Movements of the plankton-feeding manta ray *Manta alfredi* and dynamics of the East Australian Current :

Preliminary results on reasons for movement and diving behaviour

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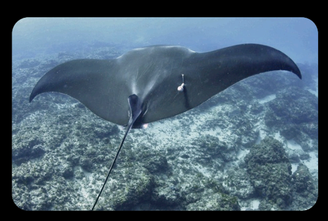
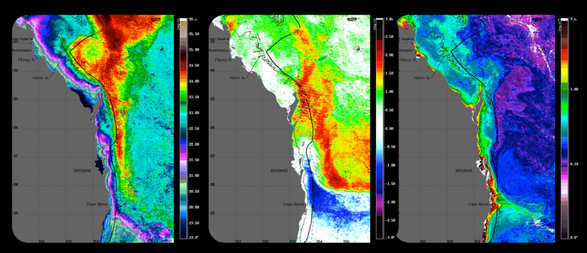
INTRODUCTION

- In eastern Australia, the newly re-described plankton-feeding manta ray *Manta alfredi*[1] seasonally migrates along the coast and is known to visit several localities along the way[2]
- To date, most research efforts worldwide have focused on assessing population status of the pelagic ray at particular geographical locations, and only recently has knowledge on the basic behaviour and ecology of *M. alfredi* improved
- Some important questions remain unanswered: Where do animals go and why? How does *M. alfredi* use the water column?
- This study aims to fill knowledge gaps in regards to the ecology of *M. alfredi* through the examination of ocean dynamics and productivity in relation to movement patterns of individual rays

HYPOTHESIS

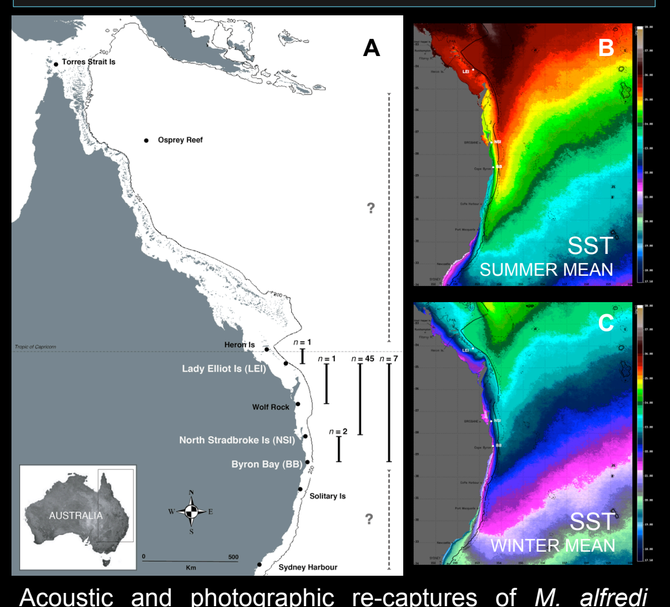
The seasonality in strength of the East Australian Current (EAC) dictates movements of *M. alfredi* along the east Australian seaboard: animals travel up and down the coast in relation to thermal fronts associated with shelf-edge upwelling of nutrient-enriched waters, ultimately favouring plankton availability.

MATERIAL & METHODS

Photo-Identification	Acoustic Telemetry	Satellite Telemetry	Remote Sensing
	  	 	 Sea Surface Temperature; SST Anomaly; Chlorophyll-*a* concentration
To identify animals and monitor spatio-temporal occurrence *using:* markings on ventral surface that are unique to each individual	To examine occurrence and residency patterns of animals *using:* V16 coded tags (Vemco) and array of VR2W receivers via AATAMS	To explore detailed movements and diving behaviour of animals *using:* Mk10-Pop-up Archival Transmitting tags (Wildlife Computers)	To relate movements to regional oceanographic processes *using:* MODIS SST & Chlorophyll-*a* 1km resolution products (NASA)

