Migrations and patterns of seabird occurrence in the Kermadec region

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Seabirds are a highly visible component of the Kermadec region's marine environment; they are also an important top-order predator. This paper discusses the occurrence and foraging behaviour of seabirds that breed on the Kermadec Islands and those that visit the region. Six of the 14 resident seabirds are pelagic feeders that forage over a large area (<1,000 km) during the breeding season, while other residents capture a large proportion of their food in waters immediately surrounding the islands. Seabirds of southern, subtropical and tropical origin generally occur within the Kermadec region during non-breeding migration, but some species that nest far from the region also visit during their breeding season. At-sea observations since 1970, together with recent tracking studies of species from northern New Zealand off-shore islands and western North America, provide spatio-temporal information about distributions. Detailed information about the foraging biology of the region's seabird taxa and marine habitat affinities is either fragmentary or non-existent. Extralimital subtropical Pacific Ocean studies are included herein to discuss likely foraging behaviour and diet.

DISCUSSION

Observations of seabirds collected from ships approaching the Kermadec Islands reveal patterns of occurrence and distribution at sea. Upon departing New Zealand, seabirds with limited ranges at sea including the gulls, terns, gannets, penguins and some petrels and shearwaters, are left behind at the shelf edge. Once in oceanic waters, pelagic species are encountered and include a mix of birds breeding on New Zealand northern off-shore islands together with birds from New Zealand sub-Antarctic islands and possibly farther afield. Mid-way between New Zealand and the Kermadec Islands, sightings of birds include those that breed on the Kermadec Islands. All Kermadec Islands, and presently with the exception of Raoul Island, are crowded with seabirds. Once within the islands' vicinity, the number of seabirds increases dramatically: not only those with smaller foraging ranges such as the Kermadec shearwater (*Puffinus assimilis kermadecensis*), white-bellied storm petrel (*Fregetta grallaria grallaria*), Kermadec storm petrel (*Pelagodroma albiclunis*) (Figure 1), grey ternlet (*Procelsterna cerulea albivitta*) and black noddies (*Anous minutus*) (C Gaskin pers obs.), but also those that undertake vast pelagic movements to and from their colonies, for example, the Kermadec petrel (*Pterodroma neglecta neglecta*), white-naped petrel (*P. cervicalis*) (Figure 2) and sooty tern (*Onychoprion fuscata serrata*) (C. Gaskin, pers, obs.). Observations include birds resting or preening on the water around the islands, as well as some visitors from farther afield.

Bird-borne tracking data gained from geolocators and satellite tags provide us with insights into oceanic range utilisation in more detail. Grey-faced petrels (*Pterodroma macroptera gouldi*) breed in New Zealand during winter. Consistent with at-sea observations, tracking data from 2006 and 2007 showed some grey-faced petrels used the Kermadec region (MacLeod *et al.,* 2008). Indications are that grey-faced petrels are most frequently located in waters with moderate sea surface temperatures (~15°C), moderately high productivity and variable bathymetry (2,000–5,000 m). These data, together with similar tracking data from black petrels (*Procellaria parkinsoni*), highlight the large distances these two species forage over during the breeding season (E. Bell, unpubl.d). Black petrel tracking data from Great Barrier Island during

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FIGURE 1. Kermadec storm petrel (*Pelagodroma albiclunis*). Photo Gareth Rapley.

2005/2006 also indicate range utilisation within the Kermadec region. Migrating species, outside their breeding season, show a different pattern. Birds moving south from the north Pacific back to New Zealand include flesh-footed shearwater (*Puffinus carneipes*, Bethell's Beach, 1 from 3, September 2006) (Rayner *et al.,* in press), black-winged petrel (*Pterodroma nigripennis*, Chatham Islands, 2 from 5, September 2008) (G. Taylor & M. Rayner, unpubl.) and Cook's petrels (*P. cookii*) (Little Barrier Island, 5 from 11, November 2009) (Rayner *et al.,* in review). All showed a fairly rapid passage through the Kermadec region. Satellite tracking of sooty shearwaters captured off the western US seaboard (Tracking Sooty Shearwaters in the California Current: 2004–2009[1]) provides greater resolution data showing a broad migration pathway centred to the east of the Kermadec Trench. One bird in 2008, travelled around Raoul and spent some time just to the south of Curtis, before heading off to the Colville Ridge en route south to mainland New Zealand waters and the Southern Ocean (see: www.seaturtle.org/tracking/?project_id=282).

