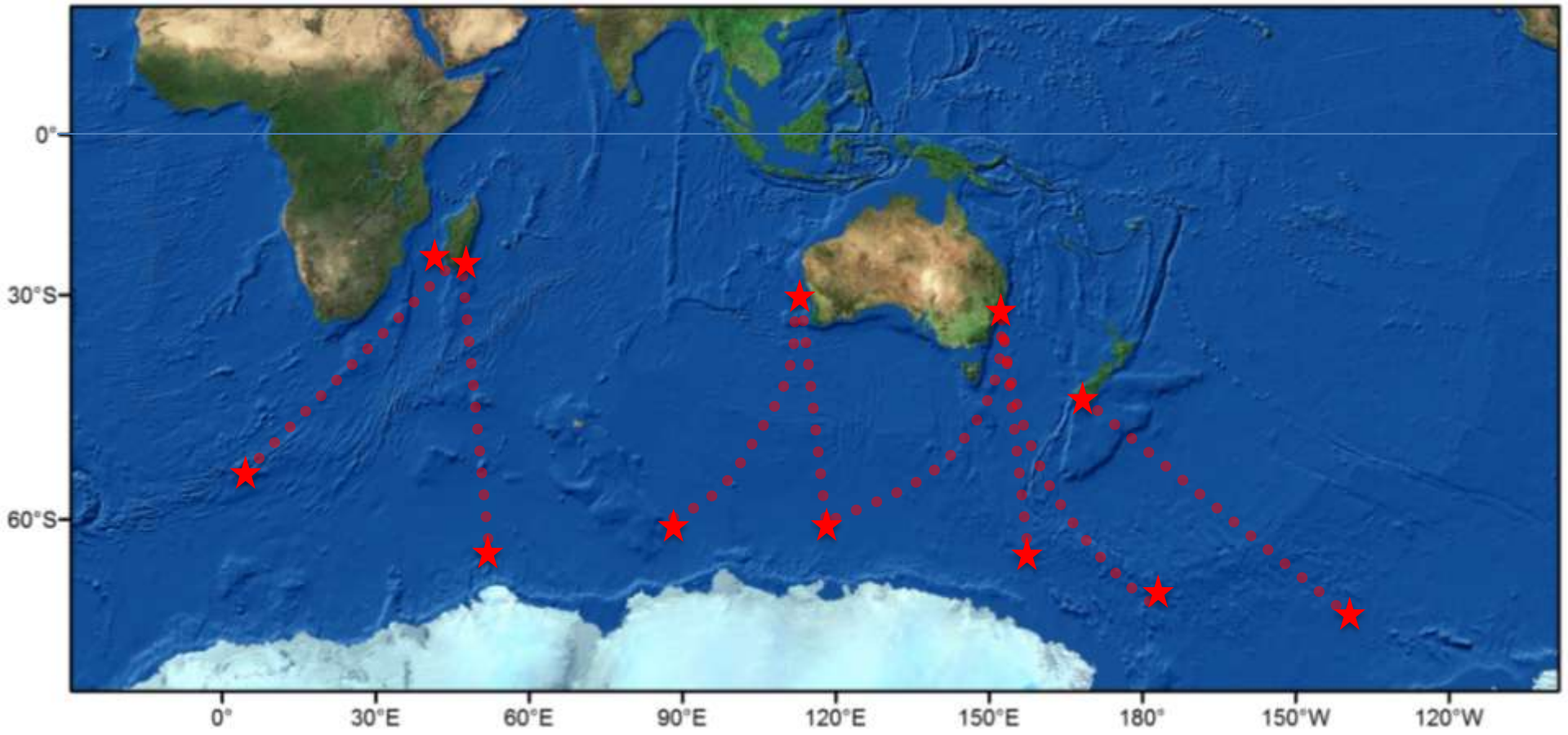
Whale migration

- Seasonal movement of individuals between different geographic location
- Typical: summer/cold-water feeding to winter/warm-water mating/calving grounds (but species-specific)
- Why is important to understand movements and migration?:
  - Conservation
  - Population Assessment (IWC)

How do we study migration?

Early years: Discovery marks

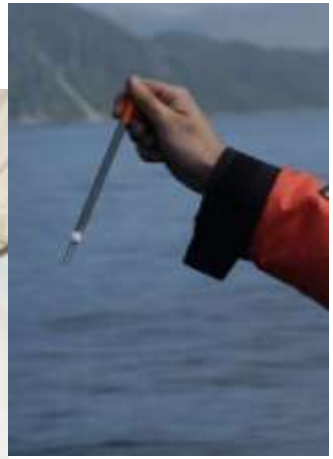
HUMPBACK WHALE MIGRATORY CONNECTIONS: DISCOVERY MARKS



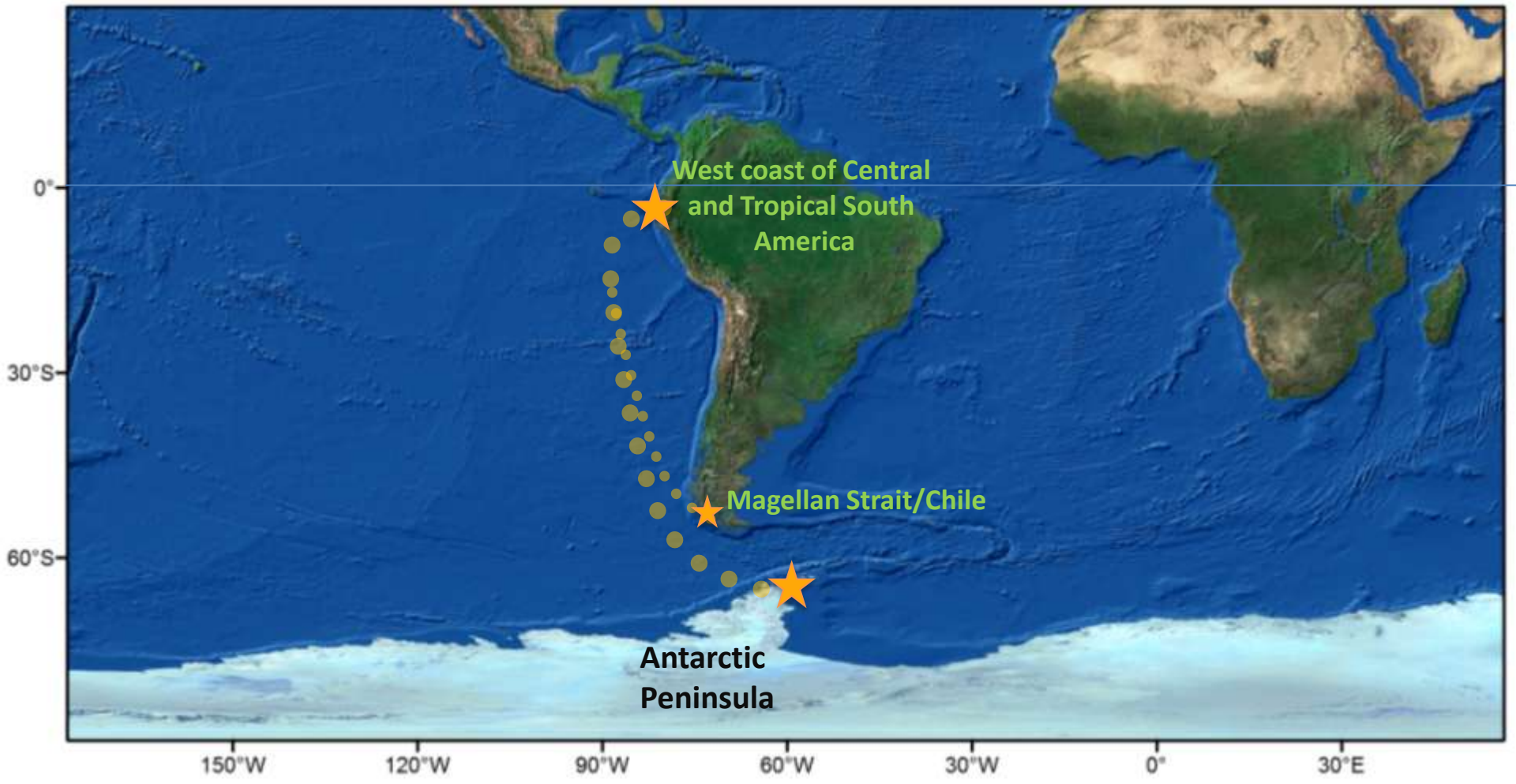
Reyner et al., 1940; Chittleborough, 1959; Dawbin, 1966; Mikhalev, 1999

How do we study migration?

