Procellariiformes associating with shoaling fish schools – northern New Zealand

Department of Conservation
Te Papa Atawhai

Chris P. Gaskin

NORTHERN NZ SEABIRD TRUST

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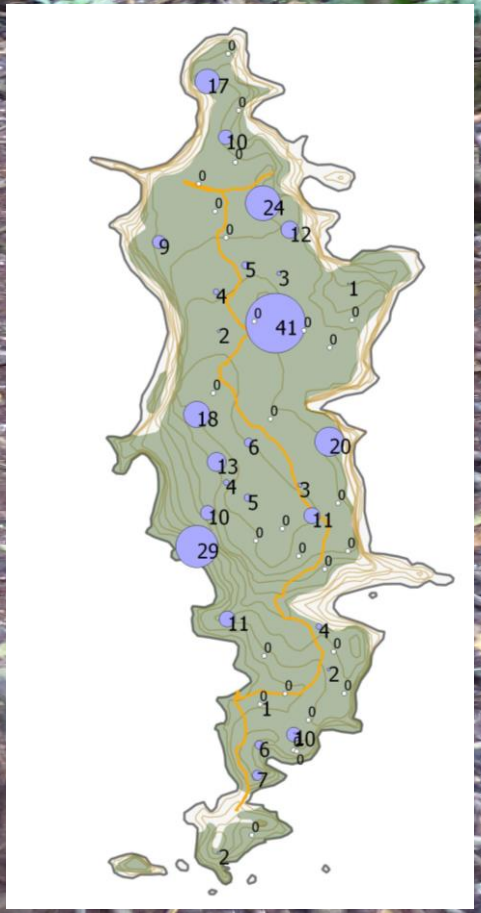
Study outline

- Assess population data for the range of procellariiform species known to associate with shoaling fish schools in northern New Zealand waters
- Summarise what is known about their general ecology including breeding biology and diet, together with any known recent changes in breeding and foraging behaviour.
- Present opportunistic at-sea observations and aerial surveys on interactions between bird species and shoaling fish, together with comments on normal and unusual bird behaviour associated with fish boil-up activity.
- Describe the variety of foraging and feeding associations.
- Identify serious data gaps
- Provide recommendations to addressing key issues in the future.

