UK Marine Environmental Mapping Programme (MAREMAP)

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Fine-scale insight into basking shark, porpoise & foraging seabird distribution around a rocky reef

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Aims

Identify & quantify controls on short-term distribution (and concentrations) of porpoises & foraging seabird aggregations

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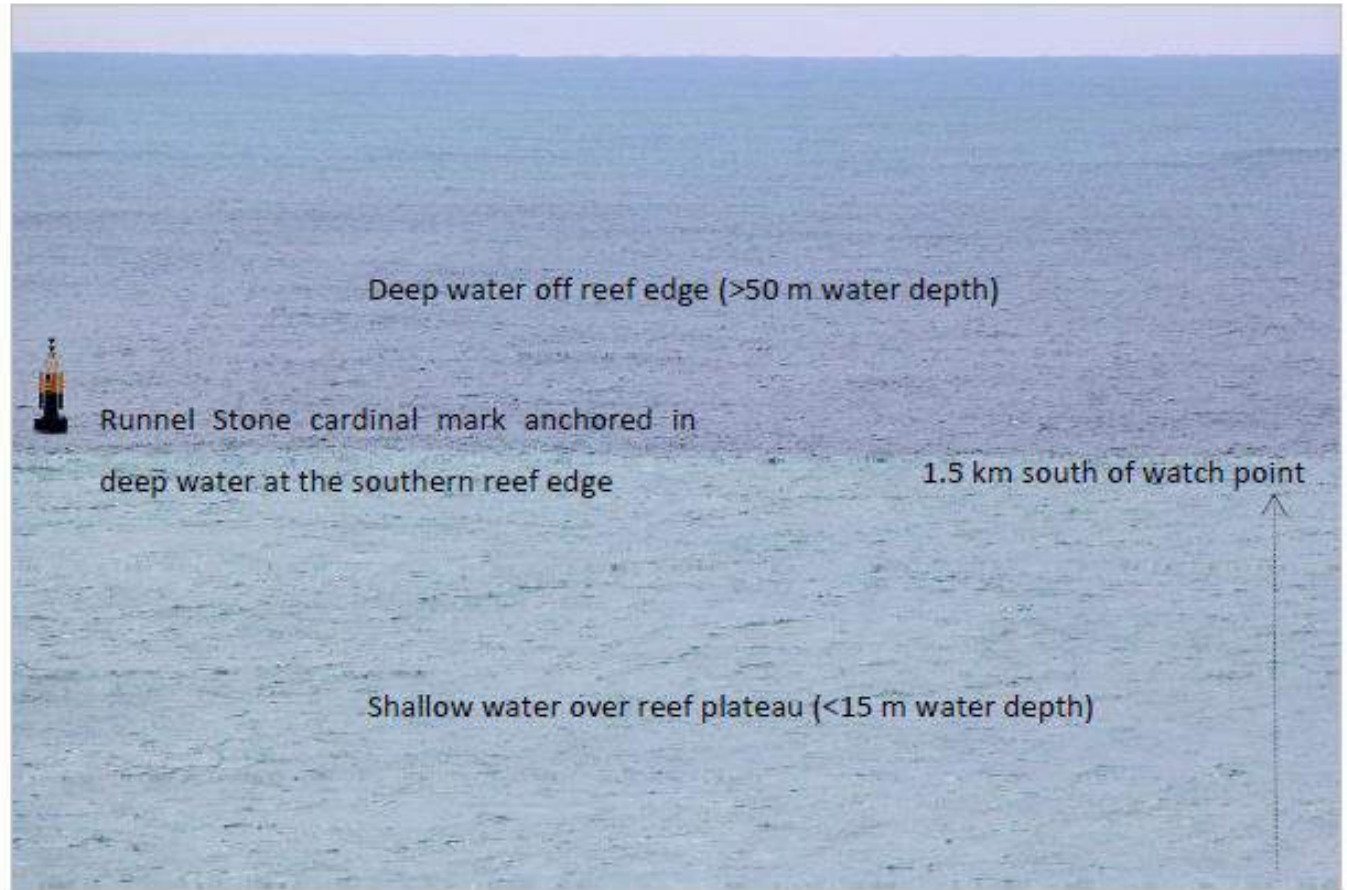© S Butler-Cowdry

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Rationale

- Current policy drivers (e.g. MPA designation & management) require low-cost survey methods to collect robust & appropriately-resolved data

- Human impacts increasing (e.g. wet renewables)

- When & where species visit nearshore waters during important stages of their lifecycle (e.g. breeding, feeding, migration)

