At-sea distribution and population dynamics of Black Petrel, Procellaria parkinsoni, on Great Barrier Island, Hauraki Gulf, New Zealand

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BLACK PETREL RESEARCH PROJECT

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- DOC long-term research project on Great Barrier Island (since 1995/96 season)
  - Long-term mark-recapture programme
  - Determine baseline population dynamics, including an accurate population estimate
  - Determine breeding success (and causes of failures)
  - Determine at-sea distribution of the Great Barrier Island black petrel population
  - Determine population trends (including survival and recruitment)

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Photo: Dave Boyle

- Medium-sized petrel
- All black
- Endemic to New Zealand
- On Great Barrier Island (c. 5000 birds)
- On Little Barrier Island (c. 250 birds)


Photo: Dave Boyle

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- Breed from October to June
  - Adults return to the colony in mid-October to clean burrows, pair and mate, then depart on “honeymoon”
  - Return to colony in late November to lay a single egg
  - Incubate egg for 57 days
  - Eggs hatch from late January through February
  - Chicks fledge after 107 days (from mid-April through to late June)
  - Adults and chicks migrate to South America for winter

BLACK PETREL STUDY SITE
GREAT BARRIER ISLAND

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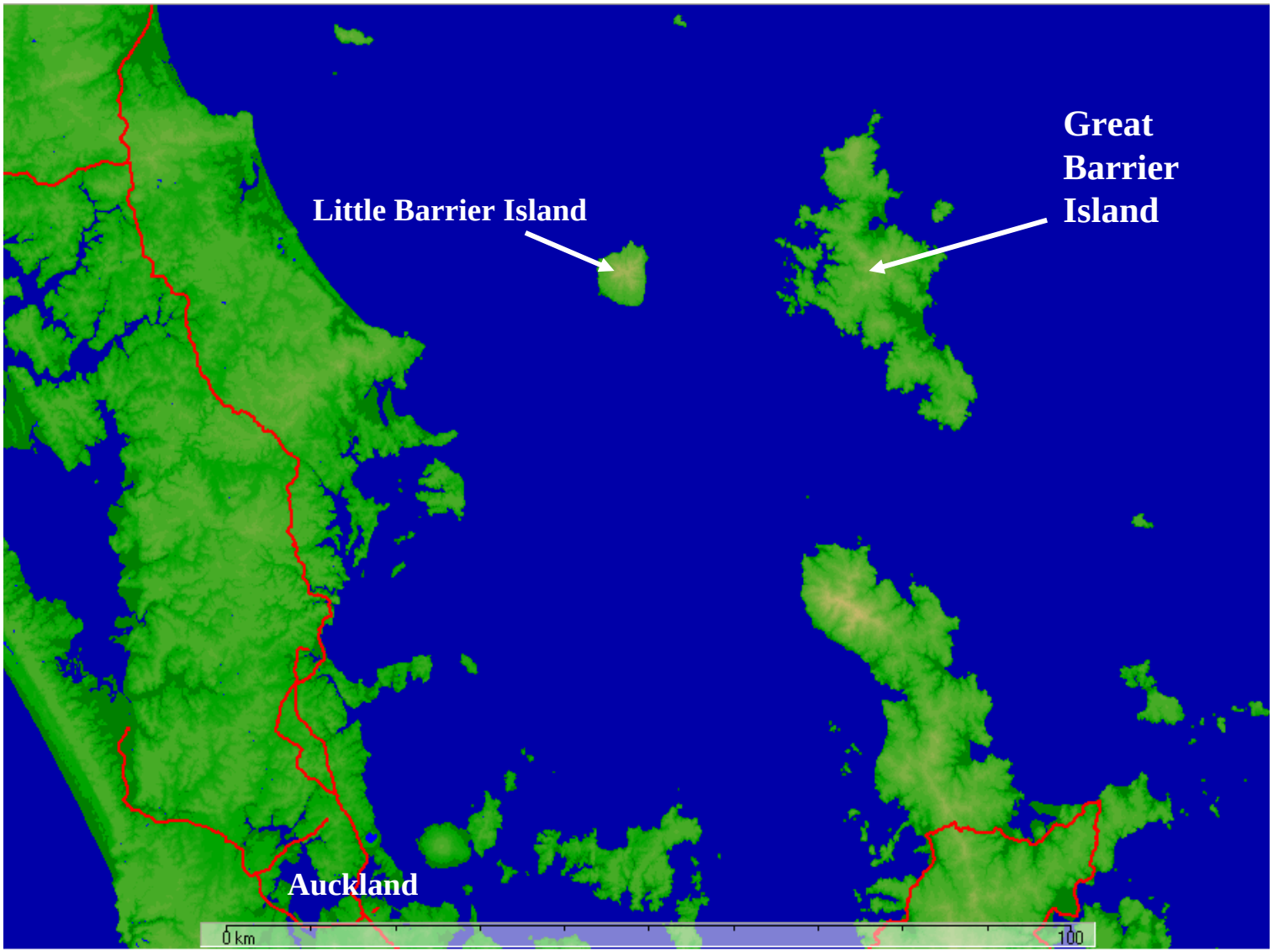