- Early years: Discovery marks
- More recently (non-lethal methods):
  - Photo-identification
  - Genotyping

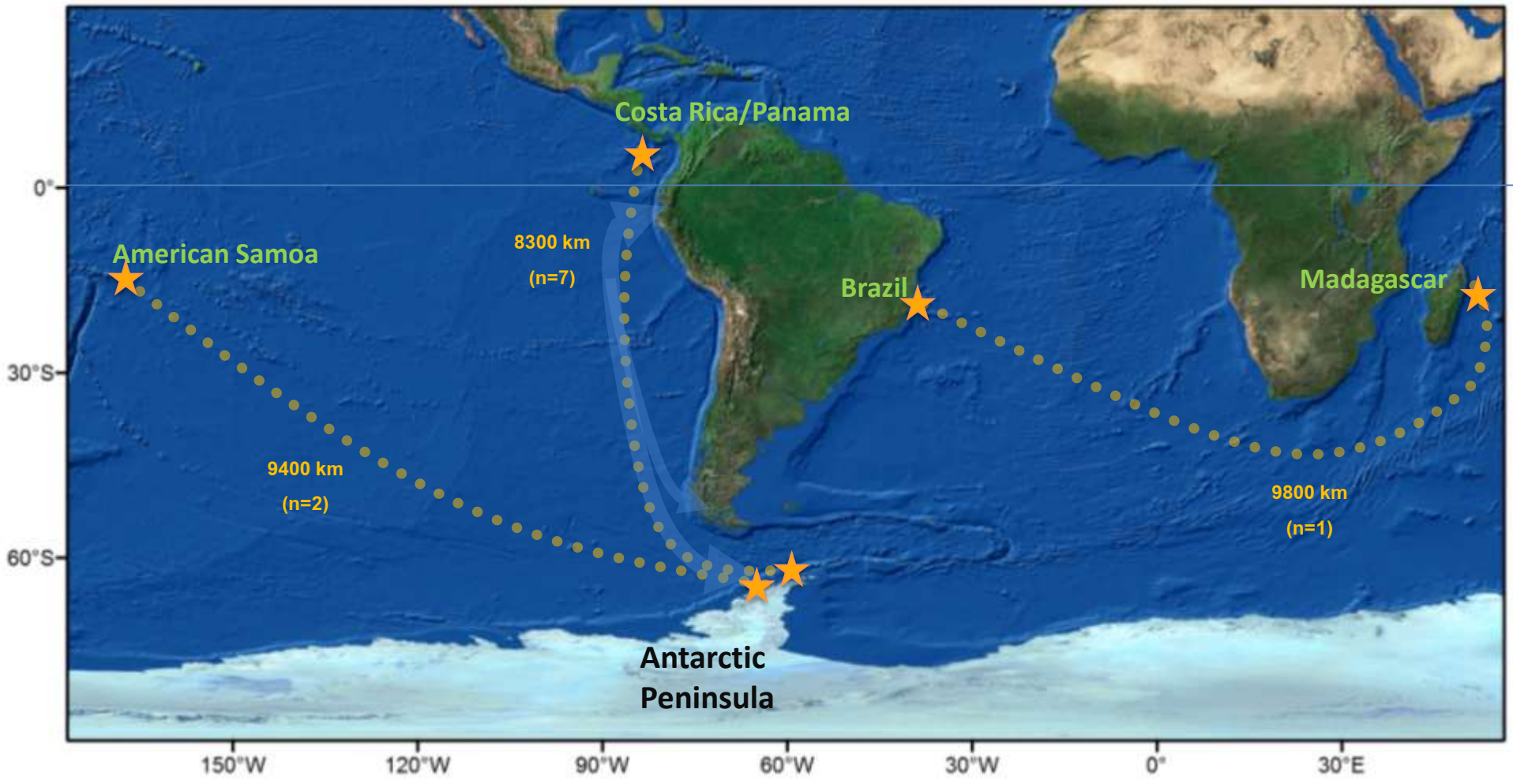


HUMPBACK WHALE MIGRATORY CONNECTIONS: PHOTO-IDENTIFICATION



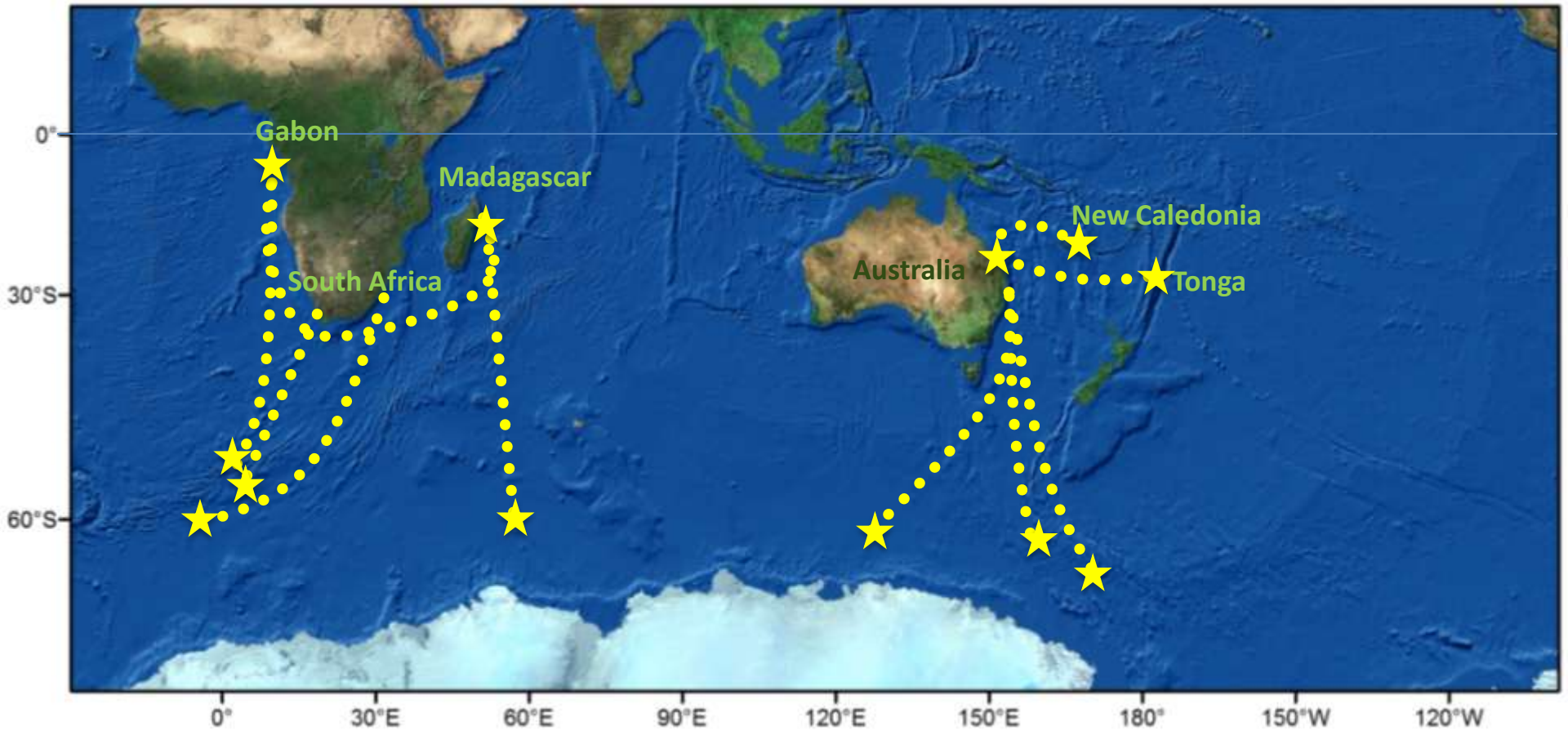
Stevick et al., 2005; Rasmussen et al., 2007; Acevedo et al., 2008

HUMPBACK WHALE MIGRATORY CONNECTIONS: PHOTO-IDENTIFICATION



Stevick et al., 2010; Rasmussen et al., 2007; Robbins et al., 2011

HUMPBACK WHALE MIGRATORY CONNECTIONS: GENOTYPE MATCHES



Pomilla and Rosenbaum, 2005; Anderson et al., 2010; IWC, 2010

How do we study migration?