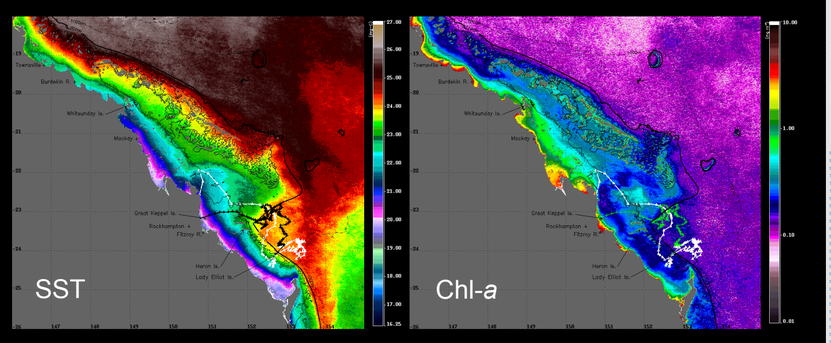
RESULTS

Distribution



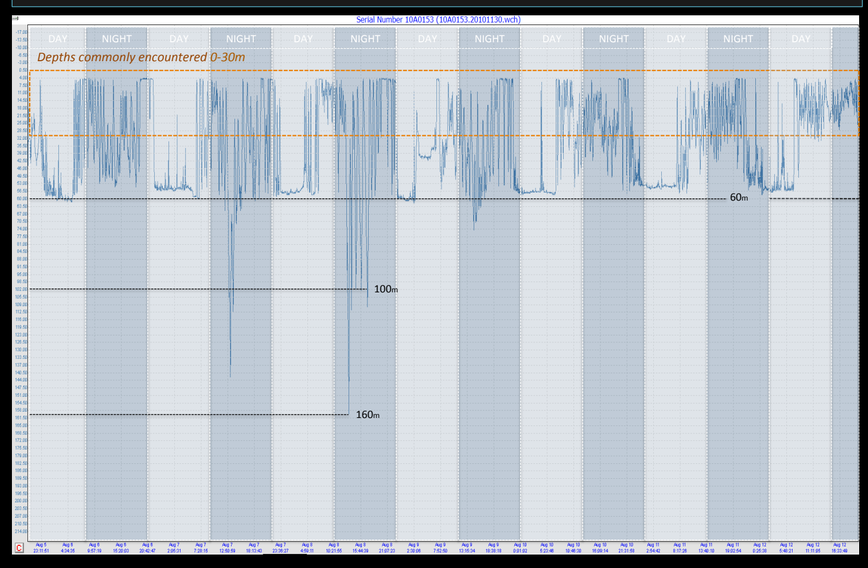
Acoustic and photographic re-captures of *M. alfredi* individuals in eastern Australia from 2005 to present (A) revealed seasonal visitation patterns at certain localities, with *M. alfredi* present at NSI and BB exclusively during summer and peaking at LEI in winter[2,3], coincident with frequent shelf-edge upwelling from NSI southward during summer[4,5] when EAC flow is strongest (B) and eddy-driven upwelling[6] near LEI in winter (C).

Horizontal movements



Light-based movement tracks for male #394 (white) and female #309 (black, green) between 27/06/10 and 15/10/10, overlaid onto SST and Chl-*a* means for the same period. Tracks show movements mostly localised off or around the shelf break, coincident with presence of cyclonic Capricorn Eddy[6] known to trigger upwelling of nutrient-enriched waters and subsequent zooplankton availability.

Vertical movements



Typical vertical movements for female #309 between 05/08/10 and 12/08/10. Examination of raw dive data after recovery of the tag revealed that the animal spent the majority of its time at depths greater than those where *M. alfredi* is usually observed (0 to 30 m). Results show considerable differences in behaviour between day and night, with the animal undertaking extensive vertical movements at night and long periods at depths of 50-60m during daytime (up to 10 consecutive hours). Occasional dives to greater depths were also recorded for this animal, with deepest point at 302 metres.

CONCLUSIONS

- *Manta alfredi* regularly undertakes mesoscale movements along the east Australian seaboard and visits specific localities
- Seasonal distributions of *M. alfredi* seem to coincide with EAC seasonality, upwelling frequency and subsequent food resource availability
- *Manta alfredi* appears to be capable of undertaking extensive vertical movements to locate and exploit specific layers of the water column
- This study represents the first detailed investigation of the movements and diving behaviour for *M. alfredi*, providing further insights into the ecology of this large planktivore

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References:
[1] Marshall et al. (2009). *Zootaxa* 2301:1-28
[2] Couturier *et al.* (in press). *J. Mar. Fresh. Res.*
[3] Jaine *et al.* (in prep). *Mar. Ecol. Prog. Ser.*
[4] Roughan & Middleton (2002). *Cont. Shelf Res.* 22: 2551-2572
[5] Roughan & Middleton (2004). *J. Geo. Res.* 109: C07003
[6] *Weeks et al. (2010). Coral Reefs* 29(4): 975-985