Data sources – populations

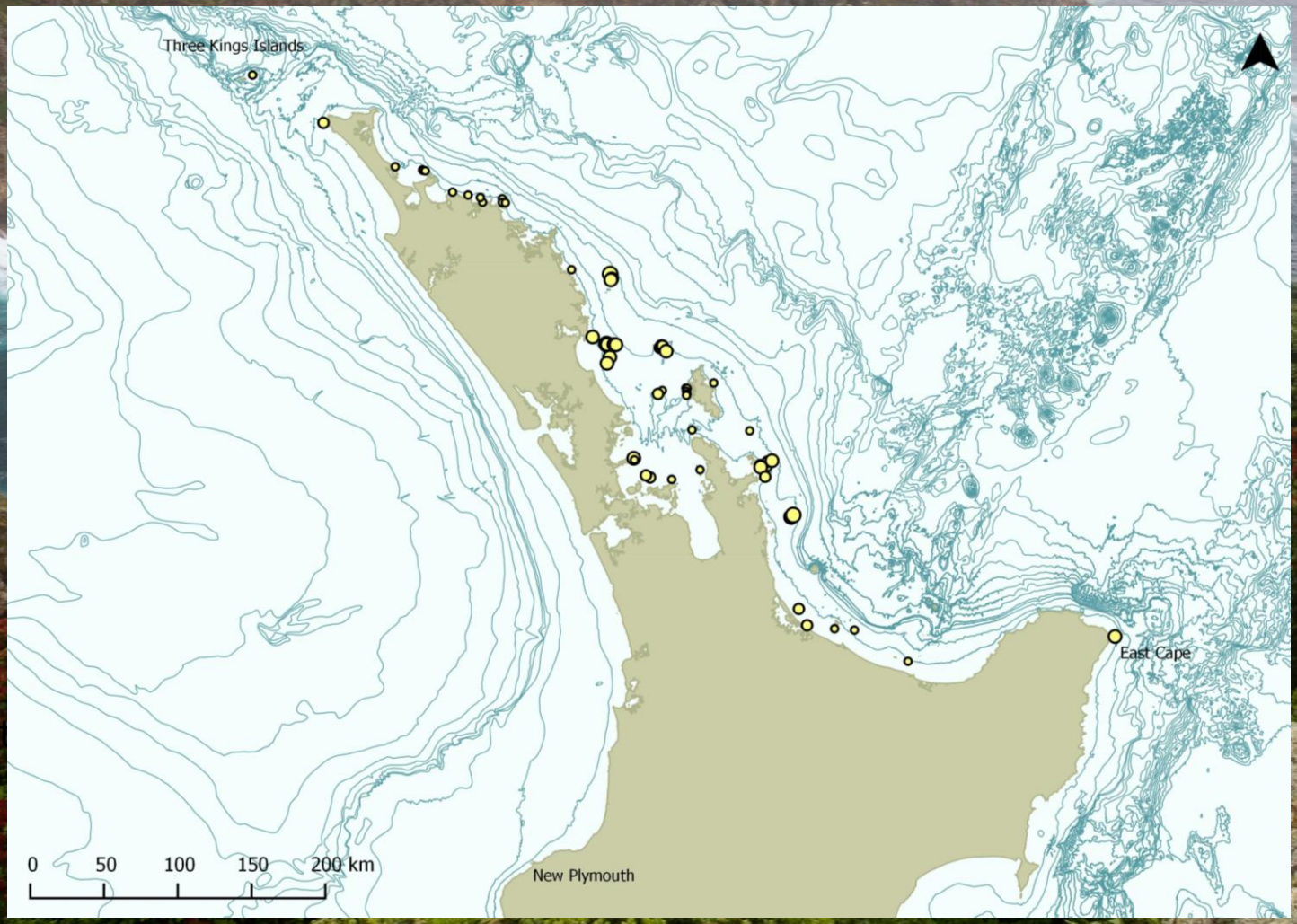
1. Island-wide single-species population and habitat modelling as in Rayner et al (2007) for Cook's petrel on Te Hauturu-o-Toi/Little Barrier Island and adopted by Friesen et al 2016-2017 for Buller's shearwater and Poor Knights Islands,
2. Single species surveys (Baker et al 2012, Bell et al 2016-2017 for flesh-footed shearwater)
3. Single-species surveying within study area (Bell et al 2006-2017 for black petrel on Aotea/Great Barrier Island)
4. Island visits with ground searches/burrow counts (multiple authors, both published and unpublished, some exhaustive, others cursory)
5. Island visits combined with the use of automated acoustic recorders.

Data sources – Buller's shearwater



Data sources – fairy prions

Data sources – fluttering shearwater



Populations (scale):