- Early years: Discovery marks
- More recently (non-lethal methods):
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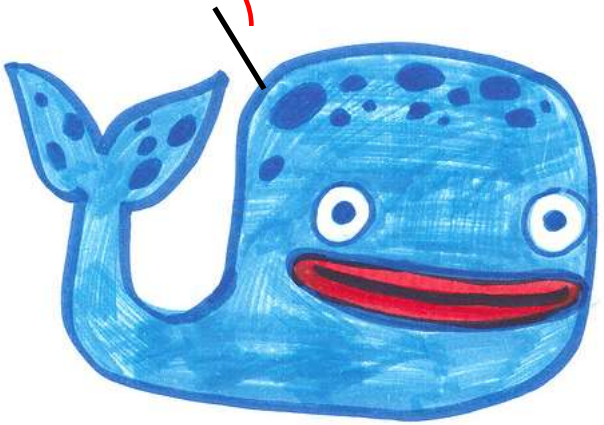
  - Genotyping

- But how about migratory routes, critical habitats and habitat use?

Satellite Telemetry

How does satellite telemetry work?



Receiving stations

Types of transmitters

- Argos system (transmissions = locations)
- "Long-term": weeks-months on average, species-specific (e.g. Mate et al., 2007)
- Body penetrating
  - "Implantable"
  - LIMPET (low-impact percutaneous external tag, Andrews et al., 2008)
- Electronics
  - Location or
  - Location +

Transmitter deployment methods

- Remotely deployed, typically close approaches with small boats

Fiberglass/carbon fiber pole

Heide-Jørgensen et al., 2003

Fiberglass/carbon fiber pole

Heide-Jørgensen et al., 2003

Pneumatic gun (ARTS)

Heide-Jørgensen et al., 2001, Gales et al., 2009

Pneumatic gun (ARTS)

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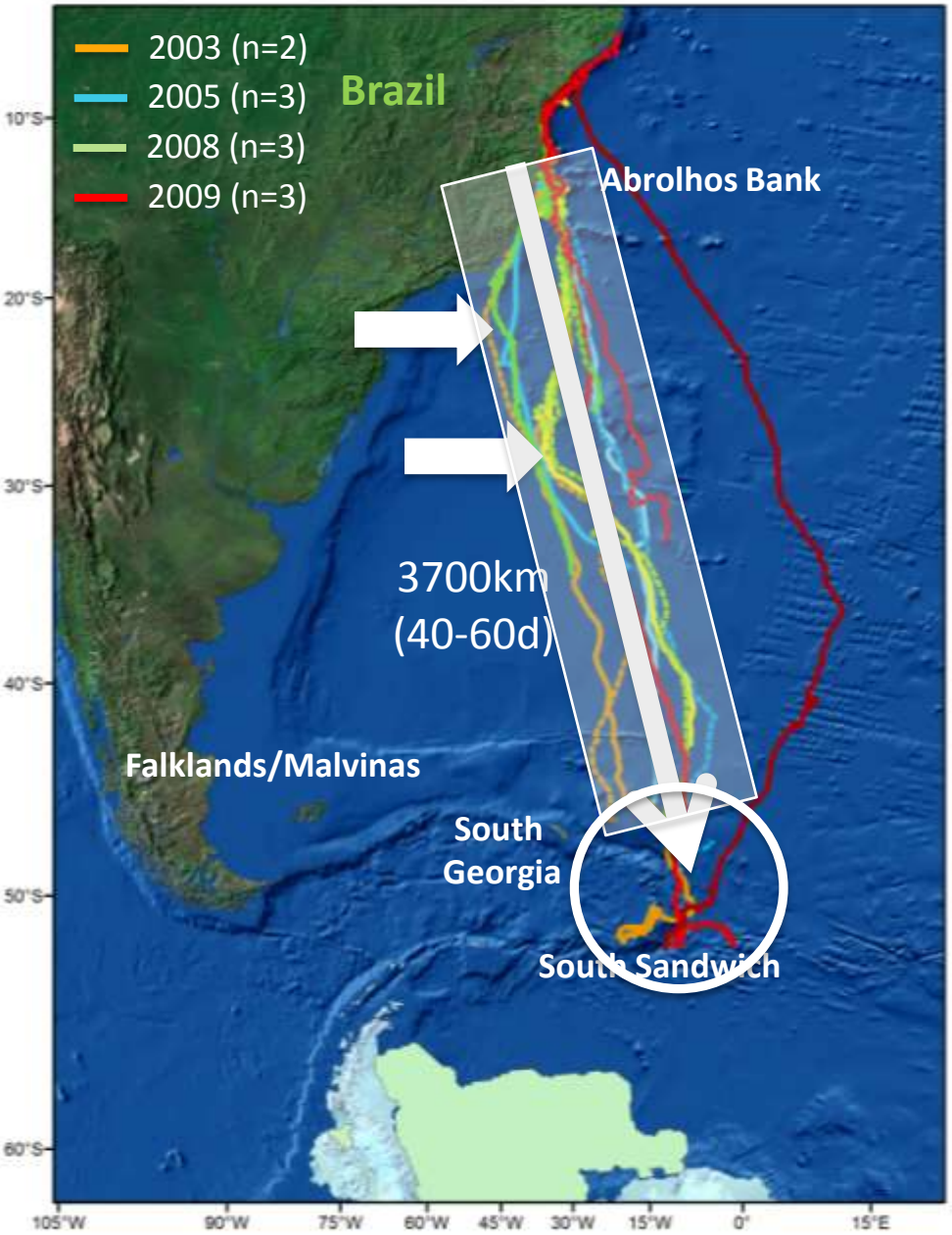
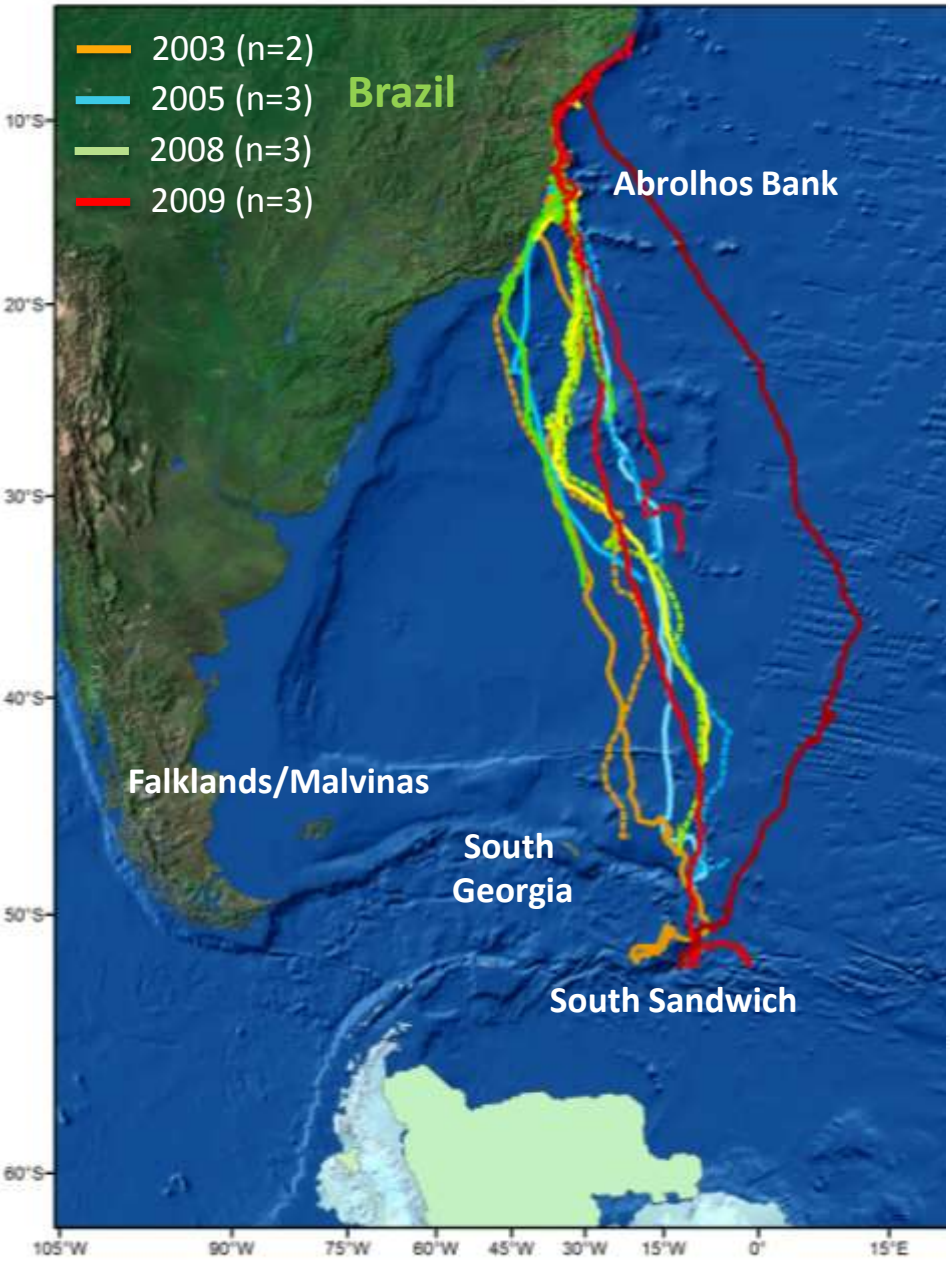
Describing migratory routes and destinations