Runnel Stone Reef MCZ (Jan '16)
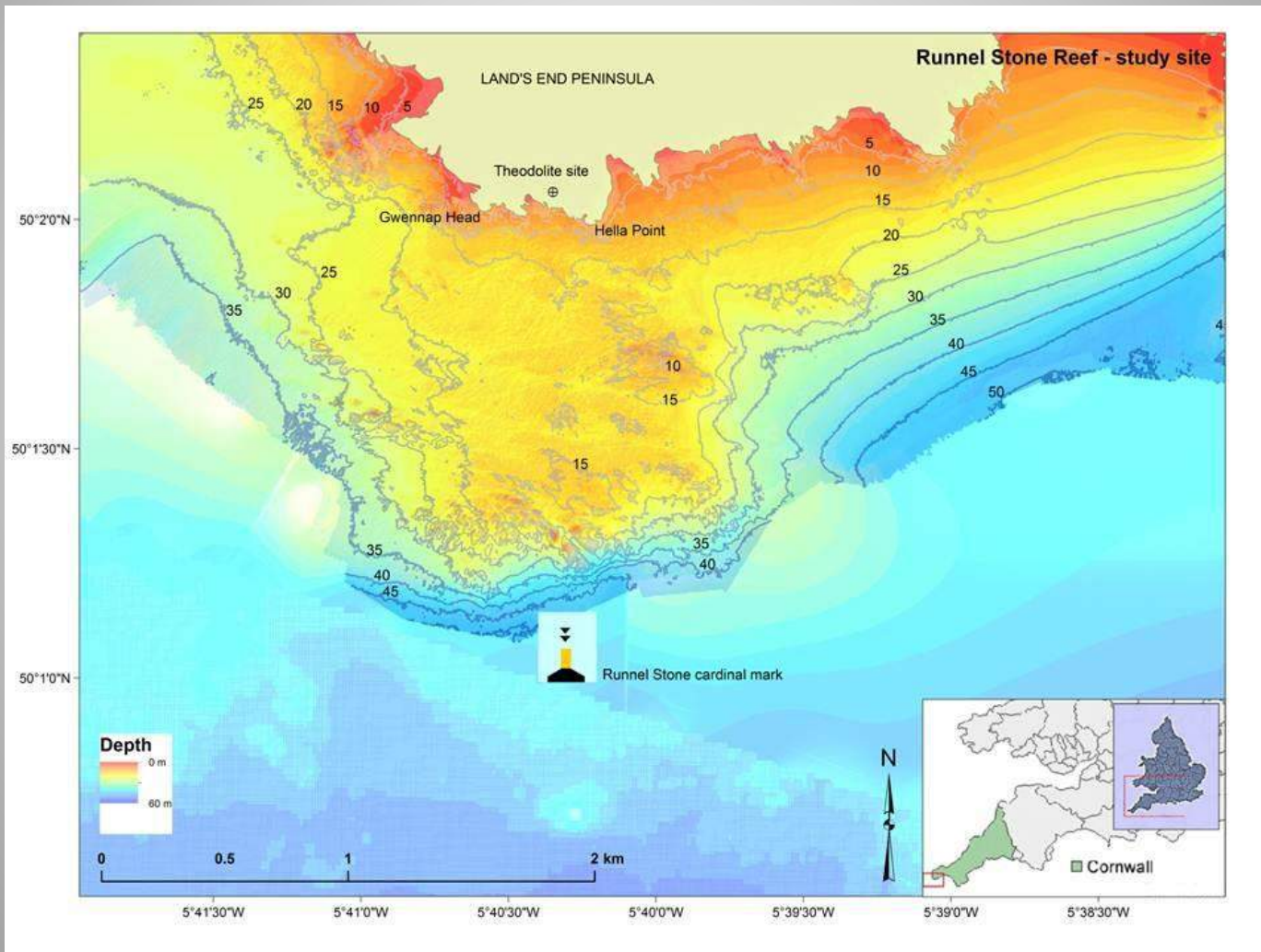
Difficult survey environment

- Tidally-swept
- High energy
- Bedrock-dominated
- Prevailing Atlantic winds
- SW swell

Deep water off reef edge (>50 m water depth)

Runnel Stone cardinal mark anchored in deep water at the southern reef edge

1.5 km south of watch point

Shallow water over reef plateau (<15 m water depth)

Reef edge clearly demarcated by colours of different water masses due to depth change.

Shear zone at outer reef edge
Separates water flows of different velocities:

- Shallow, fast-moving
- Deeper, slower moving

Data Collection

- <u>Theodolite</u>

  Records angles relative to known GPS points – accurate positions of object at sea surface.

  5x more accurate & unobtrusive than conventional visual monitoring.

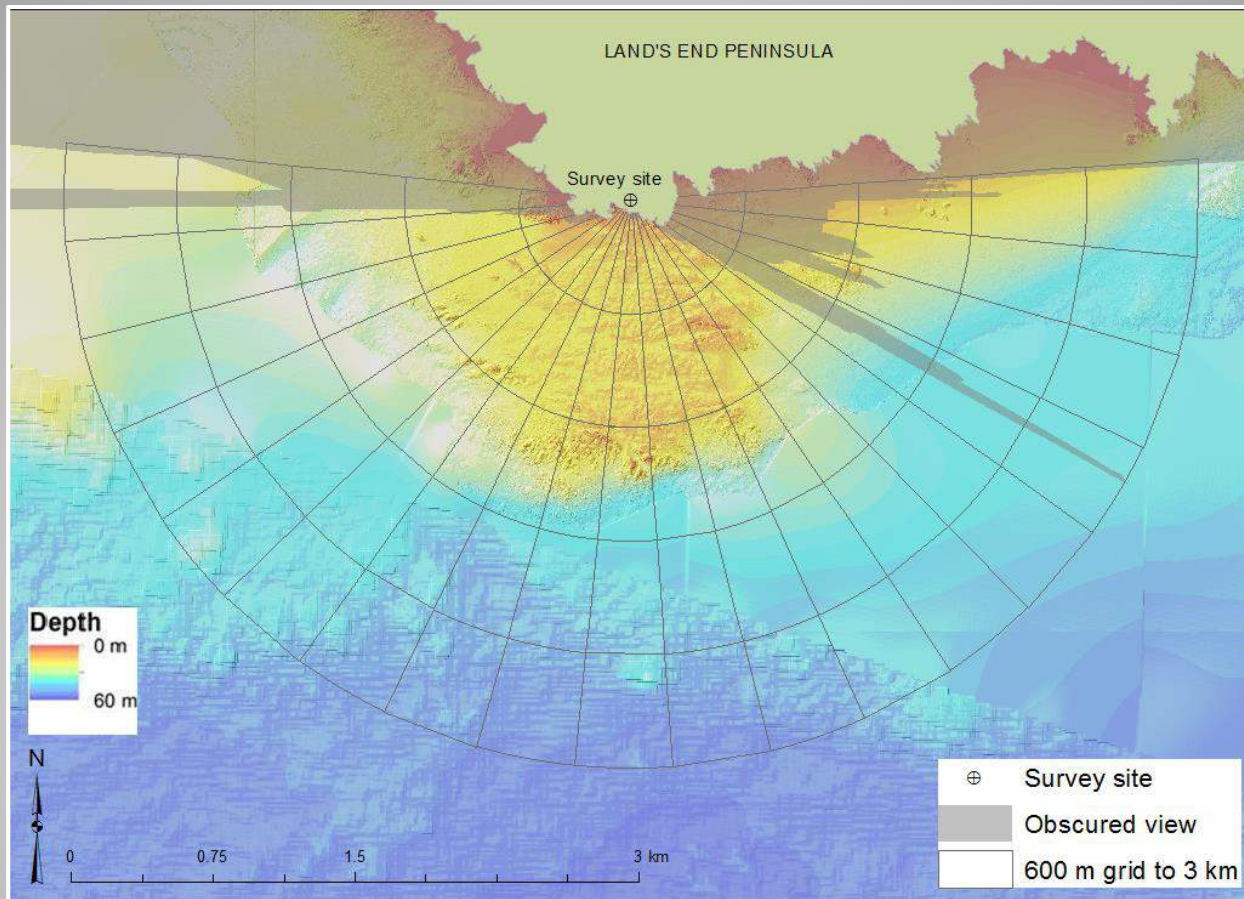 Useful where other monitoring methods not practical (e.g. boat-based surveys).