<10 or default

10-100

100-1000

1000+

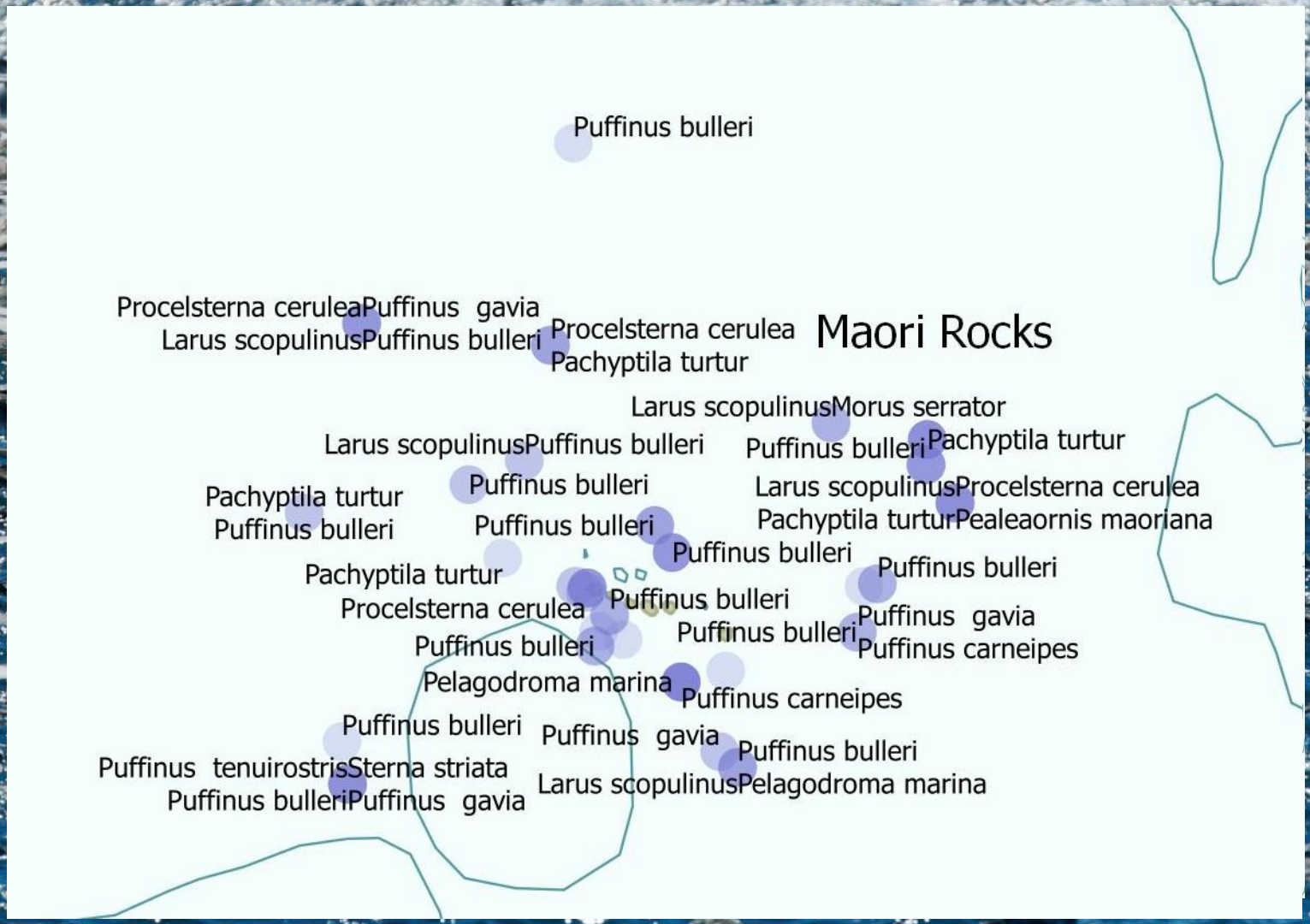
Populations – summary

- In northern New Zealand there is a paucity of accurate population data for priority seabird species
- For the most part, while breeding presence has been confirmed, there are only rough estimates of populations in northern New Zealand
- There is very little long-term monitoring of populations
- Exceptions are black petrel and flesh-footed shearwater
- In addition, many islands which could hold significant seabird populations there is no or little information.

