POP 2016-15
Yellow-eyed penguin foraging and indirect effects

Conservation Services Programme Technical Working Group Update, July 2017

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Project Objectives

1. **To describe the at-sea foraging distribution of adult and juvenile yellow-eyed penguins breeding in Otago and Southland.**
2. *To collate and synthesise existing information relevant to the indirect effect of commercial fishing induced benthic habitat modification on the mainland population of yellow-eyed penguins.*
3. *To identify mechanisms through which commercial fishing induced benthic habitat modification may affect the mainland population of yellow-eyed penguins, and provide recommendations for future research to better understand these indirect effects.*

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- **Background**

- Evidence for both acute and chronic nutritional stress
  (van Heezik 1990; Browne et al. 2011; King et al. 2012)

- Socially, culturally and economically important (Tisdell 2007)

- Functionally extinct by 2043 – 2060 (Mattern et al. 2017)

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- **Evidence for declining diet quality?**

- Highly specialised benthic strategy, c. 87% of dives
- Consistent foraging routes used, even between years

  → *Reliability of prey*
- Poor productivity and survival in modified benthic habitats

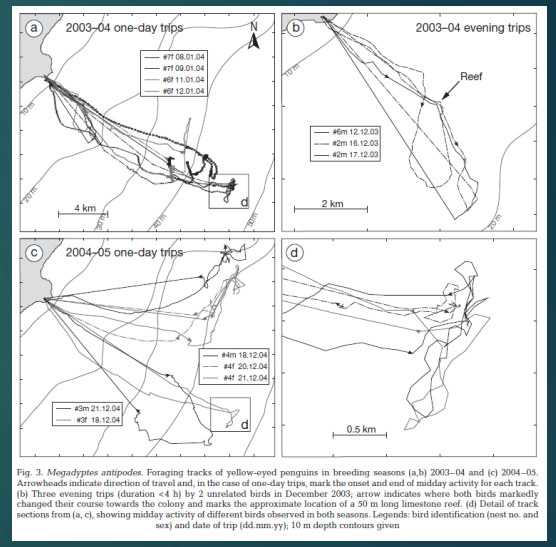

Fig. 3. *Megadyptes antipodes*. Foraging tracks of yellow-eyed penguins in breeding seasons (a,b) 2003–04 and (c) 2004–05. Arrowheads indicate direction of travel and, in the case of one-day trips, mark the onset and end of midday activity for each track. (b) Three evening trips (duration <4 h) by 2 unrelated birds in December 2003; arrow indicates where both birds markedly changed their course towards the colony and marks the approximate location of a 50 m long limestone reef. (d) Detail of track sections from (a, c), showing midday activity of different birds observed in both seasons. Legends: bird identification (nest no. and sex) and date of trip (dd.mm.yy); 10 m depth contours given

Mattern et al. 2007, 2013; Browne et al. 2011; King et al. 2012

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- **Evidence for declining diet quality?**

- Seven species make up c. 90% of diet composition
  (van Heezik 1990; Moore and Wakelin 1997)

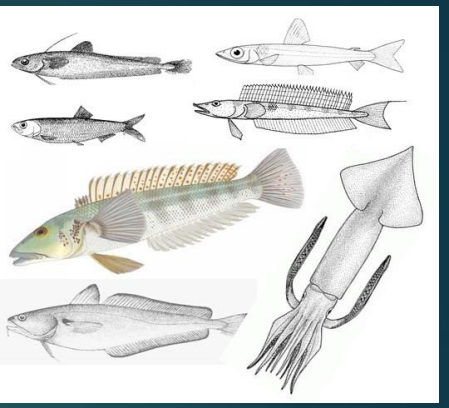
→ *Selective provisioning*

- Foraging strategy, foraging location and prey choice are highly conservative (Mattern et al. 2007)

van Heezik 1990ab; Moore and Wakelin 1997; Carbines and Cole 2009; Browne et al. 2011

Foraging range and strategies, and the overlap with benthic habitat modification

Determining diet composition through analysis of prey DNA in faeces



Determining diet quality through calorimetry

PhD scope

Immune response to breeding

Camera monitoring of timing and frequency of chick feeding events

Assessing the influence of fledgling mass, parental quality, and dispersal strategies on juvenile survival

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Project Objectives

1. **To describe the at-sea foraging distribution of adult and juvenile yellow-eyed penguins breeding in Otago and Southland.**