Photo: R Wynn

Observation team

Conditions:

Visibility >5 km, sea state ≤3

Years 2011-2013

404 hours over 55 days

Observations filtered by number of different sighting IDs each **30-minutes per 600-m grid cell out to 3 km**.

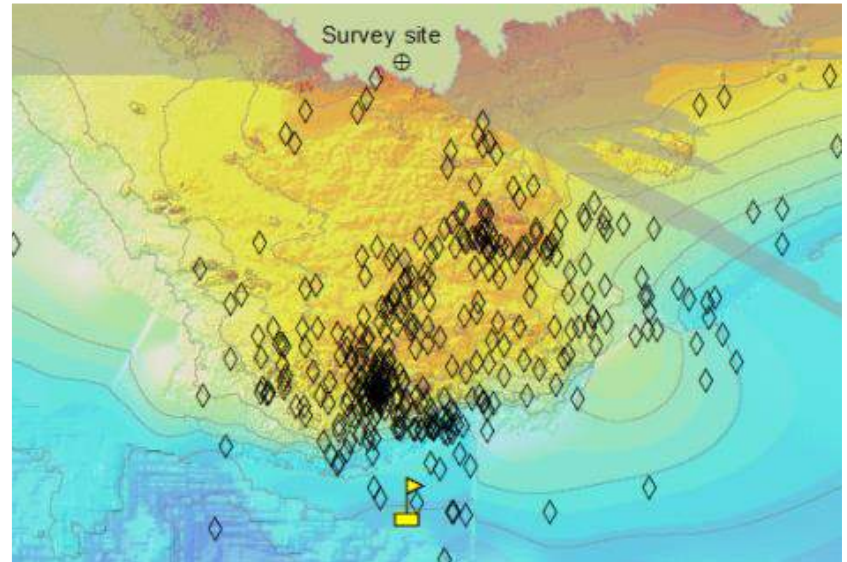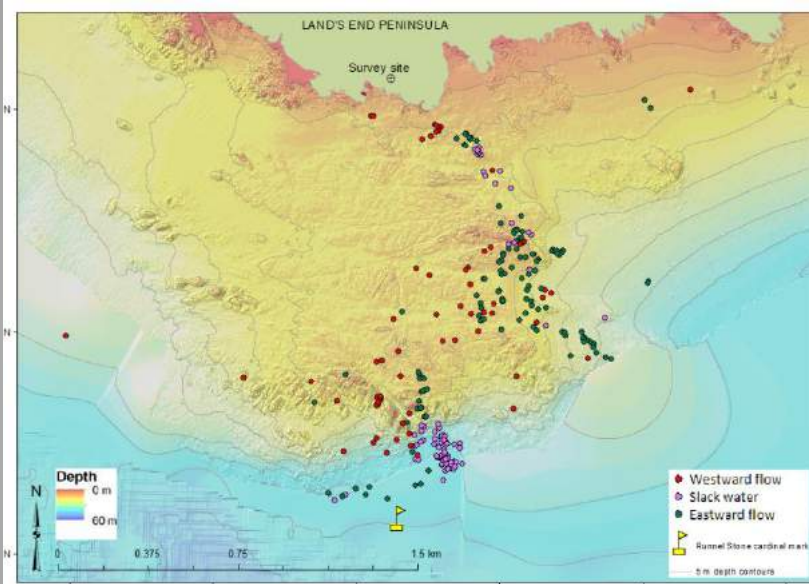= _Measure of **relative** habitat use._