South Atlantic humpback whales

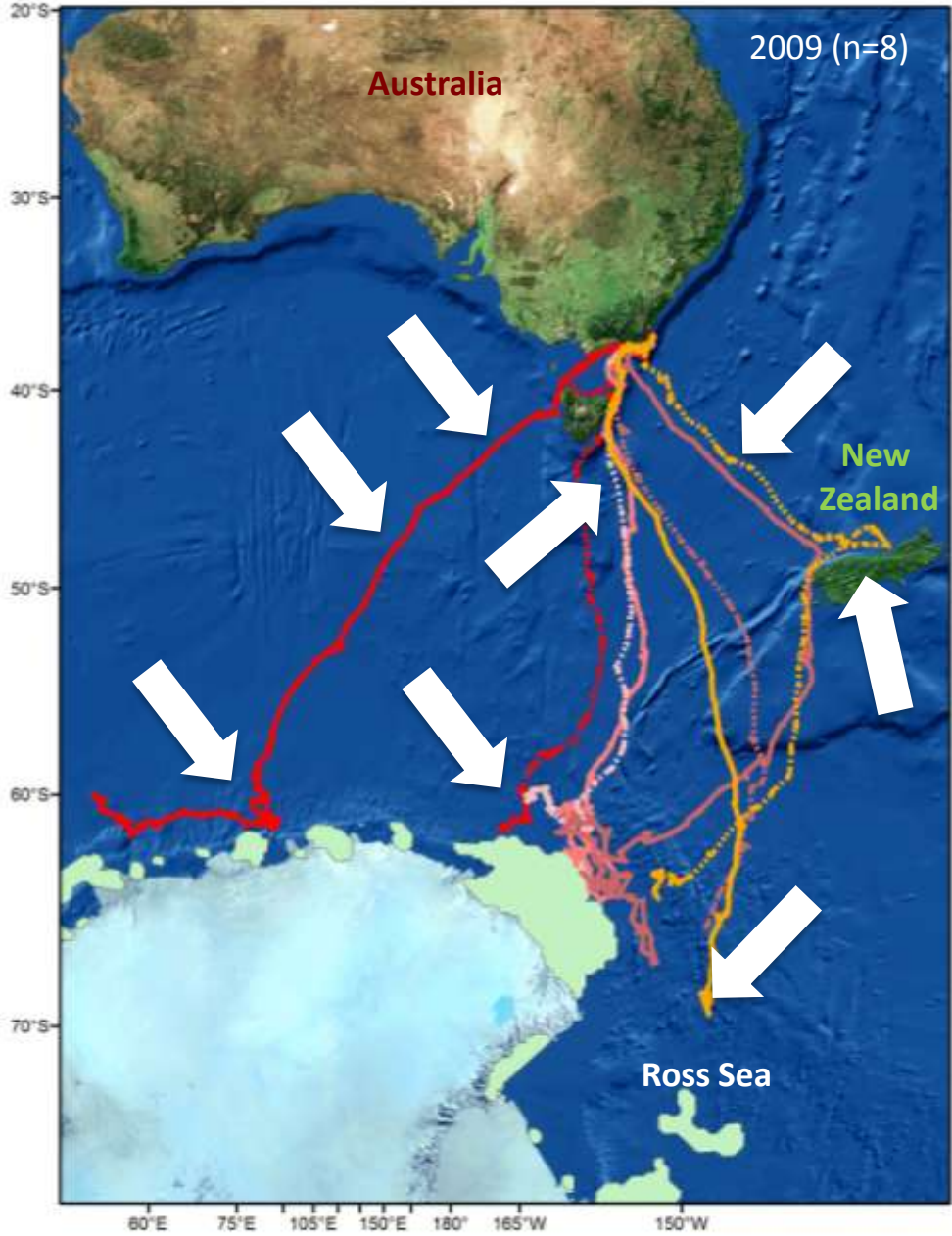


Zerbini et al., 2006; 2011; unpublished

South Atlantic humpback whales



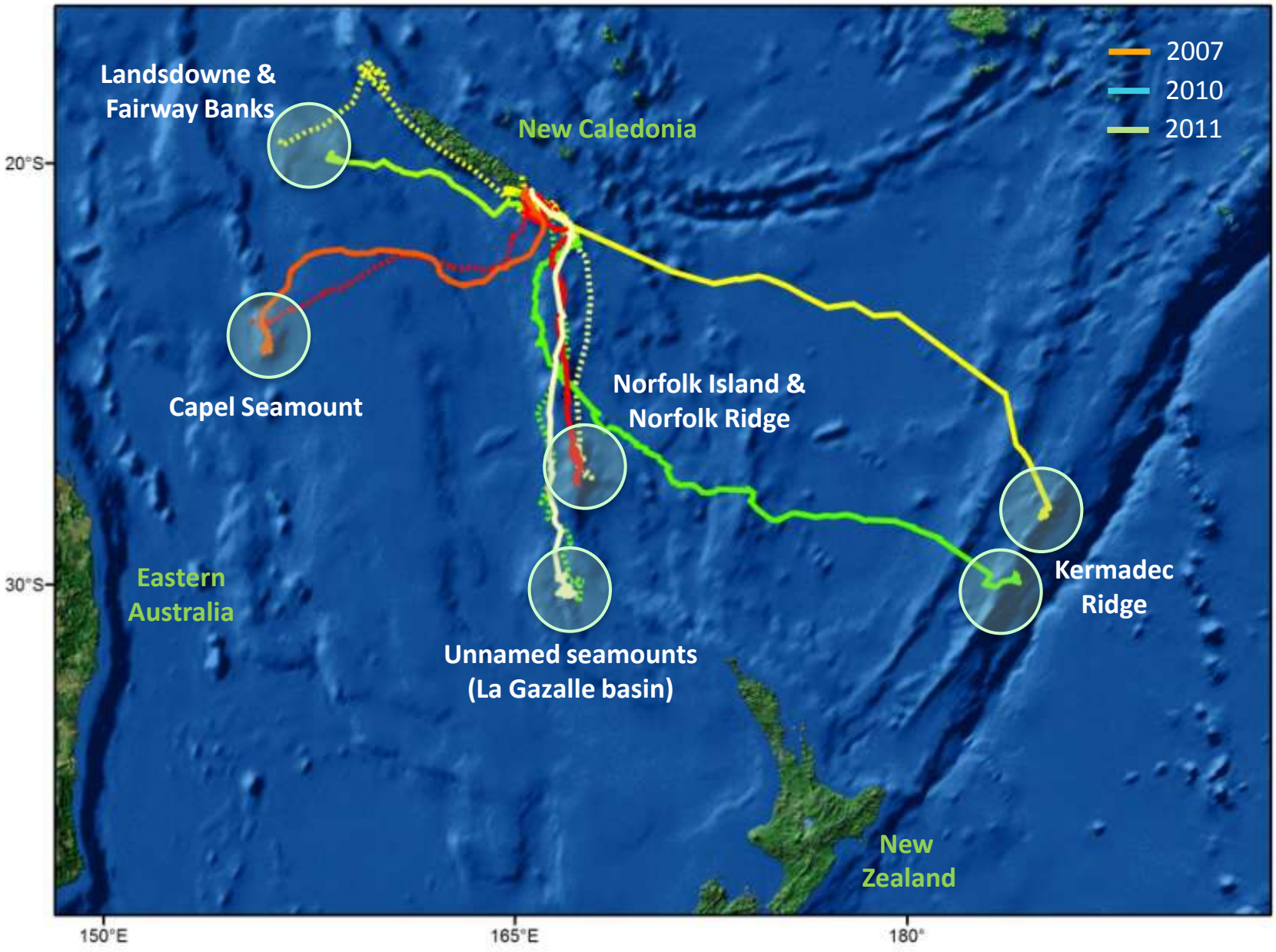
Eastern Australia humpback whales



Zerbini et al., 2006; 2011; unpublished

Discovery of new habitats

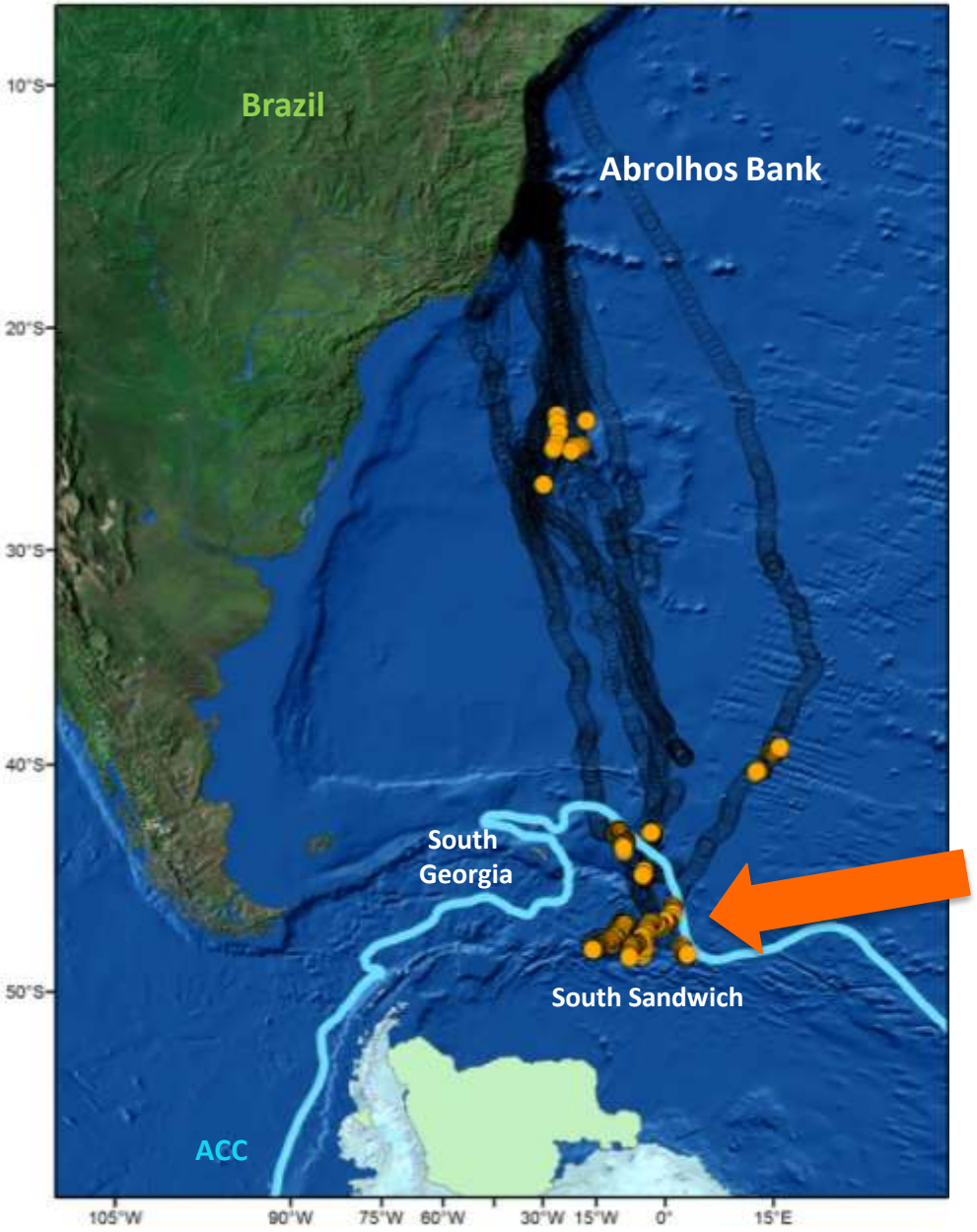
New Caledonia humpback Whales



Garrigue et al., 2010, unpublished data