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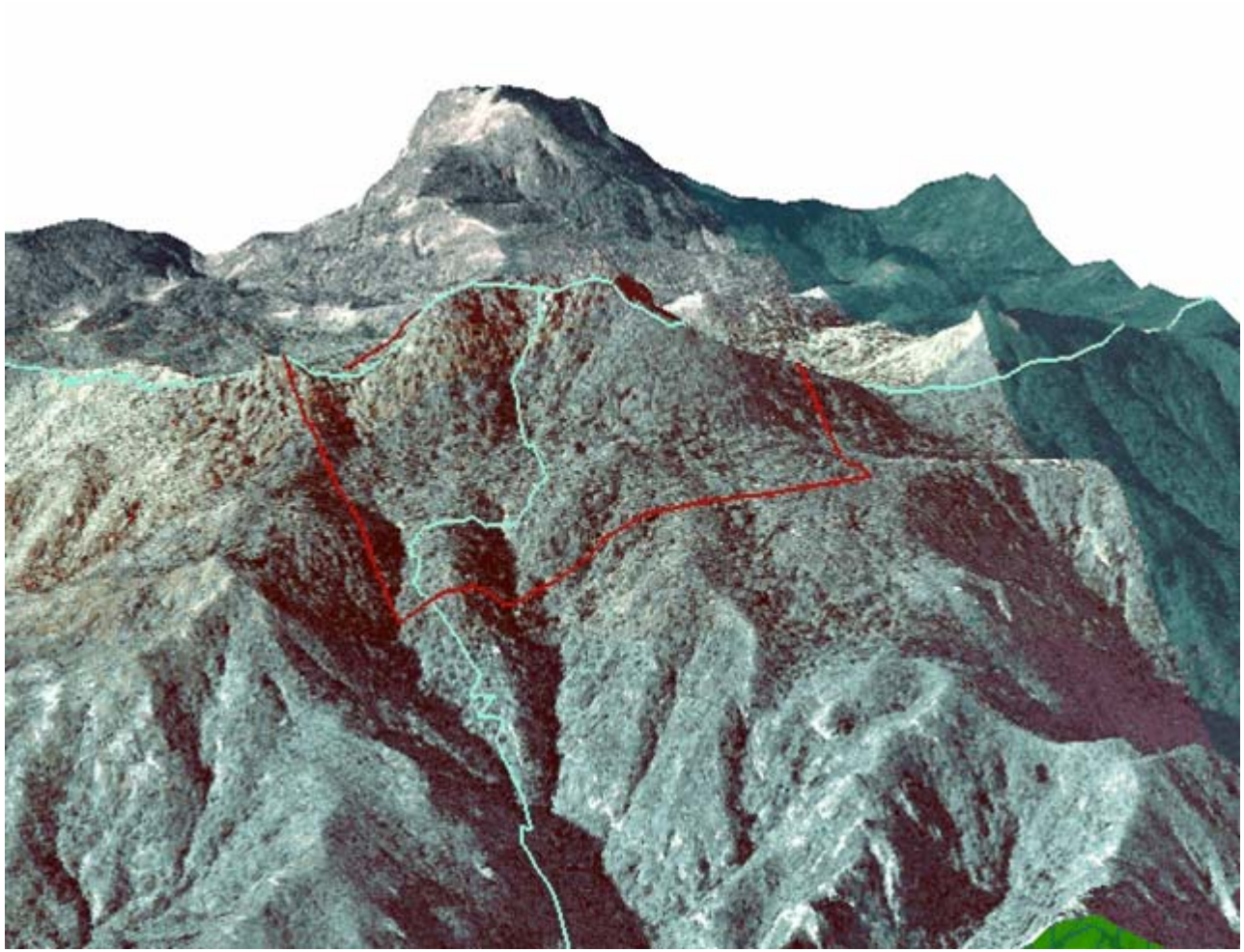
Mount Hobson (Hirakimata)