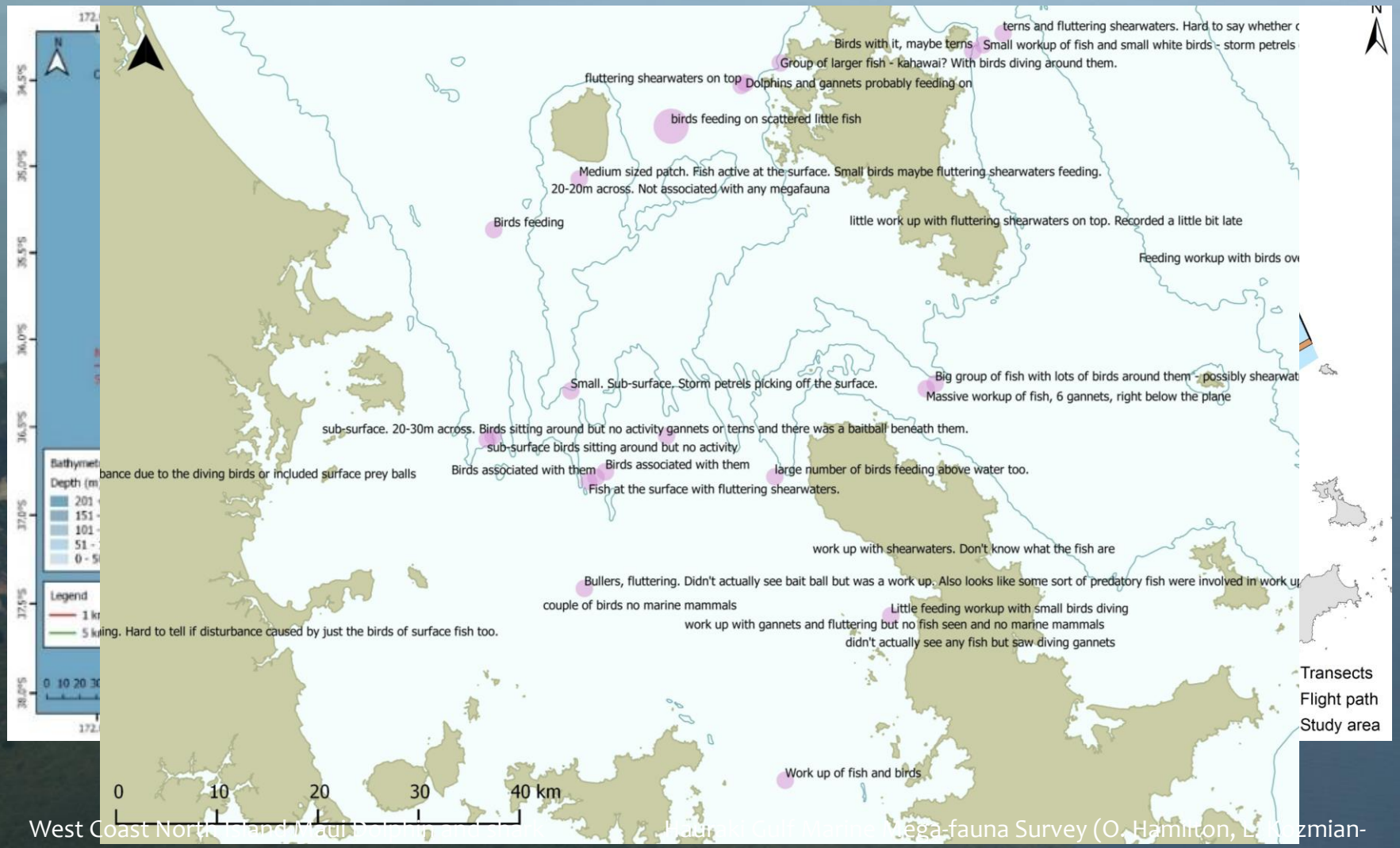
Three Kings Islands (Far North)

Moturoa Islands (Far North)

Data sources – boat-based obs.



Data sources – aerial surveys



West Coast North Island Bryde's whale and seabird surveys (C. Duffy, L. Kozmian-Ledward, DOC)

Hauraki Gulf Marine Mega-fauna Survey (O. Hamilton, L. Kozmian-Ledward, R. Constantine, University of Auckland)

Priority species

Spec	Species names		NZTCS	IUCN Red List
B	**Buller's shearwater**	Ardenna bulleri	At Risk – Naturally Uncommon	Vulnerable
F	**Fluttering shearwater**	Puffinus gavia	At Risk - Relict	Least Concern
F	**Fairy prion**	Pachyptila turtur	At Risk - Relict	Least Concern
F	**Flesh-footed shearwater**	Ardenna carneipes	Nationally Vulnerable	Near Threatened
F	**Sooty shearwater**	Ardenna grisea	At Risk - Declining	Near Threatened
W	**White-faced storm petrel**	Pelagodroma marina	At Risk - Relict	Least Concern
C	**Common diving petrel**	Pelecanoides urinatrix	Not Threatened	Least Concern
S	**NZ storm-petrel**	Fregetta maoriana	Nationally Vulnerable	Critically Endangered
B	**Cook's petrel**	Pterodroma cookii	At Risk - Relict	Vulnerable
C	**Black petrel**	Procellaria parkinsoni	Nationally Vulnerable	Vulnerable
S	**Short-tailed shearwater**	Ardenna tenuirostris	Migrant	Least Concern
N				