'Tidal-topographic' features

- Physical processes interact w/ complex topography

- Counter-currents & eddies form surface 'boils' downstream of topographic features
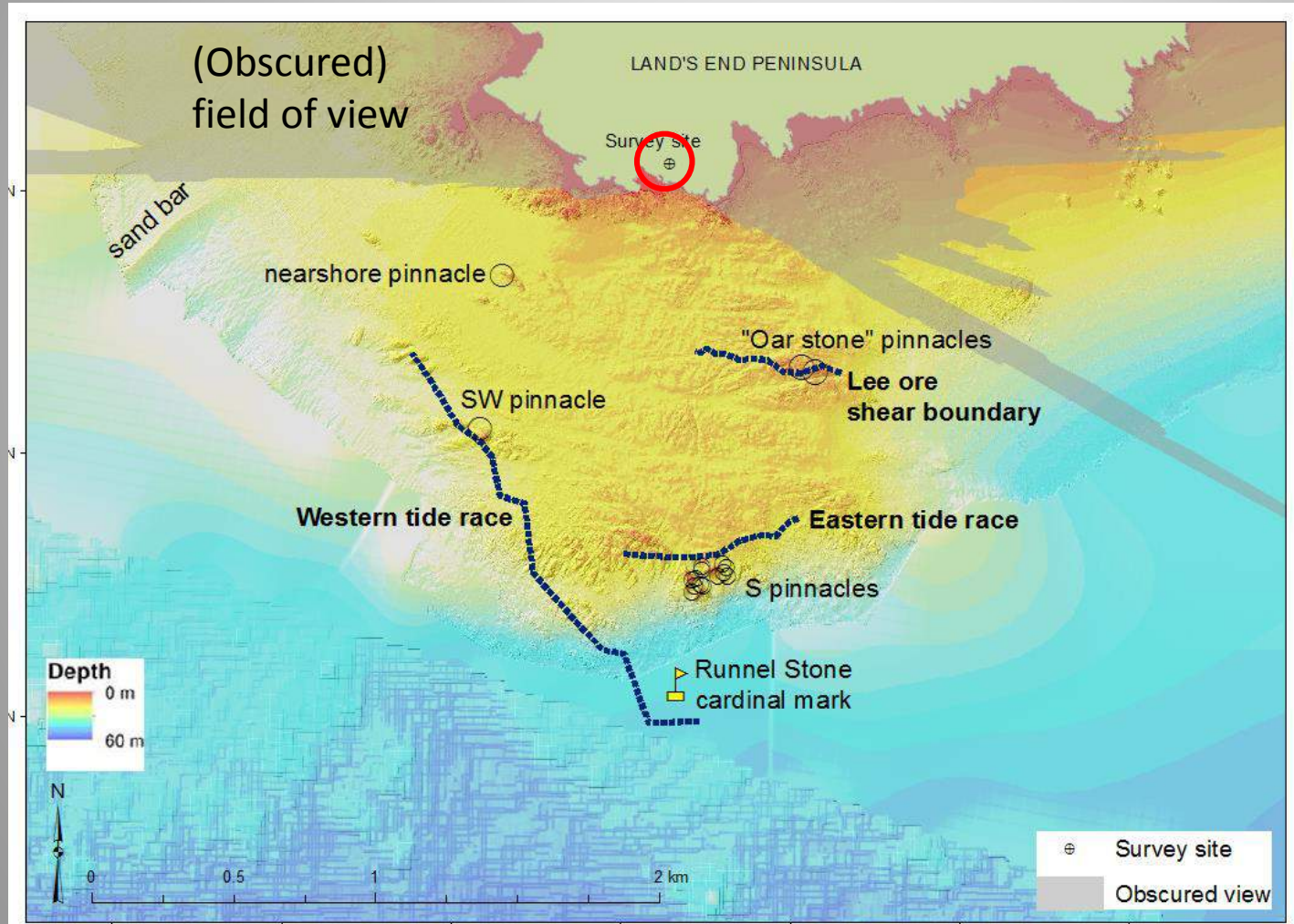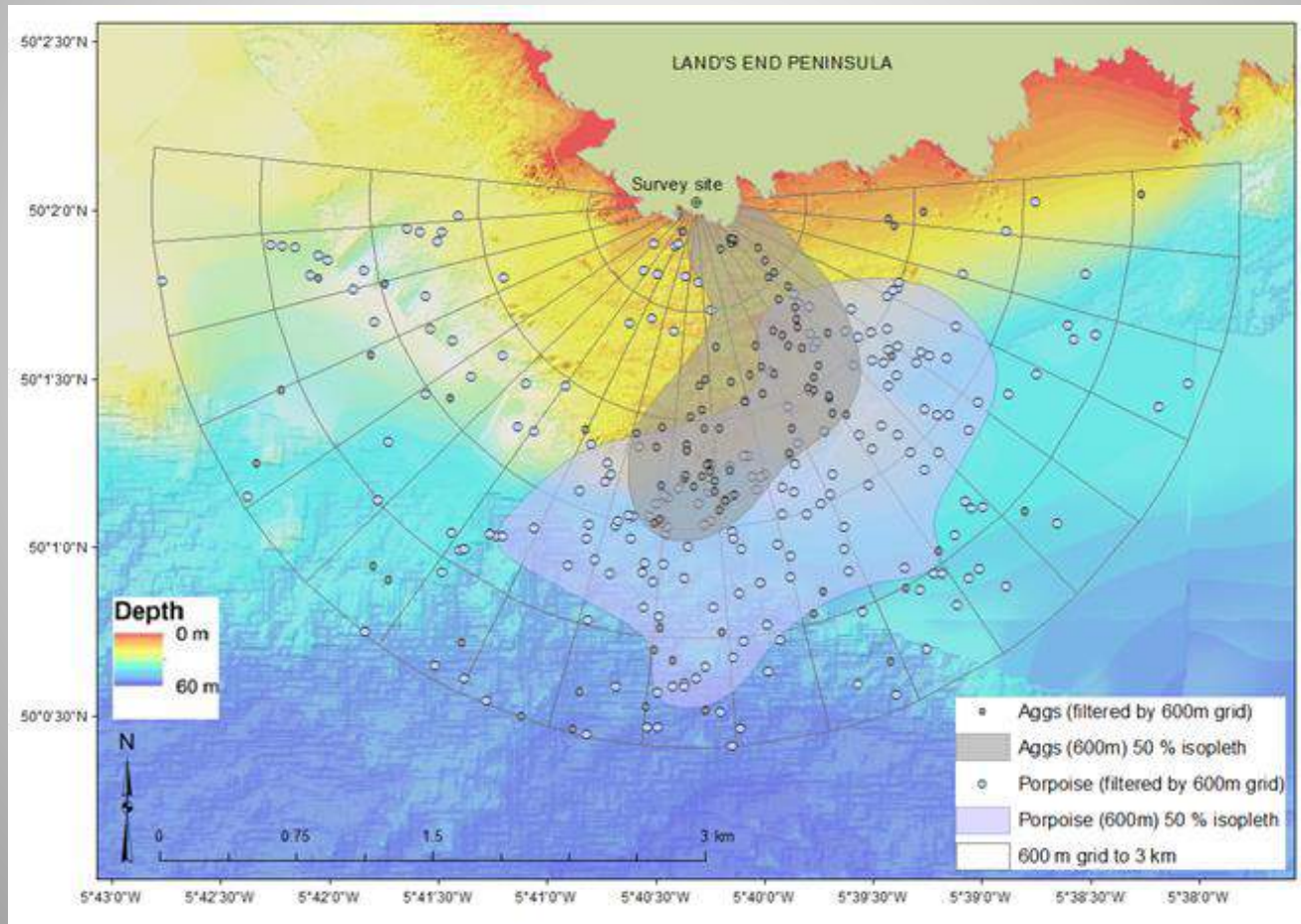
Key Results

Seabird feeding aggs (n = 110)   **Line fishing vessels** (n = 492)