- Covers 35 hectares around the summit.
- 395 numbered burrows
- 388 study burrows (including 154 in nine census grids)
- Burrows are accessed through entrance or study hatch

METHODS

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MARK-RECAPTURE & BREEDING SUCCESS

- December and January/February
- Mark-recapture of adults at the colony
  - Identify as many birds as possible in study area
  - Identify both partner in breeding burrows
  - Check study burrows during the day
  - Night captures at known launch sites and along the track system
- Random transect searches within study site for banded birds during day
- Monitor study burrows for presence of egg (and/or chick)
- Determine status of adults (breeding, non-breeding etc.)
- Determine sex of adults
- Determine breeding success (causes of breeding failure)

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POPULATION TRENDS

Program MARK

- Survival estimates (adult and juvenile)
- Divorce rates, recruitment, recapture probability etc.
- Multi-state analysis (breeder, non-breeder etc.)
- Population estimate (study burrows/transects)

SEABIRD (NIWA)

- Survival estimates (adult and juvenile)
- Population estimate
- Population trends (health of population)

RESULTS – POPULATION DYNAMICS

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BREEDING STATUS

- Number of study burrows used for breeding varies from 63-77% (**68.5% in 2008/09**)
- Breeding success varies from 67-84% (chicks fledged from eggs laid) (**76% in 2008/09**)

BANDING DATA

- 2699 birds have been captured to date
- 1437 banded as adults (1996-2009)
- 1871 banded as chicks (1996-2009)
- One record of immigration (LBI female now breeding on GBI, **recaptured in 2009**)

RESULTS – POPULATION DYNAMICS

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RETURNED CHICKS

- 79 “chicks” have been recaptured at the colony
- Earliest age at first return is 3 years [mean 5.6 ± 0.2]
- Earliest age at first breeding is 5 years [mean 6.6 ± 0.2]
- Earliest age at first successful breeding is 5 years [mean 6.6 ± 0.2]

JUVENILE SURVIVAL

- Mean apparent juvenile survival estimate
  = 0.4599 (± 0.03) during the first 3 years of life
- Mean apparent juvenile survival estimate increased to 0.8992 (± 0.04) for birds > 3 years old

RESULTS – POPULATION DYNAMICS

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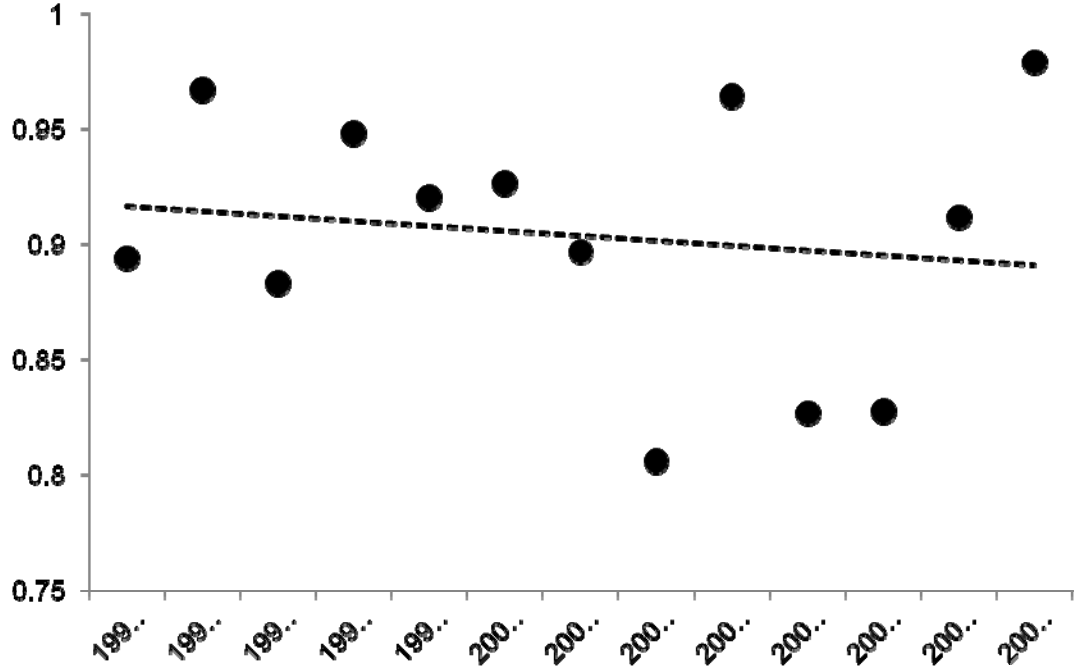
ADULT SURVIVAL