Investigating how environmental variables influence movement and behavior

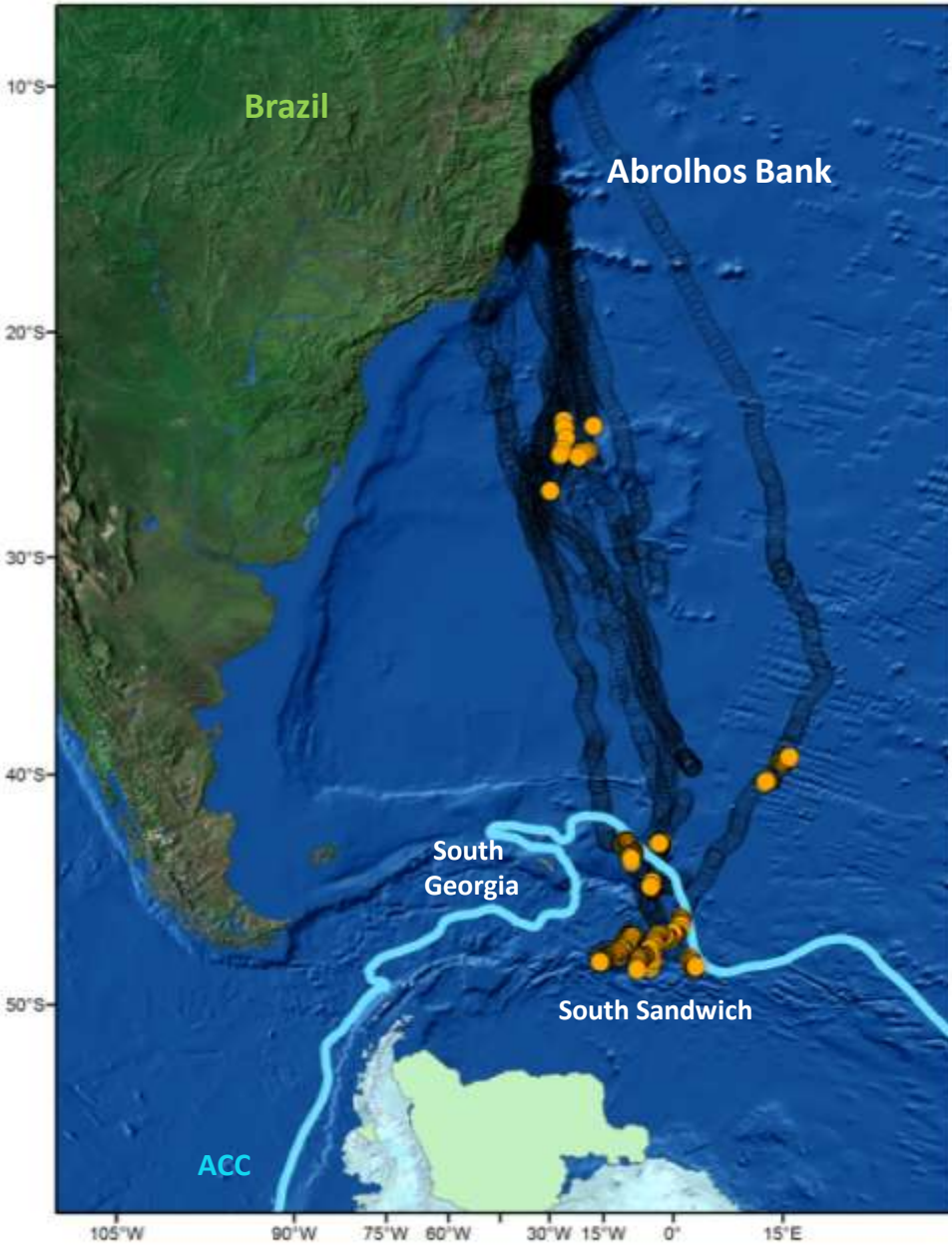
South Atlantic humpback whales



- State-space models
- Estimation of the "behavioral state" of the animals given changes in speed and movement direction
- ARS: area restricted search
- Southern boundary of the Antarctic Circumpolar Current (ACC): important feeding habitat