Procellariiform behaviour

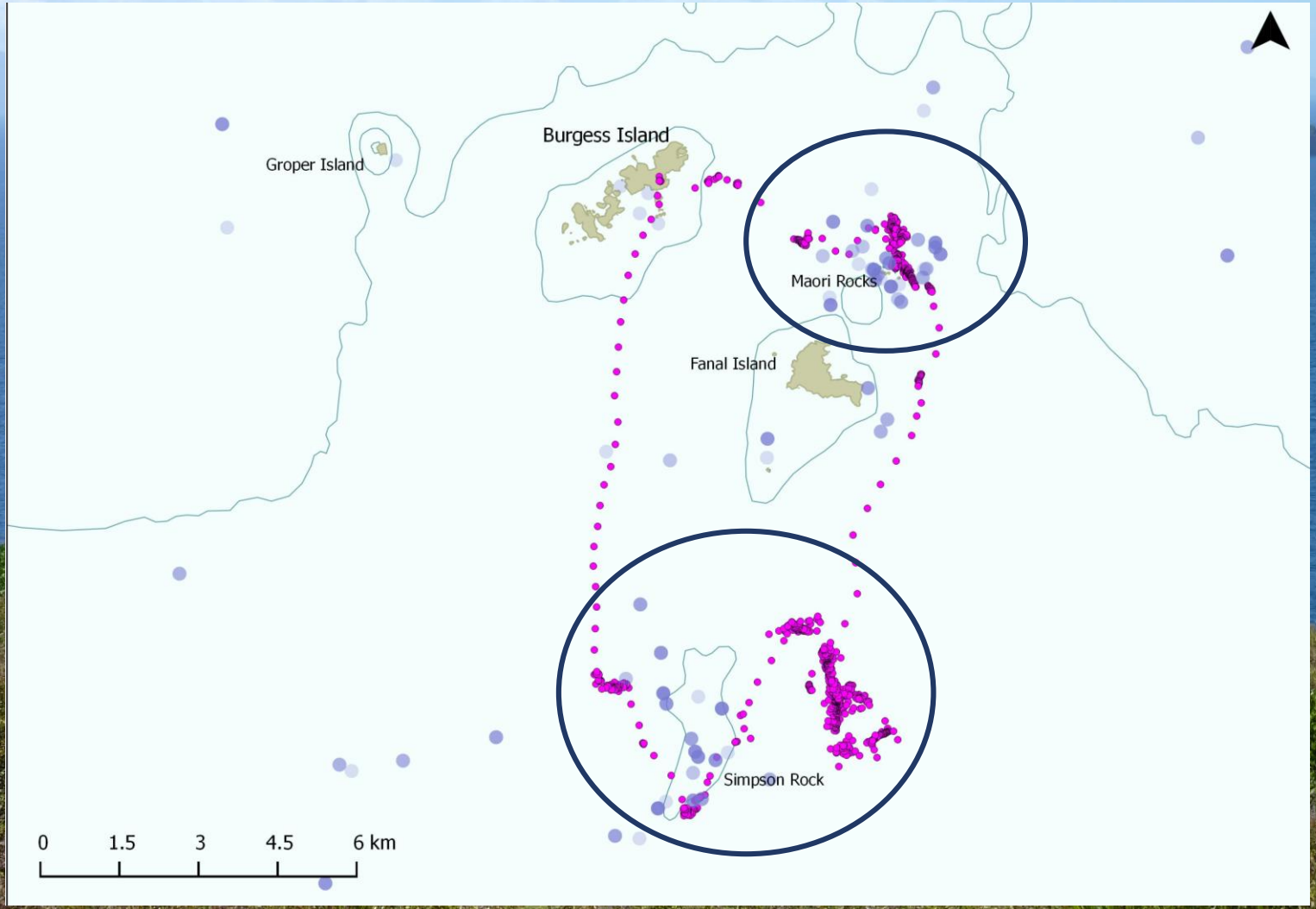
	Fish school/prey type	General description of activity	Species
1	**Trevally *Pseudocaranyx dentex* (and mixed trevally, kahawai *Arripis trutta* & kingfish *Seriola lalandii*)**	Tightly packed, very active dense schools, sometimes with several schools merging to form very large schools. Birds either forage in the wake of the schools, or in some cases feed ahead of and around the schools. Fish will erupt explosively if disturbed either from below (e.g. predatory fish) or from above (e.g. gannets flying low over a school). Shearwaters and prions have been filmed diving in the wake of school activity.	Buller's shearwater, fluttering shearwater, fairy prion, sooty shearwater, flesh-footed shearwater, short-tailed shearwater, white-faced storm-petrel, Cook's petrel (with red-billed gull, white-fronted tern and occasionally grey noddy at some locations)
2	**Kahawai**	Fast-moving schools, birds moving in 'leap-frogging' formations, shearwaters plunging and diving.	Fluttering shearwater (with white-fronted terns moving with them)
3	**Saury *Scomberesox saurus***	One instance of shearwaters and gannets diving on saury, catching fish close to the surface. Out beyond Mokohinau Islands, north of Great Barrier Island.	Flesh-footed shearwater, black petrel and sooty shearwater (with Australasian gannet)
4	**Baitfish species (e.g. Jack mackerel *Trachurus novaezelandiae*, pilchard *Sardinops neopilchardus*, koheru *Decapterus koheru*)**	Often tightly packed schools, sometimes forming spinning 'bait balls' below the surface. Birds plunging/diving and pursuing prey underwater. Dramatic.	Fluttering shearwater, flesh-footed shearwater, Buller's shearwater, white-faced storm-petrel, Cook's petrel (with Australasian gannet and cetaceans)
5	**Skipjack tuna *Katsuwonus pelamis***	Fast moving spread-out schools with birds following.	Fluttering shearwater (with gulls and terns)
6	**Crustaceans (no visible fish schools)**	Mainly euphausiids (Nyctiphanes australis) with birds actively feeding from the surface, often well- spread, occasionally across several sq. kms.	Buller's shearwater, fluttering shearwater, fairy prion, common diving petrel, white-faced storm-petrel, sooty shearwater.