Currently, there are no tracking data for Kermadec breeding seabirds. However, we know from at-sea observations that Kermadec birds such as white-naped petrel, black-winged petrel, wedge-tailed shearwater (*Puffinus pacificus*) (Figure 3) and sooty tern range widely during the breeding season (Gaskin, in press). The migration of southern-breeding storm petrels towards the equator during the seasonal cooling of subtropical and tropical waters is well known for both the western and eastern Pacific Ocean. We now have good evidence indicating likely "wintering grounds" for the central South Pacific shows the accumulated occurrence of storm petrels north of New Zealand for the months between May and October from at -sea observations (Gaskin, in press).

Seabirds use a variety of techniques to capture prey including those in the Kermadec species, which have their own strategies for finding and catching food. Two foraging techniques used in the Kermadec region include associating in mixed-species flock-feeding over subsurface predators, like tuna and kingfish. This mode is a feature of subtropical and especially tropical waters where birds often are dubbed "tuna birds". That sort of activity can include birds picking off flying fish (or flying squid), which themselves are escaping tuna or other fast-moving predatory fish and cetaceans. Secondly, nocturnal feeding is adopted by some species and has been documented in white-naped, black-winged and Kermadec petrels and among storm petrels. Nocturnal petrels usually feed alone but sometimes in the company of other seabirds including the grey-faced petrel.

For seabirds breeding in the Kermadec region, we must draw inferences from studies for the same or closely related species that breed elsewhere to speculate what Kermadec seabirds might be feeding on. Inference here is drawn from studies on Hawaiian seabirds and those of the eastern Pacific Ocean. Birds have been grouped according to foraging range – the circles at 12 nm and 200 nm and beyond. Proportions and species in each diet likely will be different for Kermadec seabirds, but it is clear seabirds utilise the whole of the Kermadec region and areas beyond. Food may be ephemeral in occurrence

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and require extensive and energy-costly foraging trips for some birds. Some of the pelagic birds also will find food closer to islands, taking advantage of the complexity of the region's submarine topography with its trenches, basins, ridges, seamounts and islands and their influence over water masses, currents and, consequently, over the associated marine life.

MARINE FAUNA POTENTIALLY IMPORTANT TO KERMADEC SEABIRDS

- Tuna and swordfish long-line fisheries dominate those operating in Kermadec waters. A number of Kermadec seabirds feed in association with these subsurface predators, in particular, tuna – the so-called "tuna birds".
- Ommastrephid squids are surface-dwelling cephlapods and are common and widespread in all warm waters. Harrison (1990) noted that the frequency with which seabirds (and tuna and dolphins) feed on juvenile squid implies that squid are a very important component of the subtropical marine ecosystem.
- Flyingfish (Exocoetidae) and flying squid taken in flight or just after they (the fish) land in the water. Commonly observed for masked boobies, pterodroma petrels and some shearwaters.
- Diurnal feeding on non-cephalopod invertebrates, and fish eggs and fish larvae. These are likely to be important for storm petrels, grey ternlets and black noddies.
- Vertical migration of smaller mesopelagic fishes, cephalopods and planktonic creatures.
- It is quite possible that a significant component of the diet of grey ternlets and white-bellied storm petrel and Kermadec storm petrel consists of sea striders (*Halobates* spp.) (Harrison and Seki, 1987; Spear *et al*., 2007).

CONCLUSION

We are a long way from fully understanding the relationships between seabirds occurring in the Kermadec region and the local physical and biological oceanographic processes. There currently is the need for a great deal of future research with seabird biologists working in close collaboration with other marine biologists and oceanographers. In terms of future research into seabirds' foraging behaviour, a start has been made. New Zealand Department of Conservation staff have fitted geolocators to black-winged petrels breeding on Raoul Island, part of MR's research fellowship investigating seabirds, specifically *Cookilaria* petrels, as indicators of ocean hotspots for resource management.