Cormack Jolly Seber analysis [adult survival and probability of recapture model: Phi(t) P(t)]

- Mean adult apparent survival = 0.9039 (± 0.02)
- Mean probability of recapture from one year to the next = 0.7836 ± 0.03



RESULTS – POPULATION DYNAMICS

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DIVORCE

- Multi-state model to determine divorce rate
  - Overall divorce rate = 12.7% per year
  - Probability of breeding each year (despite divorce) = 64%

SKIPPING

- Multi-state model to determine the probability of transition from one state to another
  - Successful breeder or an unsuccessful breeder changing to a non-breeder = 0.2806 (28%)
  - But, if a bird does skip a year, it is more likely to breed successfully the following year (42% compared to 35%)

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AT-SEA DISTRIBUTION

- December and January/February
- Deployment of Lotek™ light loggers on known breeding adults
  - In December (retrieve in January/February)
- Deployment of SIRTrak™ GPS loggers on known breeding adults
  - In December
  - In January/February (after retrieval, downloading of December information and recharging)
- Deployment of Oxford University (UK) GPS loggers on known breeding adults
  - In December and January/February
- Retrieval of BASTrak™ loggers from previous seasons
- Retrieval of any other devices from previous seasons

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AT-SEA DISTRIBUTION ANALYSIS

- Download and filter data
- Analyse and interpret:
  - Average trip length and maximum distance from colony
  - Distance, speed and direction of travel between locations
  - Time spent in specific locations (& identify foraging areas)
  - Fisheries overlap and risk of interaction
  - Behaviour (resting, foraging, direct flight etc.)
  - Areas of use (feeding, flight etc.)

Relating areas of use to environmental variables (chlorophyll-a, sea-surface temperature etc.) and proximity to fishing activities

AT-SEA DISTRIBUTION

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LOTEK LIGHT LOGGERS

- Deployed 28 devices in December 2007
  - 10 males, 5 females, 13 unknown
- 8 retrieved in February 2008
  - Covering incubation and early chick rearing
  - Downloaded and analysed (in progress)
  - Redeployed in December 2008
  - Retrieved in February 2009

AT-SEA DISTRIBUTION

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LOTEK LIGHT LOGGERS

- 20 loggers left on to record migration to South America and non-breeding stage movements
- 18 devices retrieved (14 in Dec. 2008 and 2 in Feb. 2009)
- **BATTERY MALFUNCTION**
  - Data only collected for 3-8 months (instead of 15 months!!!)
  - Two devices lost at sea (only attachment device retrieved)
  - Problems with downloading and analysis (ongoing)

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LOTEK LIGHT LOGGERS

- 50 replacement loggers
- Devices to be deployed in December 2009
  - Mixture of male and females
  - Breeding pairs
  - Individuals that have been handled before (and nested in burrow for over 8 season)

ALL DEVICES TO BE RETRIEVED THIS SEASON
FEBRUARY 2010

AT-SEA DISTRIBUTION

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BASTRAK LIGHT LOGGERS

- 10 devices deployed in December 2008
  - 1 female, 6 males and 3 unknown
- 1 device left at hut for ground-truthing
- After battery malfunction with Lotek loggers in 2009, BASTrak devices left on to record migration to South America and non-breeding stage movements

ALL DEVICES TO BE RETRIEVED THIS SEASON
FEBRUARY 2010

AT-SEA DISTRIBUTION

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GPS LOGGERS

- Deployed 5 SIRTrak GPS loggers in December 2008
  - 1 female, three males and 1 unknown
- Four devices retrieved (one lost at sea)
  - Only one with accurate track
  - Bird (male) headed to East Cape
- Four devices to be deployed in December 2009
- Downloaded after one trip
- Recharged and redeployed on different birds in Feb. 2010
- Downloaded after one trip