Procellariiformes feeding in association with cetaceans

High resolution tracking

1. GPS and satellite (PTT) transmitters, provide high-res foraging data could potentially be correlated directly to observed fish school activity.
2. Provide a better understanding of the foraging ecology of high priority seabird species
3. Complement contemporary studies of breeding ecology of fairy prion, fluttering shearwater and Buller's shearwater – specifically breeding success.

High resolution tracking



Potential indirect fisheries impact on Procellariiformes

Potential indirect fisheries impact on Procellariiformes

Recent work suggests investigation is warranted:

- Foraging times of **Buller's shearwaters** during the incubation period may have increased in the past 40 years from 4 days to up to 14 days (Harper 1983, Taylor 2013).
- M. Berg (in prep.) found through stable isotope analysis of **fluttering shearwater** feathers 1918-2015 that δ13C values had declined in recent years (1998-2015) compared to earlier (1968-1979; 1918-1939). Berg suggested four possible scenarios for this decline: baseline shift, prey type change, reduced primary production, and extended foraging range

Data gaps

1. There is an almost total lack of accurate, up-to-date population and trend data for Procellariiformes in the region, including those breeding at several globally important sites.
2. The foraging behaviour and diet of Buller's shearwater, fluttering shearwater and fairy prion is relatively unknown, especially with respect to their relationship with fish school activity.
3. The question of what drives fish school activity needs to be much better understood, especially in terms of:
   a) bathymetric features
   b) oceanographic and environmental factors
   c) krill and other prey availability
   d) fish spawning
   e) seasonality.
4. The contribution this feeding association with fish schools has for the diet of key species at critical stages of their life cycles is unknown.

Indicators of change

- As predators at the top of the food chain, seabirds are crucial components of marine ecosystems and possess attributes that make them useful as indicators of change in the marine environment.
- Seabird populations represent a viable and relatively cost-effective ‘canary in the cage’ for the long-term assessment of marine ecosystems across broad spatial scales.
- Dependent on several critical factors: accurate up-to-date baseline population data, long-term monitoring of key species and sites using consistent methodology, and adequate resources to support long-term research.

Recommendations

1. Research is required to determine the distribution, size and status of priority species throughout the region. Multi-year studies are required to determine trends.
2. Modelling exercise using existing at-sea and aerial survey data for seabird and fish school observations.
3. High-resolution tracking of key indicator species to determine foraging ranges and distribution at different stages of breeding.
4. Tracking programme to be complemented by a continuation of collecting data at seabird colonies (chick development, adult attendance and provisioning, breeding success) for Buller's and fluttering shearwaters, and initiating a contemporary survey and breeding study for fairy prion.
5. The tracking programme could be undertaken synchronistically with aerial and/or boat-based surveying for fish school and cetacean feeding to 'ground truth' activity showing up in the tracking data.
6. These surveys would also provide a means to document fish school activity, through photography and video imaging, as it relates to seabird activity.

Recommendations contd.

7. **Investigate prey types of priority species using regurgitations gathered opportunistically, stable isotopes (current and historical), and sampling through fish schools including trawling with micron-mesh nets for fish spawn, fish larvae, and studying stomach contents of fish species.**
8. **Determine the proportion these feeding associations with fish schools contribute to the diet of priority procellariform species – measured against other prey types.**
9. **Further investigate cetacean and Procellariiform associations.**
10. **Adopt a collaborative, integrated, multi-disciplinary approach for all these recommendations.**

thank you – tena koutou