(a) Pre-moult foraging of adults

(b) Winter foraging of adults

(c) Fledgling dispersal (juveniles)

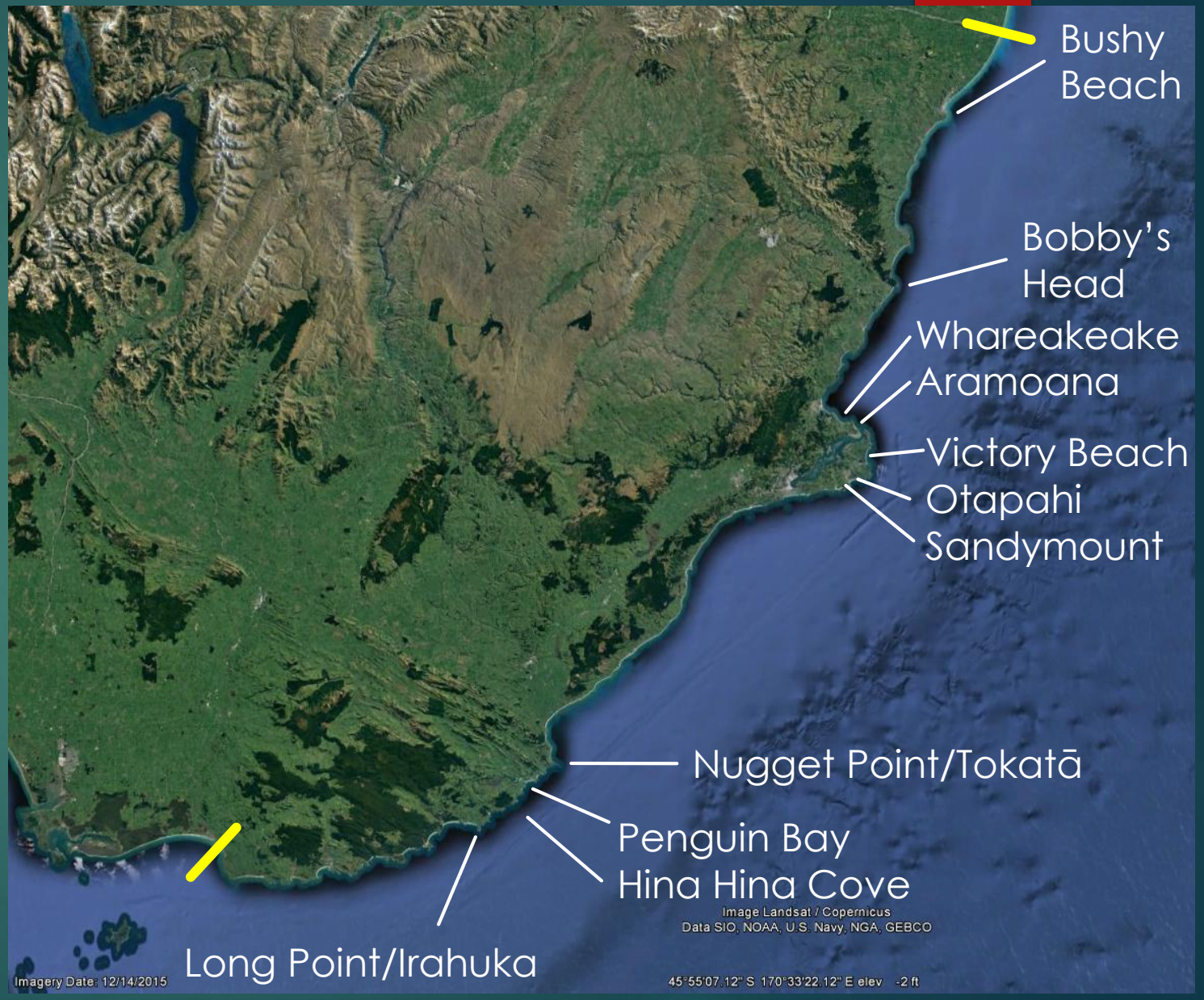
Ellenberg and Mattern (2012)

ADULT PRE-MOULT FORAGING RANGES

Preliminary results

METHODS

Site and individual selection
Sample size
Device selection



METHODS

Site and individual selection
Sample size
Device selection

Axytrek-3 (TechnoSmArt, Italy)