ALL DEVICES TO BE RETRIEVED FEB. 2010

AT-SEA DISTRIBUTION

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GPS LOGGERS

- Collaboration with Oxford University, UK
- Deploy up to 20 high-resolution GPS devices
  - Breeding birds
  - Mixture of males and females
- Short foraging trips during incubation and early chick-rearing
  - January/February 2010 trip
- Downloaded after one trip
- Re-charged and redeployed on another bird

ALL DEVICES TO BE RETRIEVED FEB. 2010

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PRELIMINARY RESULTS

LOTEK light loggers

- Deployed in Dec. 2005 and retrieved in Feb. 2006
- Covering incubation and early chick rearing
- 6 males, 3 females, 2 unknown
- 17 tracks recorded
- Generally 2 trips per bird
- Most had one long trip and one short trip

RESULTS - AT-SEA DISTRIBUTION

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LOTEK LIGHT LOGGERS

- 11 birds came from nine burrows
- Loggers worn for between 42 and 57 days
- Showed no adverse affects
- 17 foraging trips were recorded
  - 6 birds made two foraging trips
  - 5 birds made only one long foraging trip
  - 65% of the trips were longer than 15 days
  - Maximum trip duration was 39 days
  - Maximum trip distances varied from 1487 to 9850 km
  - Both males and females had variable foraging areas

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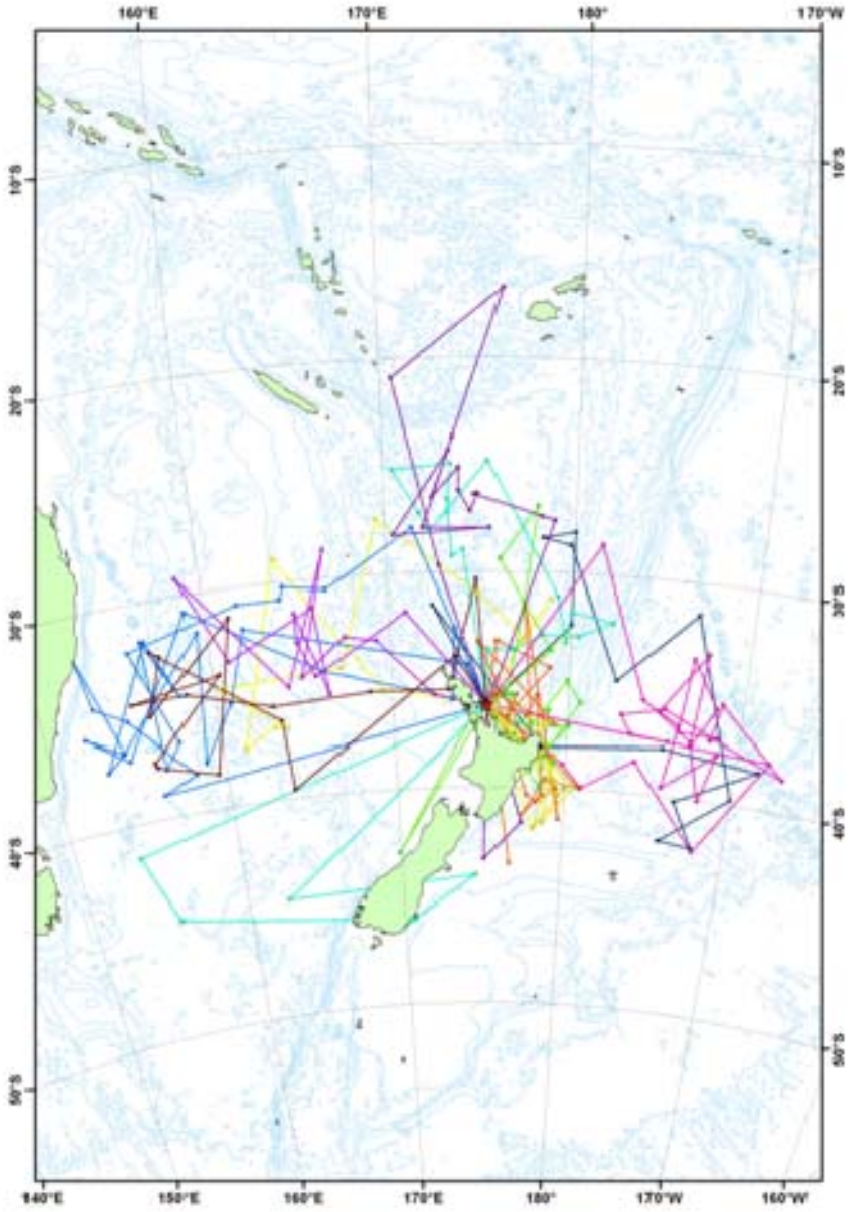
- Mainly travelling to the west and east of northern New Zealand
- 1 male travelled much further south than the other birds
- 1 male travelled north of New Zealand (to Fiji)
- 4 birds approached the Chatham Rise
- 4 birds travelled towards the Australia
- 5 birds foraged in the Bay of Plenty and East Cape area
- Showed distantly different foraging patterns



