National Environmental Research Program

TROPICAL ECOSYSTEMS hub

A Synthesis of NERP Tropical Ecosystems Hub Project 6.3 Research Outputs 2011-2014

Compiled by RRRC

Seabird Foraging on the Great Barrier Reef

Islands and cays of the Great Barrier Reef support breeding populations of 20 seabird species, including wedge-tailed shearwaters.

These seabirds are top level predators whose feeding and reproduction success is linked to both local and large-scale ocean circulation. As sea-surface temperatures continue to rise with global climate change, it is predicted that there will be substantial negative impacts on seabird populations of the Great Barrier Reef.

A team of researchers from James Cook University mapped main feeding (foraging) areas for Great Barrier Reef breeding shearwaters at three scales: near-colony, at-distance, and overwinter migration areas.

The team found that, during breeding, adults use only near-colony foraging grounds to feed chicks. Foraging activity and prey availability at these sites is linked to ocean dynamics and river flood plume characteristics adjacent to the coast.

Many important sites are outside the Great Barrier Reef Marine Park and overlap with known commercial fisheries. Great Barrier Reef shearwaters overwinter in Micronesia where there are significant commercial tuna fisheries. This finding raises further conservation concerns for this species.

The project results provide new insight into the factors that determine seabird feeding and reproduction success in tropical ecosystems. They provide a basis for predicting how climate variation or other human pressures may impact seabirds in the future.

Importantly, the results show the dynamic nature of ocean features important to seabirds, highlighting the need for future research that assesses the effectiveness of traditional verses alternative designs for marine protected areas.

Photo: Pichost.me

Near-Colony Foraging

Adult wedge-tailed shearwaters use only near-colony foraging grounds to feed chicks during breeding. Most feeding trips last one day. Near-colony feeding occurred in five distinct regions within 300 km of the colony (**Figure A**).

A range of ocean features were important in defining feeding habitat within these five regions.

In all regions, foraging was more likely to occur nearer to steep sea-surface temperature (SST) gradients.

In the inshore zone (area 1), there was a strong association between feeding activity and the location of freshwater plumes, as well as links with higher than average chlorophyll-a levels. These associations were not apparent elsewhere.

Year to year variation in the success of reproduction of wedge-tailed shearwaters breeding in the southern Great Barrier Reef was found to be affected by the 'Capricorn Eddy'. This influenced chick feeding rates and meal sizes independent of foraging site used.

Feeding areas 2-5 are all regions where the edge of the Capricorn Eddy interacts with steep underwater topography (**Figure B**). These areas are likely upwelling zones where cooler ocean waters are brought into contact with the warmer shallower waters of the Great Barrier Reef lagoon. The intensity and scale of the eddy in any one season determined it's likely influence on food availability.

Foraging area 1 is where ocean waters from the Capricorn Eddy interact with freshwater river plumes carrying terrestrial inputs. High levels of feeding activity are clearly associated with the gradients created by the meeting of these waters, suggesting significant enhancement of prey availability.

These findings highlight the importance of river dynamics and terrestrial inputs on the success of reproduction each year.

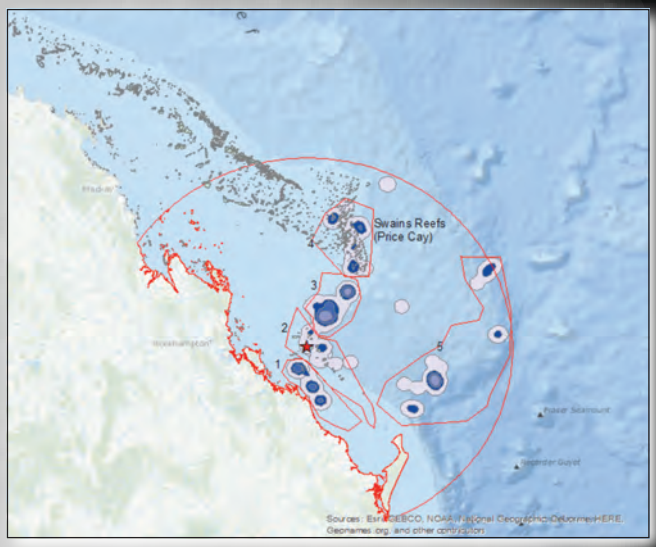

Figure A. *The five principal foraging regions used by southern GBR breeding wedge-tailed shearwaters when obtaining food to feed chicks.*

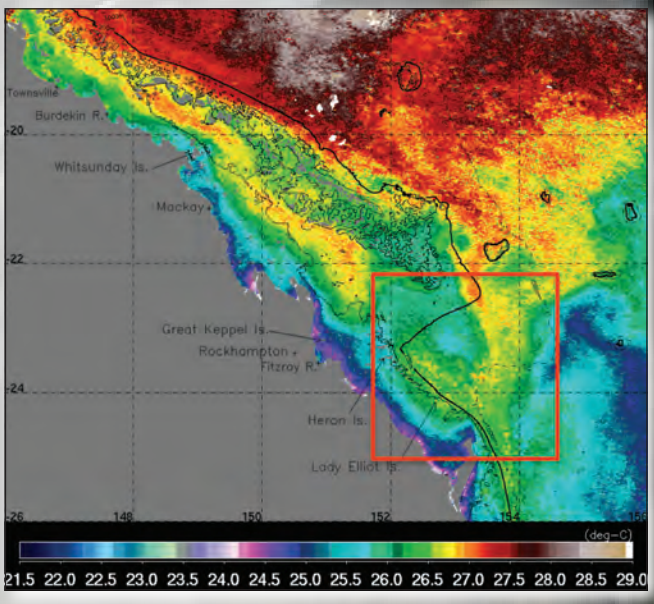

Figure B. *Sea-surface temperature (SST) satellite image demonstrating the activity of the 'Capricorn Eddy' (enclosed within the red box) interacting with steep bathymetry along the continental shelf edge adjacent to the Capricorn-Bunker and Swains Reef regions in the southern GBR.*

