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Summary article: Using paleoecology and spatial ecology to promote the restoration of mottled petrel within New Zealand

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As apex predators, seabirds are particularly vulnerable to shifts in prey availability, which in turn drives population success. Understanding exactly how shifts in trophic webs, driven by threats such as climate change and over-fishing, affects populations requires species-level knowledge of their foraging ecology. An examination of these factors over large temporal scales, including historical data, can provide insight into how current populations may be expected to respond to changes in available resources or environmental conditions.

Breeding mottled petrels from remnant populations in southern New Zealand have a broad foraging range, including as far south as the pack ice in the Southern Ocean. Accordingly, mottled petrel may play an important role as proximate indicators of ecosystem functionality in this region. The main aim of this research is to determine what ecological factors will drive the successful restoration of mottled petrel populations, specifically the factors that influence breeding success including foraging ecology, provisioning behaviours and diet of mottled petrels.

During 2013 – 2016, breeding mottled petrel on Codfish Island (Whenua Hou) were tracked using archival leg-mounted geolocation loggers. Whole blood samples were collected from tracked adults at one monthly intervals during the chick-rearing period, and were analysed for their carbon and nitrogen signatures, inferring foraging locale and diet respectively. Furthermore, the chicks of tracked adults were monitored for provisioning frequency, meal size and growth. Bones from deceased adult mottled petrel were collected in order to undertake comparative diet studies against museum-held historical samples at a later date.

Loggers from breeding adults are currently being collected on Codfish Island, and tracking data will be analysed (for all years) once these have been retrieved. Analysis of carbon and nitrogen signatures from the whole blood of adults tracked during 2013 – 2016 was recently completed, with results showing striking inter-annual variation. In 2013 chick growth was retarded and provisioning rates were lower (average one feed every six days), though meal size was no different to 2014 or 2015. This nitrogen signature of adult blood from the 2013 indicated that birds consumed lower quality prey from lower trophic levels, such as krill, than all other years. Concurrently, the carbon signature indicated that birds were foraging in more southerly locales (further from the breeding colony), likely explaining the decreased frequency of feeds during this year. These findings indicate that in 2013, when sea surface temperatures around southern New Zealand were warmer, mottled petrels were forced to forage further away from the colony in order to find sufficient quantities of prey, though these were of poor quality, and had a subsequent negative impact on chick growth, condition and likely post-fledging survival. No differences in prey quality, provisioning regimes or chick growth were observed between 2014 and 2015. However, in 2016 mottled petrels fed their chicks high quality prey in smaller quantities, though more frequently. Chicks in 2016 fledged in significantly better condition than previous years, though their growth rates were comparable. This change in foraging behaviour during 2016 was associated with cooler sea surface temperatures in local waters.

These findings show that mottled petrel breeding success, and subsequent population health, is impacted by prey availability, which in turn is linked to prey availability. As extreme weather events, linked to altering sea surface temperatures, increase in both severity and frequency, we may expect mottled petrel to experience more ‘boom or bust’ years. Future analysis of diet from fossil bone samples will provide insight into how mottled petrel coped with such challenges in the past, and will help guide conservation action for this species into the future.

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