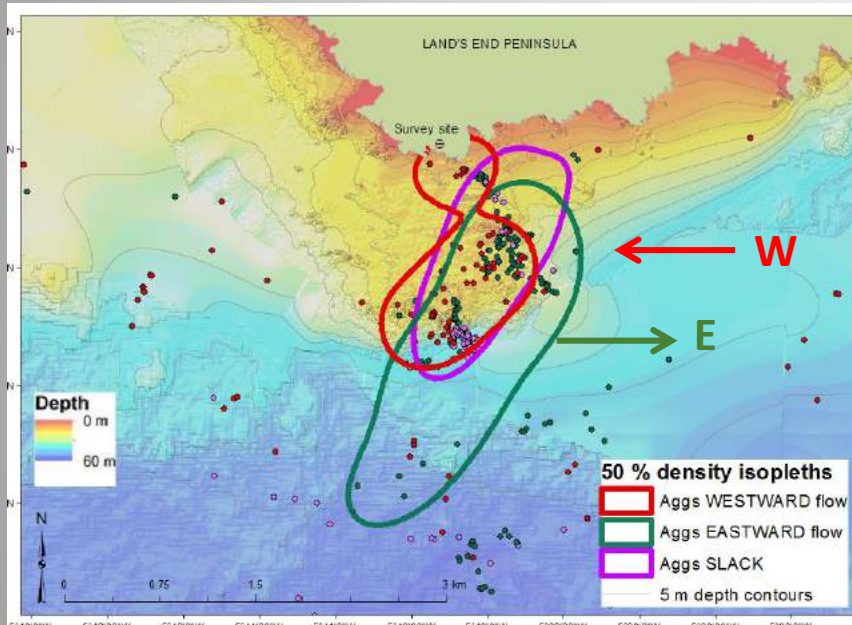
- Overlapping spatial preferences (significant r = 0.83, p < 0.001)
- **Clustering around topographic highs** at reef margin
- Few obs in water deeper than 30 m
- Notable **absence in western quadrant**
- (Minimal interaction/impact)
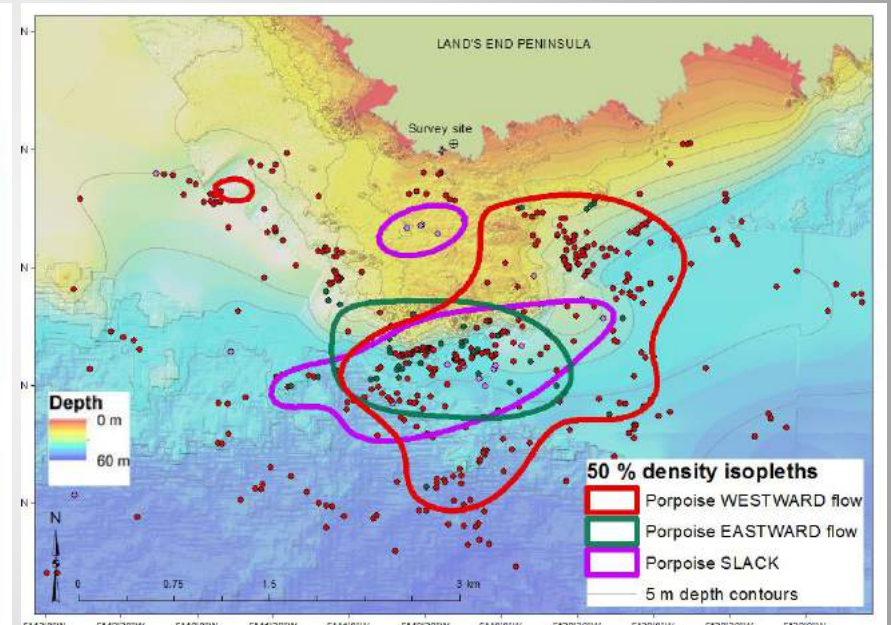
Core habitat: feeding seabirds vs porpoises

Sightings filtered by tide

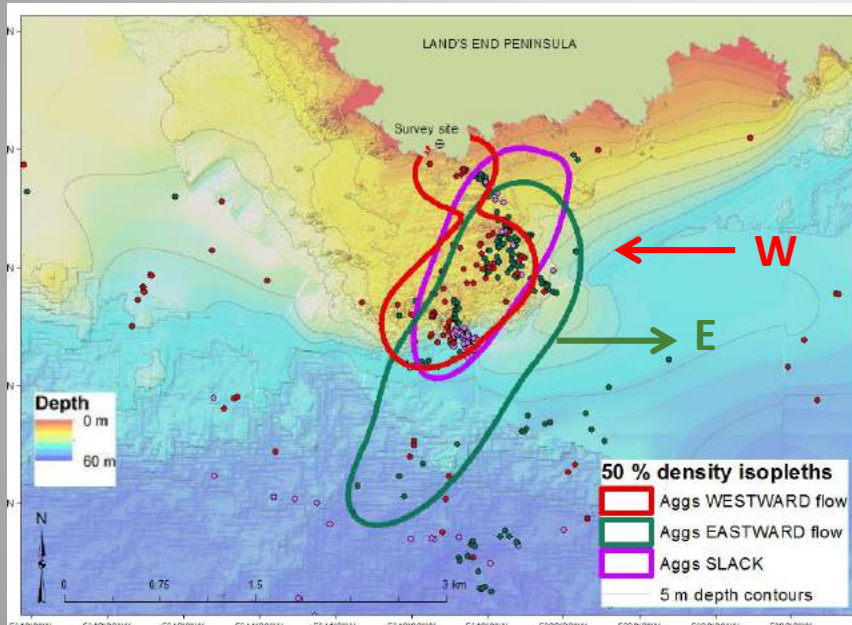**Seabird feeding aggregations**   **Harbour porpoises**

- *Eastward*: <u>Seabird</u> feeding events dispersed along eastern reef margin
- *Westward*: restricted to shallower (<20 m) areas of plateau
- *Westward*: more strongly associated w/ topographic highs
- *Slack*: clustered in concentrated area south of S. pinnacles

Sightings filtered by tide

Seabird feeding aggregations **Harbour porpoises**
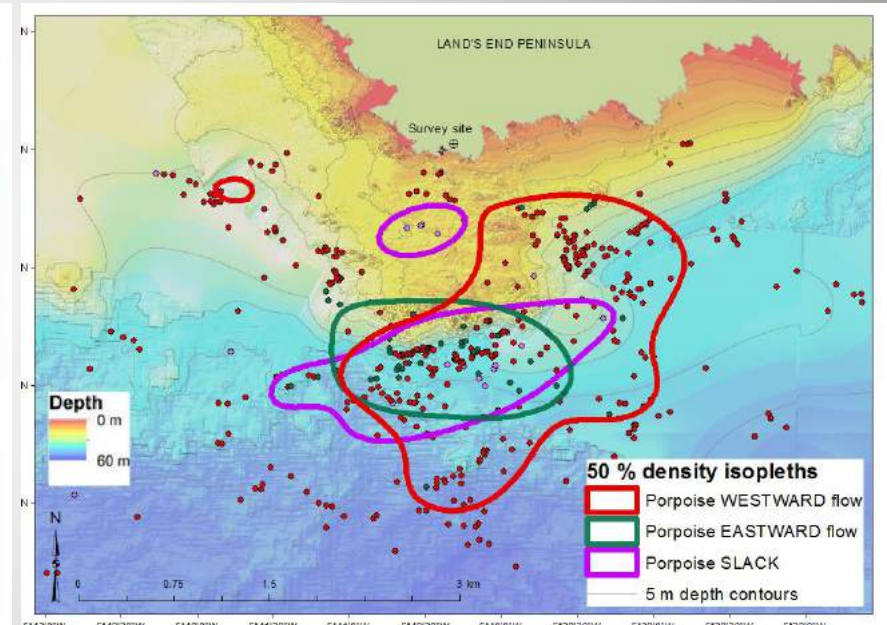
- <u>Porpoises</u> core habitat areas overlap
- Three kernels share concentrated area adjacent to S. reef margin
- Notable **absence in western quadrant**
- *Westward*: sightings more dispersed (different to seabirds)