- GPS/TDR and accelerometer
- 2000mAh battery (custom build)
- Weight: c. 59g (c. 1.13% bodyweight)
- Dimensions: 74 x 23 x 40mm
- Archival, set to 1 GPS fix/min
- Activity and salt switches

GPS/TDR

DEPLOYMENTS

Aramoana, North of Dunedin (1 male, 1 female*)

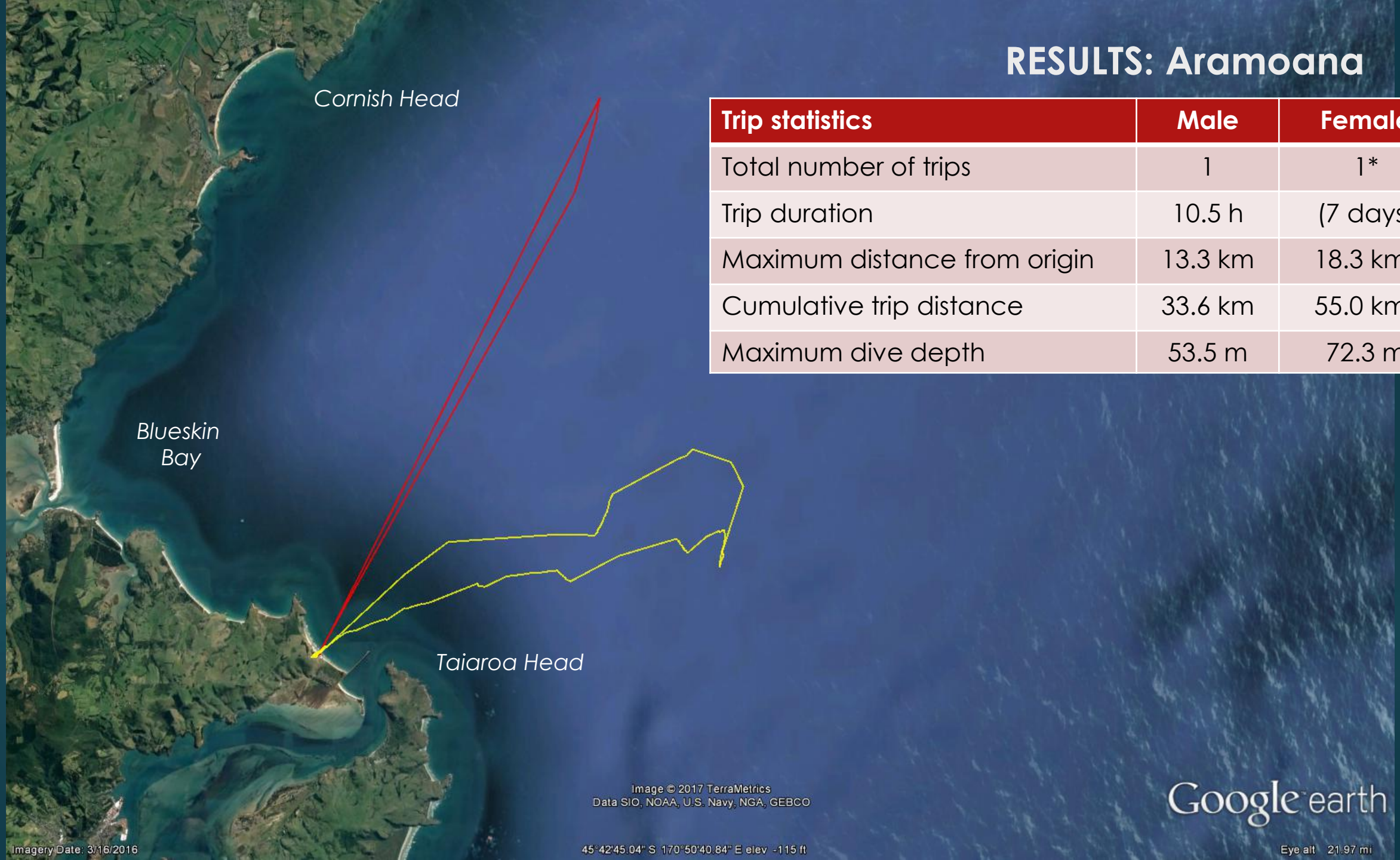
Otapahi, Otago Peninsula (2 males, 2 females)