Photo: Brad Congdon

At-Distance Foraging

Seabird breeding colonies from Heron Island, Lord Howe Island and New Caledonian use at-distance foraging areas that do not overlap significantly. This lack of overlap implies food resources accessed by each colony during breeding are distinct and that reproductive success at each location is determined by local ocean conditions.

On Lord Howe Island, data on an entire chick-rearing period has been used to highlight the influence of the lunar cycle on food availability and chick feeding rates at this breeding location.

Shearwater foraging locations and activity at medium and larger spatial scales significantly overlaps and potentially interacts with a number of important commercial fisheries, including the Western and Central Pacific Tuna Fishery, which is the world's biggest tuna fishery.

These findings raise significant conservation concerns for seabirds feeding in these waters. The data collected on prey dynamics can be used to help predictions of the likely consequences of changing ocean circulation on prey availability to other top predators in these fisheries.

Overwinter Migration Foraging

Wedge-tailed shearwaters breeding in the southern Great Barrier Reef migrate 6,000 km north to a single foraging area to the east of Guam in Micronesia (**Figure C**). These are the first tropical tube-nosed seabirds known to migrate a long distance across the equator in winter.

Migration patterns and non-breeding feeding sites are highly consistent between years. Core areas have notably high sea-surface temperatures, very low wind speeds and low primary productivity. These are ocean features normally thought to produce poor foraging habitat.

Feeding associations with sub surface predators considerably improve prey availability to shearwaters beyond what would be expected. Any significant reduction in subsurface predators due to commercial fishing could be a serious threat to the survival of non-breeding shearwaters.

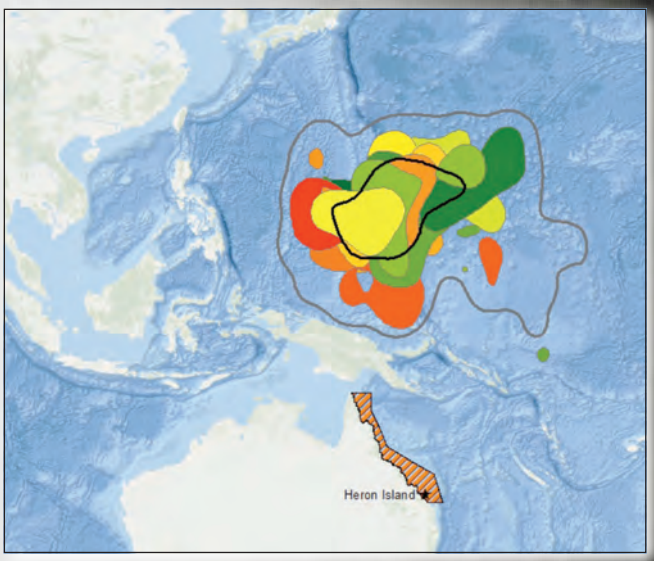

Figure C. *Core foraging areas for adult non-breeding wedge-tailed shearwaters from Heron Island on the southern Great Barrier Reef (GBR), from May to October/November 2012.*

Changing Conditions & Adaptation

Studies of seabirds breeding in the southern Great Barrier Reef indicate that regional changes in sea surface temperatures influence shearwater feeding rates and meal sizes; and prey availability to other species.

There is also a direct link between shearwater prey availability, sea surface temperatures and patterns of water stratification driven by the Capricorn Eddy.

The Capricorn Eddy plays a significant role in regulating forage-fish dynamics. There is a direct link between prey availability and chick growth and survival to ocean indicators that can be used to identify potential tipping points of change in the system.

Variability within years indicates other important driving factors, including freshwater flood plumes that influence shearwater feeding behaviour at some locations accessed by southern Great Barrier Reef breeding seabirds.

The survival of chicks is not just dependent on changing ocean conditions, but also on the ability of chicks to compensate for changes in prey availability and/or the ability of adults to compensate by altering feeding behaviour.

Previous studies of two species breeding on the southern Great Barrier Reef indicate that chicks have limited capacity to adapt in response to rapid changes in food availability.

Studies of adult wedge-tailed shearwaters at Heron Island found limited ability to compensate for rapid changes in food availability by changing feeding behavior. This indicates a limited capacity to respond to rapid changes in chick requirements and that, during periods of poor food availability, adults maintain their own condition at the cost of chick growth and survival.

It is concluded that breeding seabirds would be unable to adapt to any rapid reductions in food availability as expected under existing climate change scenarios. This would, lead to negative impacts on overall chick survival, colony reproductive output and long-term breeding success.

Further Reading

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Photo: Nickj (Wikipedia)