Environmental controls on distribution

(Results from modelling)

Tidal range = proxy for time in the spring-neap cycle

| Species	SEABIRDS	PORPOISES
SPATIAL COVARIATES		
Mean depth	2	1
Mean slope	1	2
Mean aspect	3	
(Interaction?)	(Slp:Dep) 4	(Slp:Asp) 3
TEMPORAL COVARIATES		
SURVEY VARIABLES		
Significant wave height		3
Sea state		
Cloud cover	2	2
Wind speed	1	1
Wind direction		4
TIDAL VARIABLES		
Tide direction		6
Tide speed		
Tide height		
Tidal range	3	5
Tidal hour		
Tidal flow group		
TEMPORAL VARIABLES		
Month		
Hour	4	

Basking sharks (n = 36)

- Aligned adjacent to visible tidal boundaries at interface of faster and slower water masses *off* reef edge

- Aligned w/ shear zones in shallower areas of reef plateau

- 11 sharks tracked for >10 mins
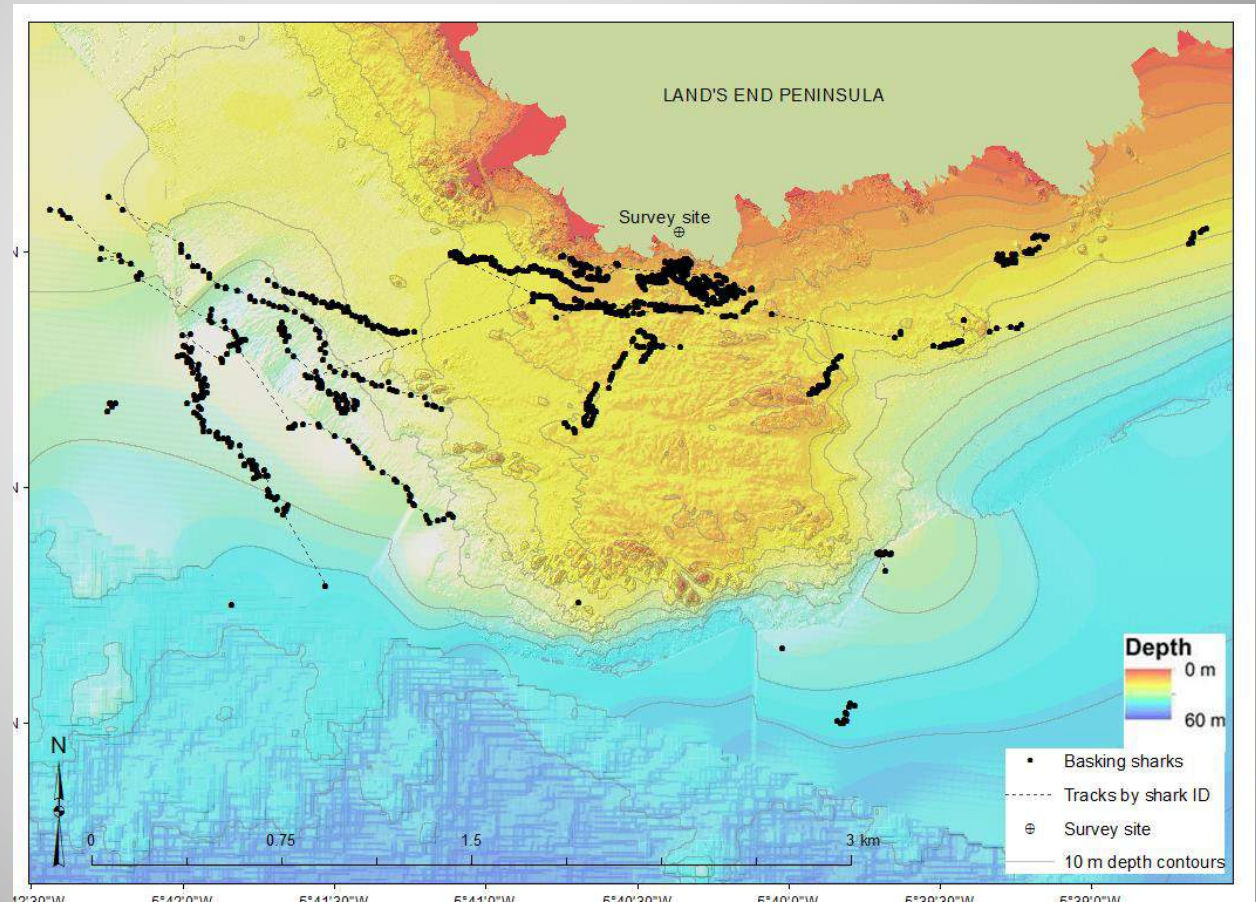
Single basking shark track