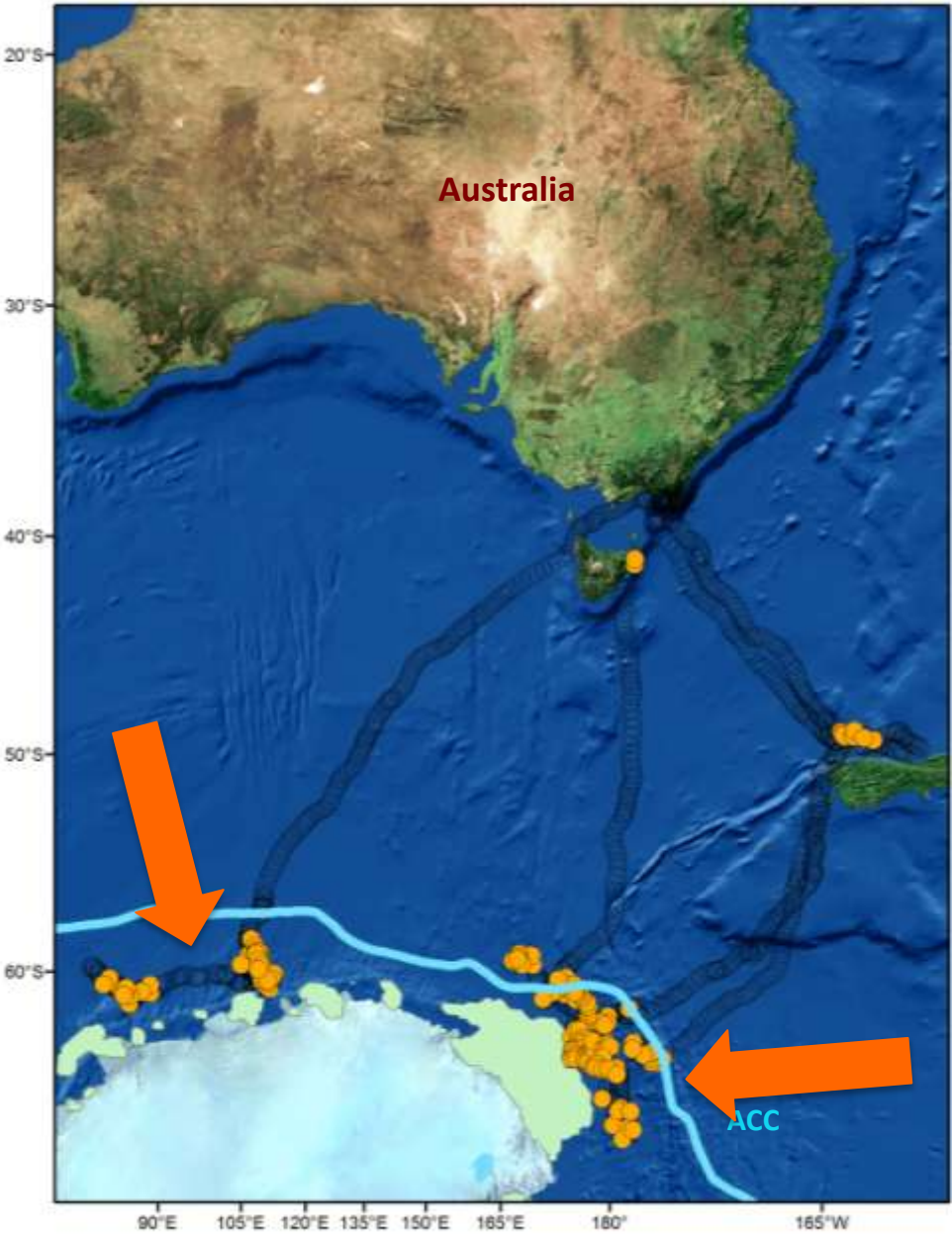
Zerbini et al., 2011; unpublished

South Atlantic humpback whales



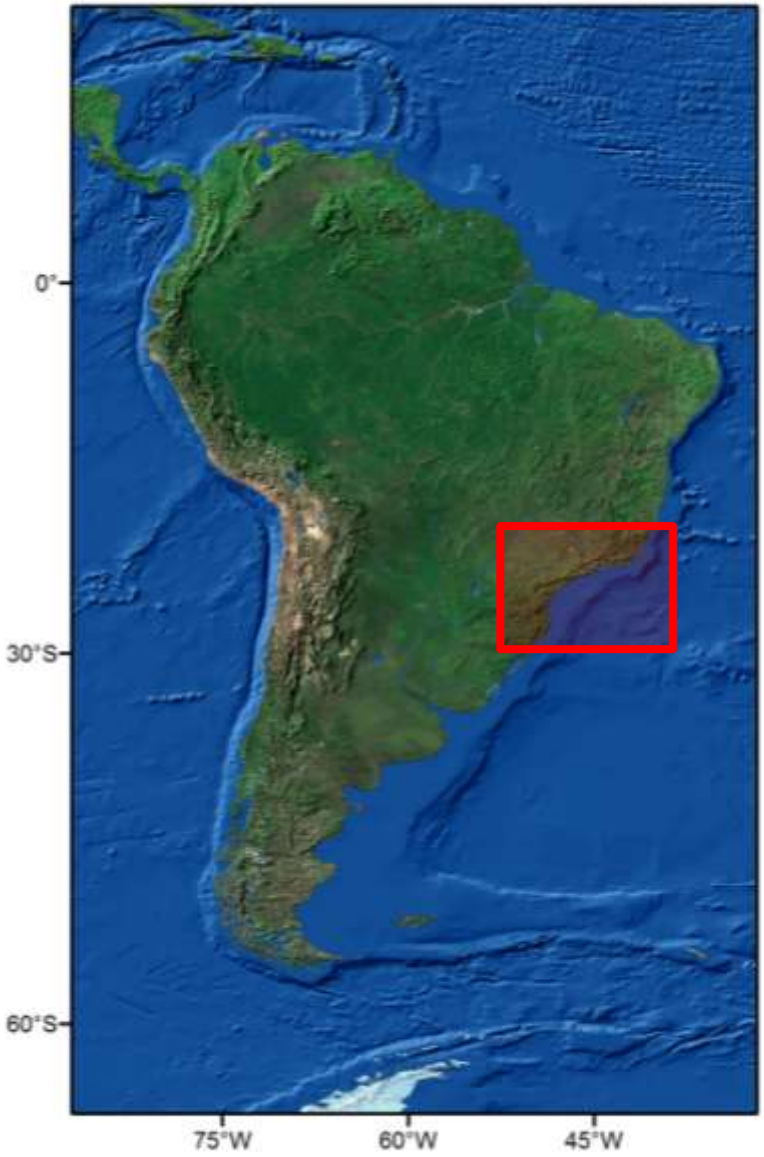
Zerbini et al., 2011; unpublished

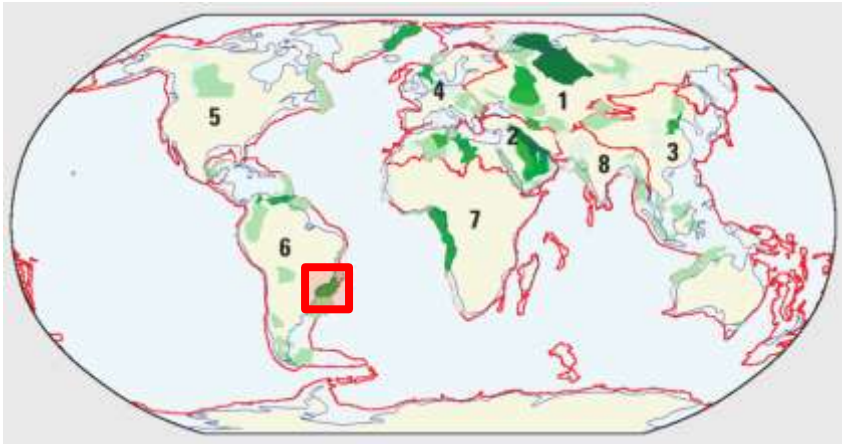