RESULTS – AT-SEA DISTRIBUTION

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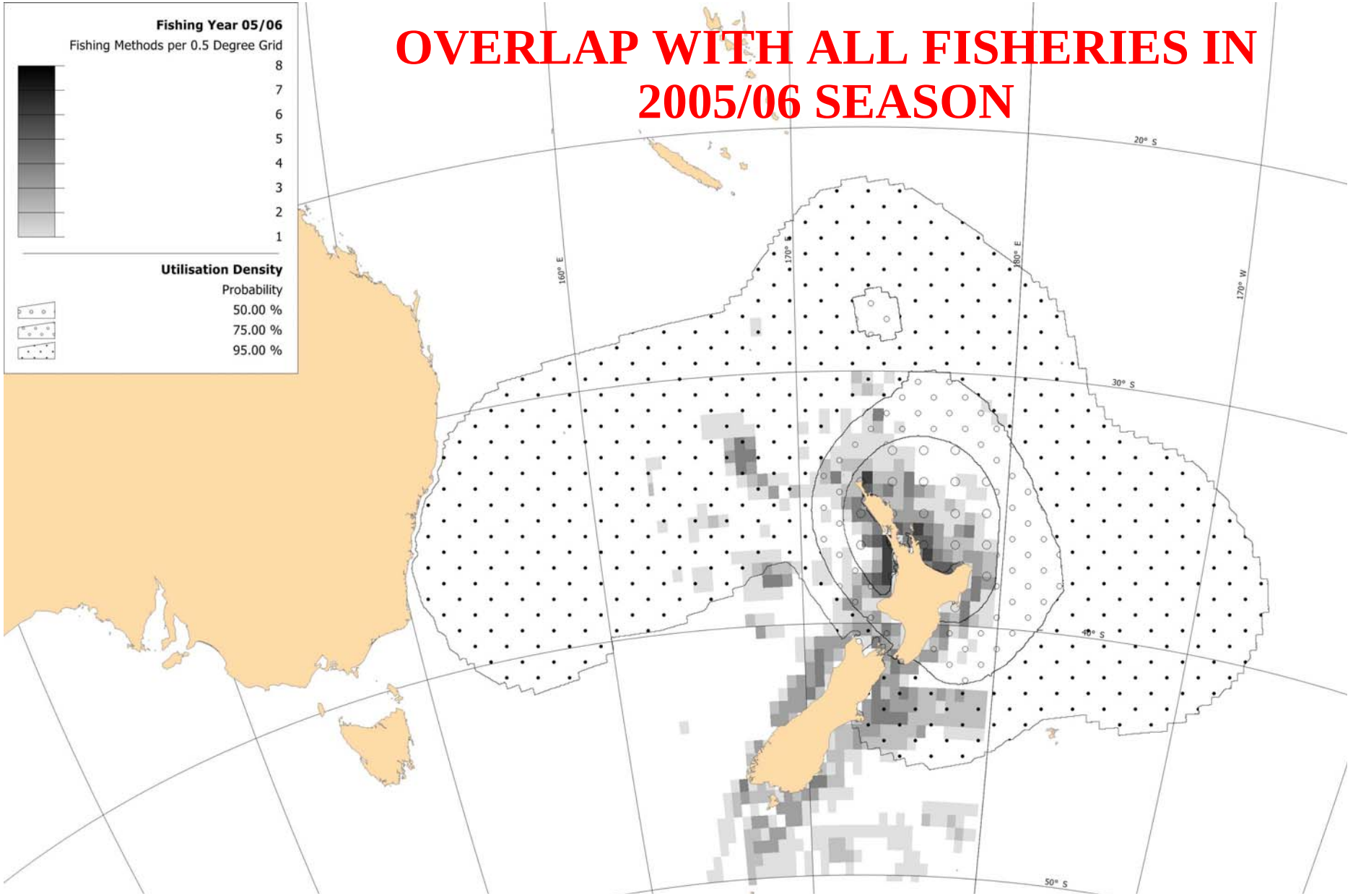
OVERLAP WITH ALL FISHERIES IN 2005/06 SEASON