- High resolution in time (<30 secs) and space (20-m)
- Moving back and forth over a 40-m distance
- Tracked over 18 minutes
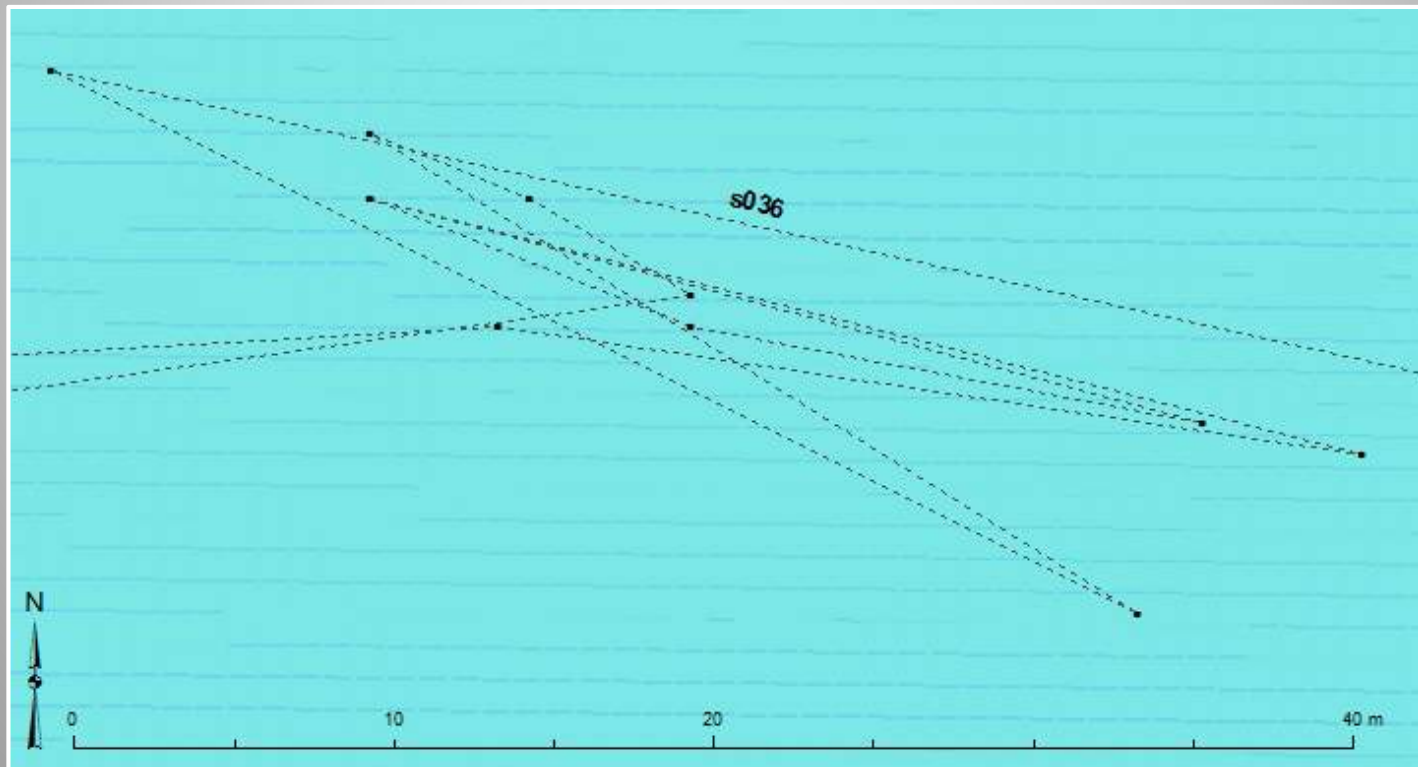
Shore-based X-band marine radar

- To supplement ADCP
- Digitally recorded images of sea surface
- Analysis of wave properties based on linear wave theory
- Interpreted to map shallow water areas (up to 4 km)

LAND'S END PENINSULA

NCI

sand bar

Runnel Stone Reef

N

© Dr Paul Bell (NOC-L)
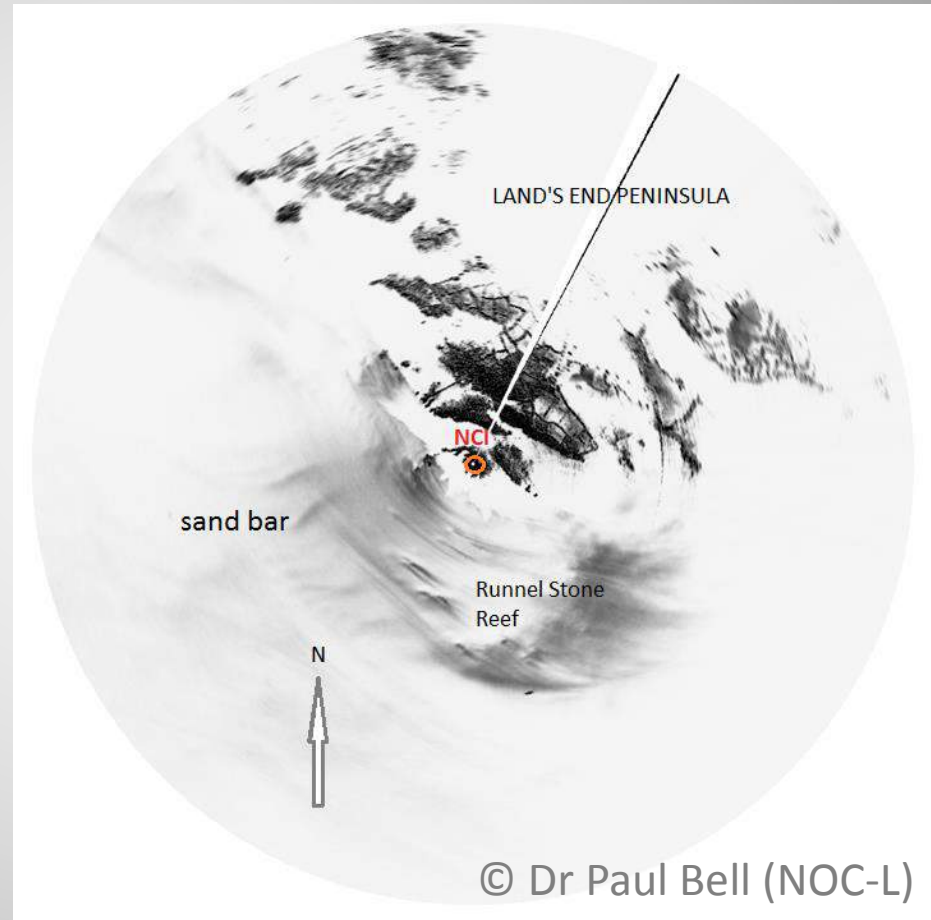
Linear 'shadows' to east of topographic highs indicate eastward flows during this recording