Nugget Point/Tokata, Catlins (1 male, 1 female)

Penguin Bay, Catlins (1 male*, 2 females)

Long Point/Irahuka, Catlins (1 male*, 1 female*)

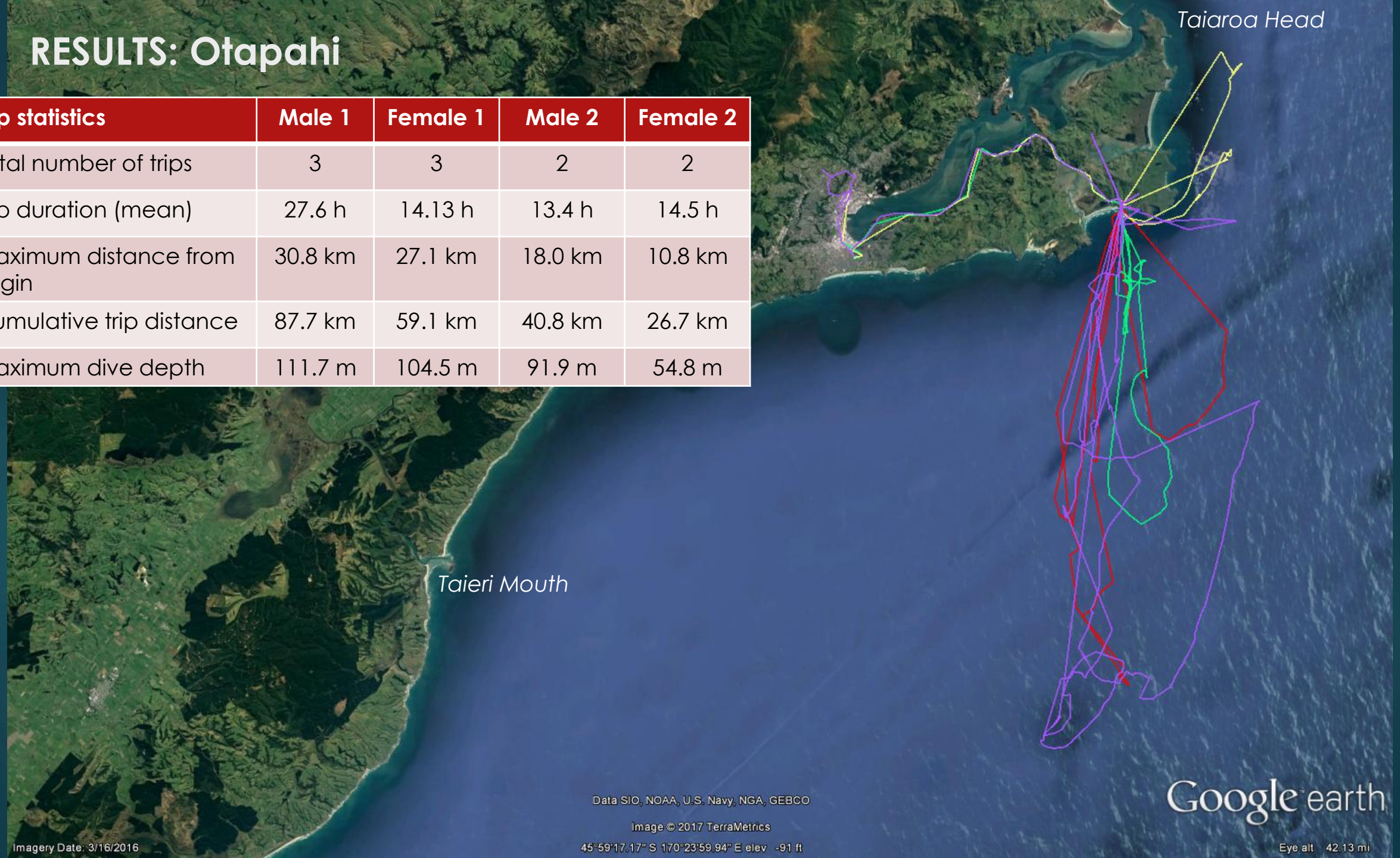
RESULTS: Aramoana

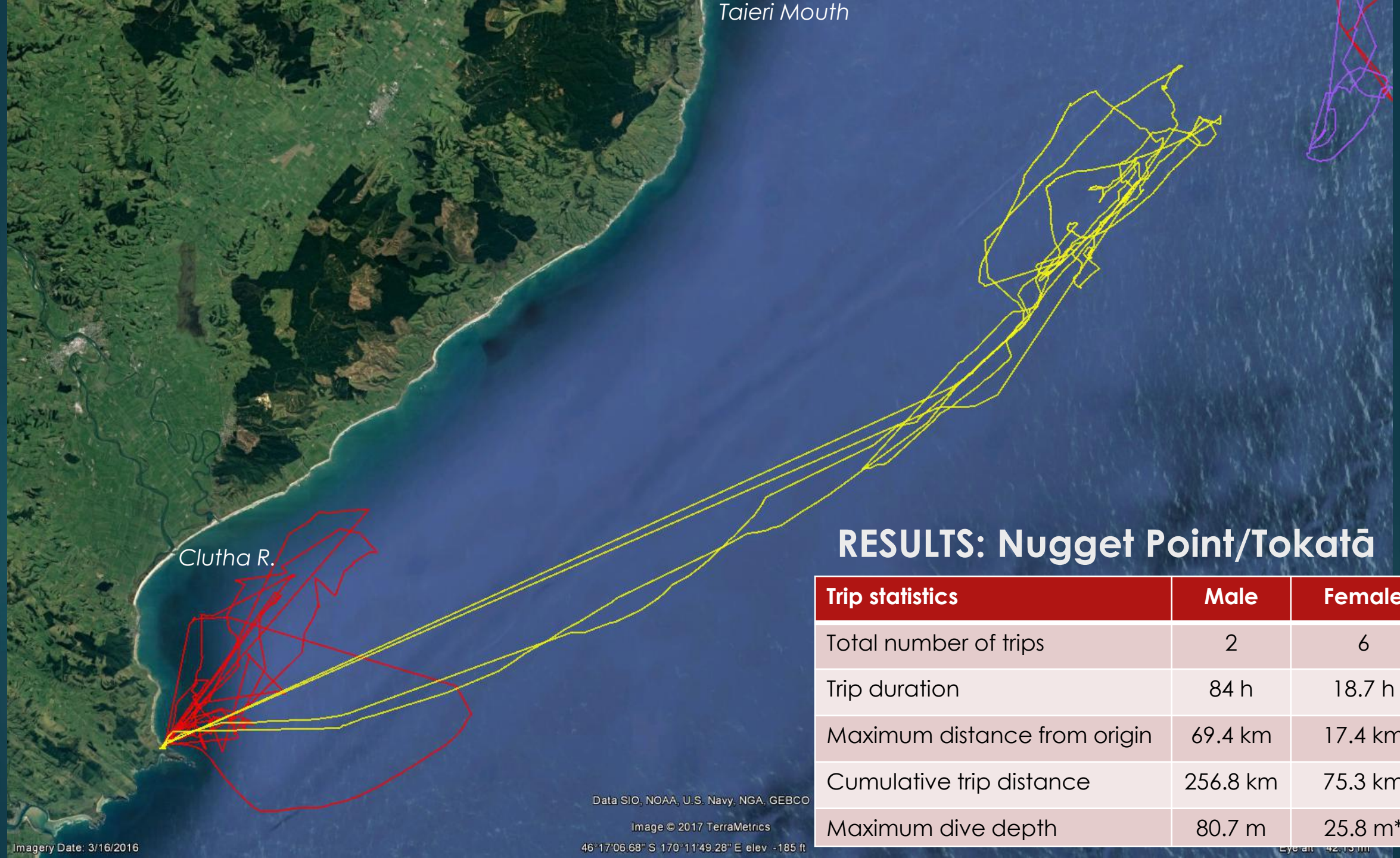


Trip statistics	Male	Female
Total number of trips	1	1*
Trip duration	10.5 h	(7 days)
Maximum distance from origin	13.3 km	18.3 km*
Cumulative trip distance	33.6 km	55.0 km*
Maximum dive depth	53.5 m	72.3 m