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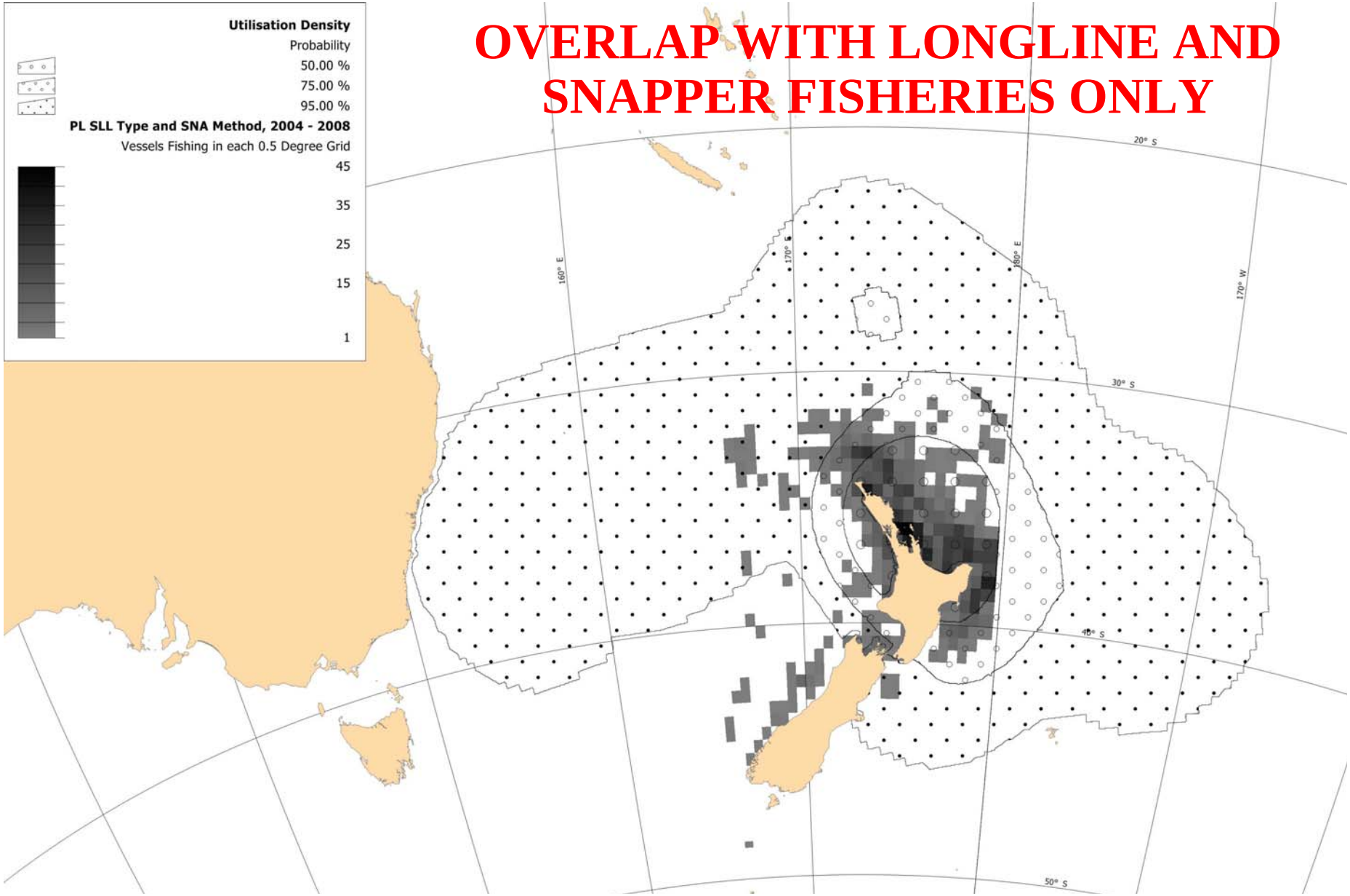

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