Eastern Australia humpback whales



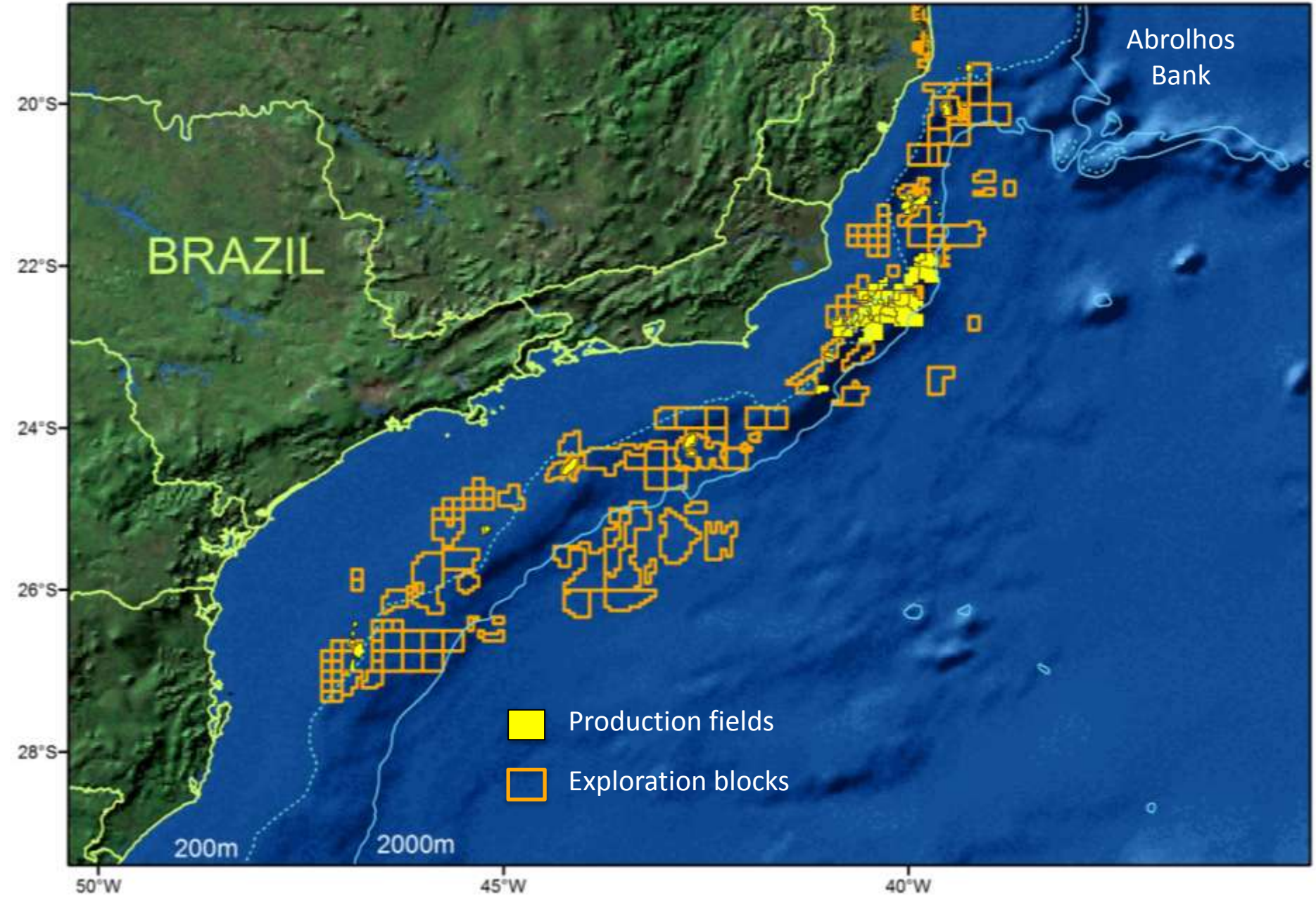
Gales et al., unpublished

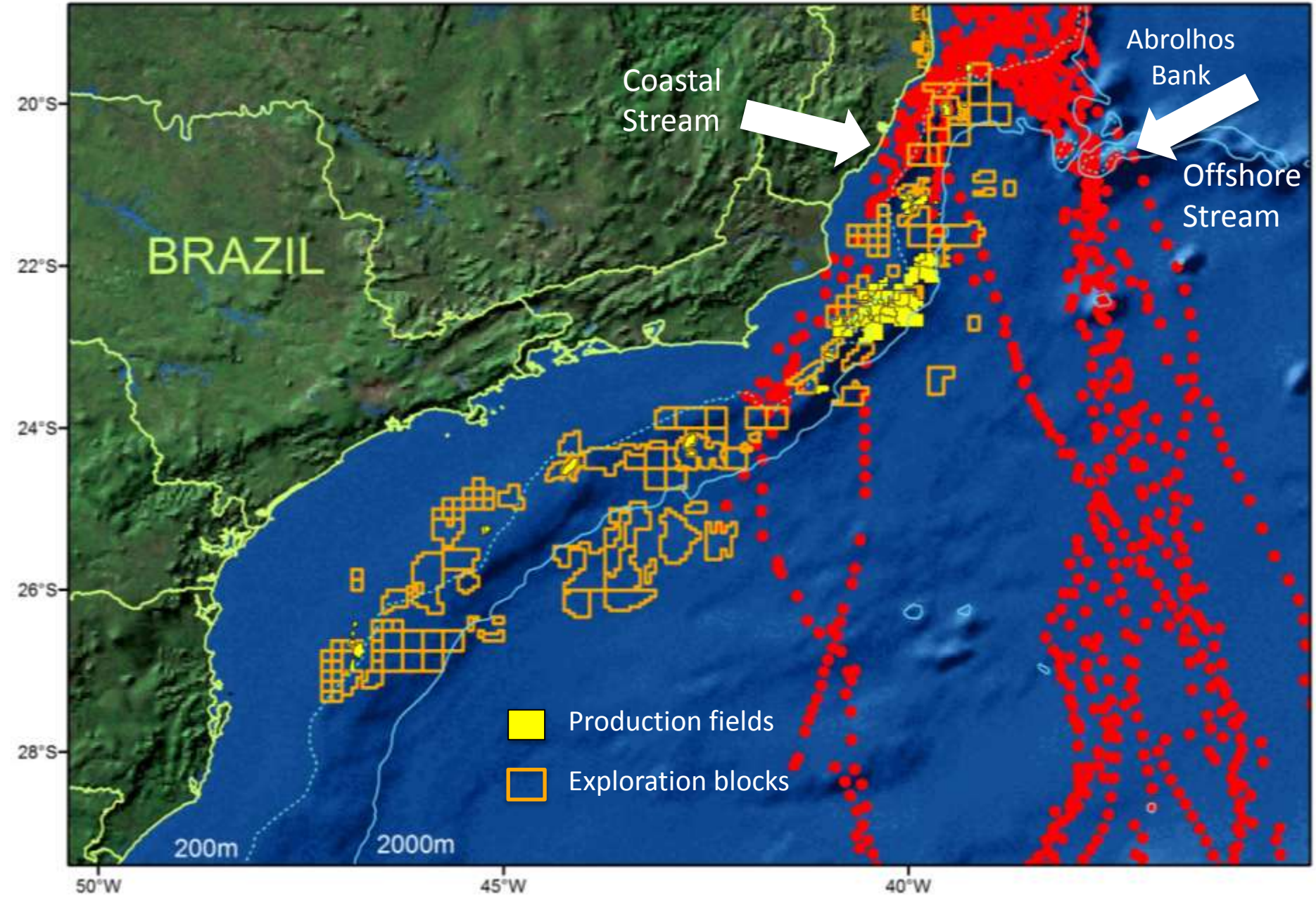
Assessing habitat use relative to anthropogenic activities