The Kermadec Islands are challenging places to work – they are remote islands and require major and costly expeditions, and seabirds themselves don't make it easy. Their burrowing and the sheer density within colonies make these islands extremely sensitive places for research teams to move about on. Seabirds breeding at the Kermadecs, plus those that visit, utilise a vast area – far greater than the precious surrounding 12 nm marine area currently reserved. Seabirds allow us to take at least two perspectives on this:

1. Seabird populations are dependent on a healthy marine ecosystem and, with growing populations in the wake of eradication programmes, there is an imperative to better understand the dynamics at play across the whole region, including fisheries interactions and influences.
2. Seabirds target productive marine habitats where they integrate ecological signals, presenting useful biological indicators for understanding variation in marine

FIGURE 2. White-naped petrel (*Pterodroma cervicalis*). Photo Peter Harrison.

FIGURE 3. Wedge-tailed shearwater (*Puffinus pacificus*). Photo Gareth Rapley.

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FIGURE 4. Red-tailed tropicbird (*Phaethon rubricauda*). Photo Karen Baird.

productivity in space and time. Seabirds can potentially teach us a great deal about the state of that marine environment and future ecosystem responses to climate change or changes brought on by certain fisheries.

Further information and maps can be found at: www.thekermadecs.org/sites/default/files/content/Migration patterns of seabird occurrence in the Kermadec region.pdf.

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REFERENCES

Gaskin, C.P. In press. *Seabirds of the Kermadec region: their natural history and conservation*. Science for Conservation. Department of Conservation, Wellington.

Harrison, C.S. 1990. *Seabirds of Hawaii: natural history and conservation*. Cornell University Press, New York. 288 p.

Harrison, C.S.; Hida, T.S.; Seki, M.P. 1983. Hawaiian seabird feeding ecology. *Wildlife Monographs 85*. Wildlife Society, Bethesda MD. 71 p.

Lovegrove, T.G. 1978. Seabird observations between New Zealand and Fiji. *Notornis 25*: 291–298.

MacLeod, C.A.; Adams, J.; Lyver, P, O'B. 2008. At-sea distribution of satellite-tracked grey-faced petrels, *Pterodroma macroptera gouldi*, captured on the Ruamaahua (Alderman) Islands, New Zealand. *Papers and Proceedings of the Royal Society of Tasmania 142*: 73–88.

Marchant, S.; Higgins, P.J. (eds) 1990. *Handbook of Australian, New Zealand and Antarctic birds*. Volume 1, Part A: ratites to petrels. Oxford University Press, Melbourne.

Myers, J.G. 1921. Notes on the *Hemiptera* of the Kermadec Islands, with an addition to the *Hemiptera* fauna of the New Zealand Subregion. *Transactions and Proceedings of the New Zealand Institute 53*: 256–257.

Rayner, M.J.; Taylor, G.A.; Thompson, D.R.; Torres, L.G.; Sagar, P.M.; Shaffer, S.A. In press. Migration and diving activity in three post-breeding flesh-footed shearwaters (*Puffinus carneipes*). *Journal of Avian Biology*.

Rayner, M.J.; Lawrence, H.A.; Hauber, M.E.; Thompson, D.R.; Sagar, P.M.; Bury, S.J.; Landers, T.J.; Phillips, R.A.; Ranjard, L.; Steeves, T.E.; Shaffer, S.A. In review. Contemporary and historic separation of transhemispheric migration between two genetically distinct seabird populations.

Shaffer, S.A.; Tremblay, Y.; Weimerskirch, H.; Scott, D.; Thompson, D.R.; Sagar, P.M.; Moller, H.; Taylor, G.A.; Foly, D.G.; Block, B.A.; Costa, D.P. 2006. Migratory shearwaters integrate oceanic resources across the Pacific Ocean in an endless summer. *Proceedings of the National Academy of Sciences of the USA 103*: 12799–12802.

Spear, L.B.; Ainley, D.G.; Walker, W.A. 2007. Foraging dynamics of seabirds in the Eastern Tropical Pacific Ocean. *Studies in Avian Biology Series 35*. Cooper Ornithological Society, Norman OK. 99 p.