RESULTS: Otapahi

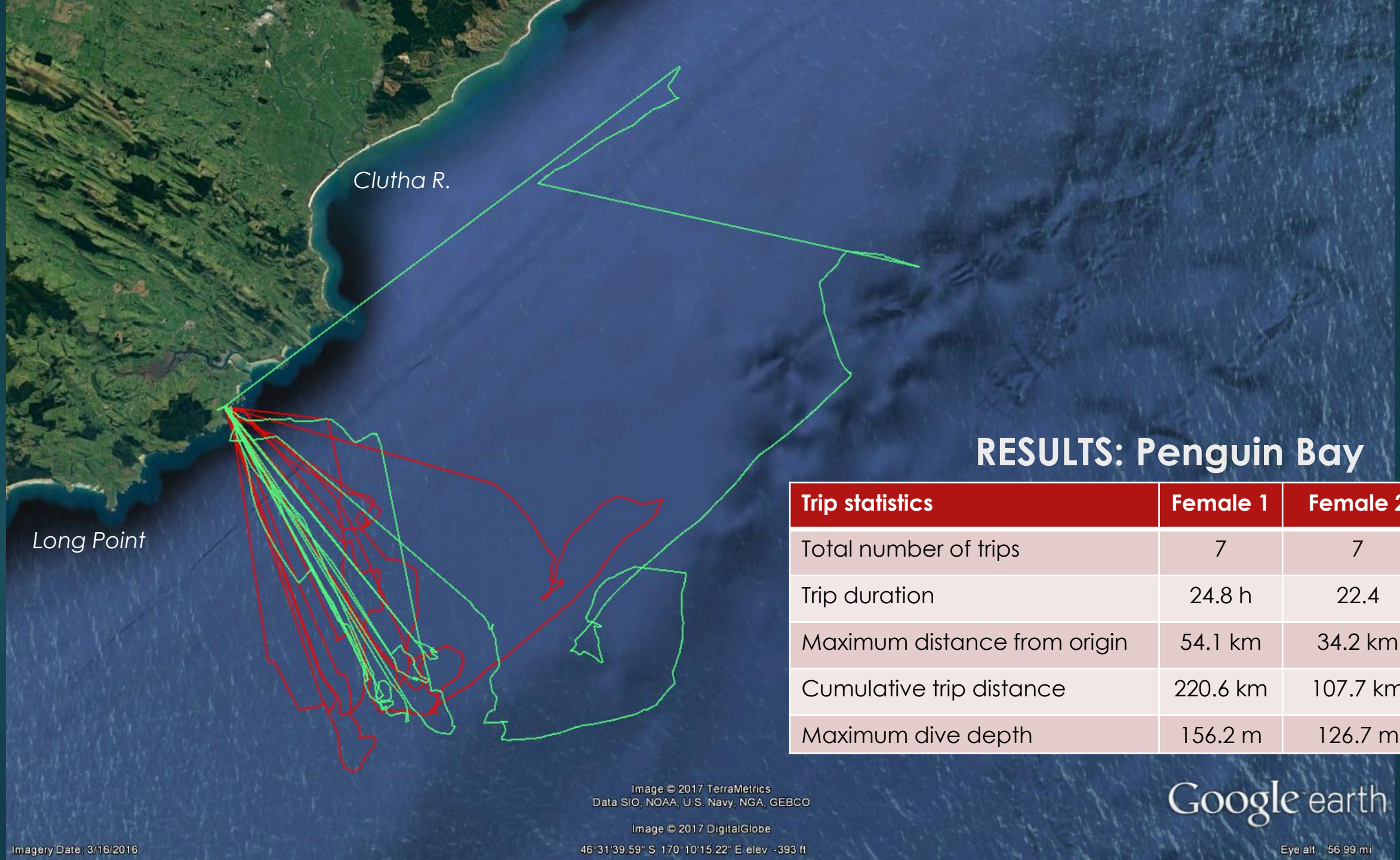
Trip statistics	Male 1	Female 1	Male 2	Female 2
Total number of trips	3	3	2	2
Trip duration (mean)	27.6 h	14.13 h	13.4 h	14.5 h
Maximum distance from origin	30.8 km	27.1 km	18.0 km	10.8 km
Cumulative trip distance	87.7 km	59.1 km	40.8 km	26.7 km
Maximum dive depth	111.7 m	104.5 m	91.9 m	54.8 m





RESULTS: Nugget Point/Tokatā

Trip statistics	Male	Female
Total number of trips	2	6
Trip duration	84 h	18.7 h
Maximum distance from origin	69.4 km	17.4 km
Cumulative trip distance	256.8 km	75.3 km
Maximum dive depth	80.7 m	25.8 m*