Cumulative oil production + remaining reserves + undiscovered resources

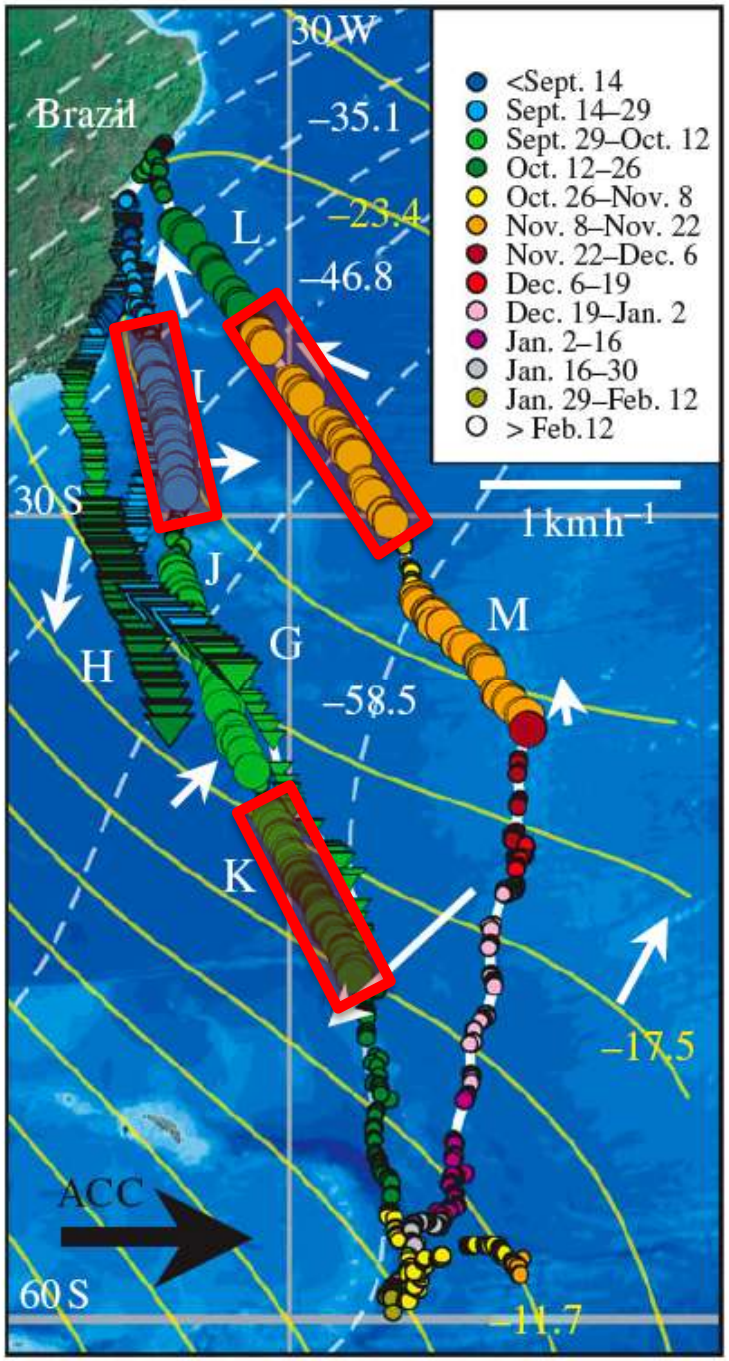

Abrolhos
Bank
BRAZIL
20°S
22°S
24°S
26°S
28°S
50°W
45°W
40°W
Production fields
Exploration blocks
200m
2000m


Abrolhos
Bank
Coastal
Stream
Offshore
Stream
BRAZIL
20°S
22°S
24°S
26°S
28°S
Production fields
Exploration blocks
200m
2000m
50°W
45°W
40°W

Basic biology: Insights into navigation abilities

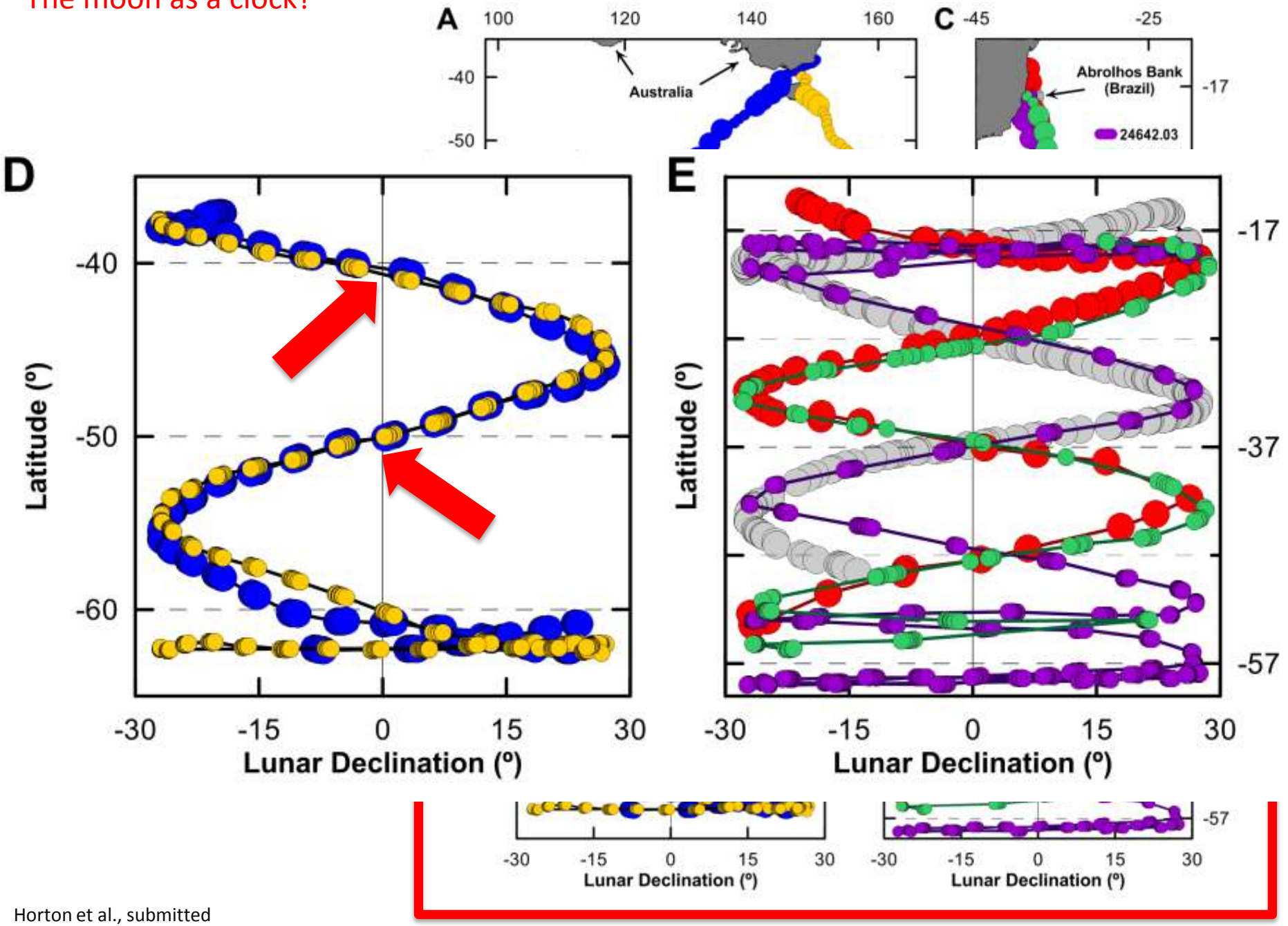
Straight as an arrow ….

- Precise navigation during migration
- “Constant course” for hundreds kilometers with precision often within 1°
- Need to better understand navigational cues used by these animals



Horton et al., 2011

The moon as a clock?



Horton et al., submitted

Concluding remarks

- Satellite tagging has become an powerful non-lethal technique to understand various aspects of the biology of large whales and to promote their conservation

- Complements and sometimes provides more detailed information than other methods used to study movements and migration

- Progresses in technological development will likely improve satellite telemetry methods in the near future and make it more efficient and more accessible to scientists interested in large whale research


MUCHAS GRACIAS !