Radar-derived current flows

- Hourly measurements
- Complete tidal cycle during a spring and neap

- Speed and vector
- 160-m resolution
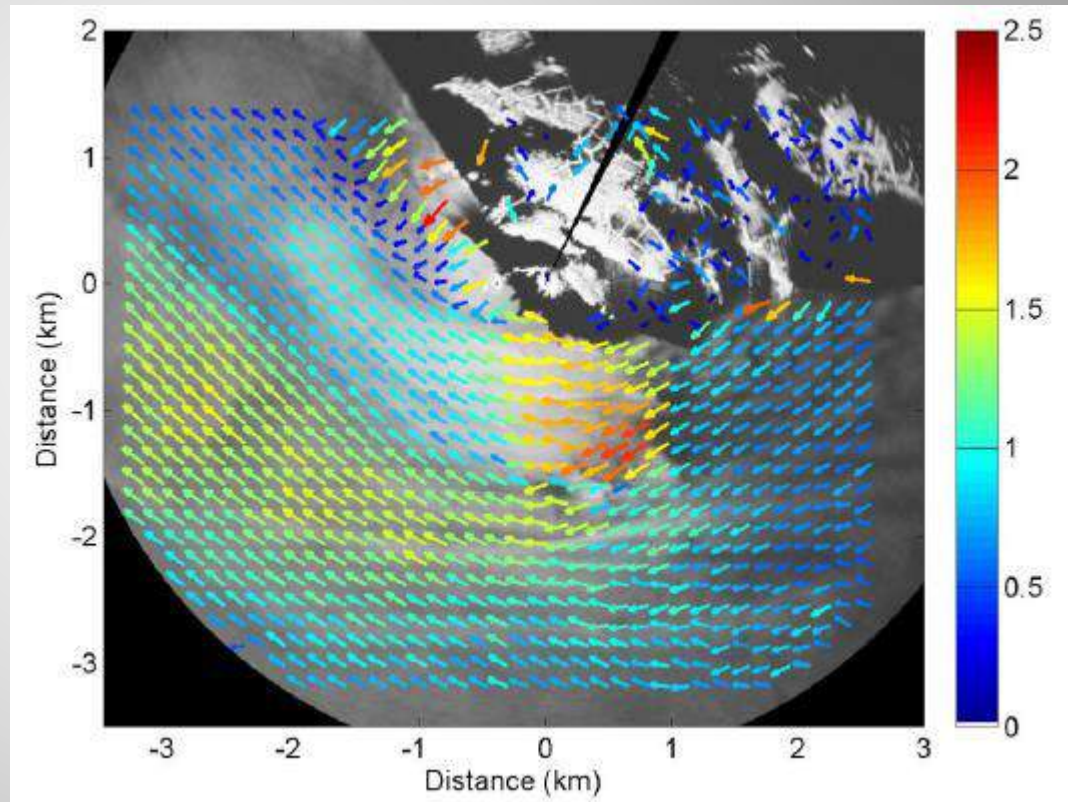
Future analysis

- Flow information attributed to each 'segment' of a shark track

- Movement information will be analysed in relation to extremely high resolution flow information (TEMPORAL), as well as static bathymetric covariates (SPATIAL).
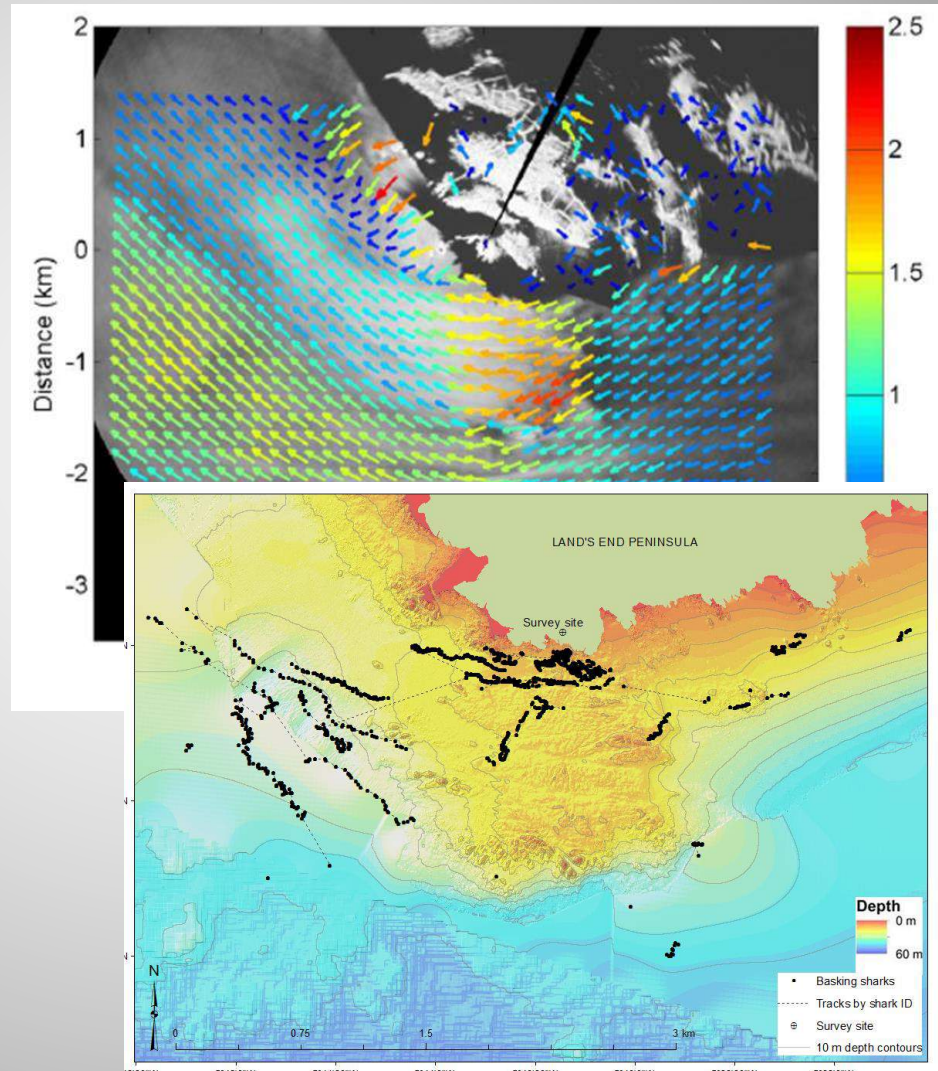
Conclusions

- Range of fine-scale survey methods

- Each species exhibits niche distribution patterns and/or preferential habitat use

- Application for conservation & marine management regimes

- 'Hotspot' areas suggestive of localised zones of enhanced prey availability

(Photo: S Butler-Cowdry)

Acknowledgements

- MAREMAP partners
- NOC
- NERC

Further info, see my e-thesis

(Photo: Marine Discovery)

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