RESULTS: Penguin Bay

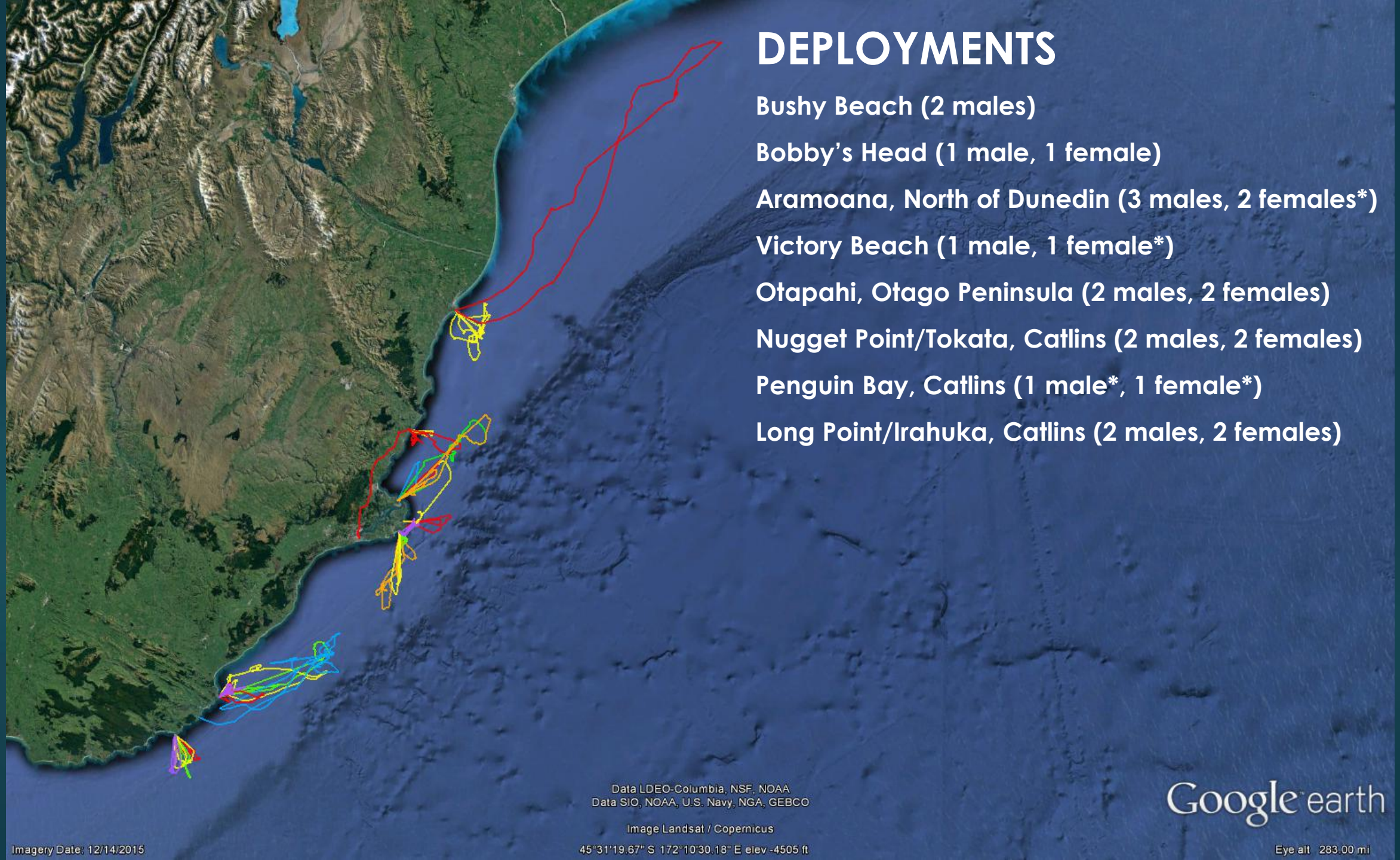
Trip statistics	Female 1	Female 2
Total number of trips	7	7
Trip duration	24.8 h	22.4
Maximum distance from origin	54.1 km	34.2 km
Cumulative trip distance	220.6 km	107.7 km
Maximum dive depth	156.2 m	126.7 m

Further analyses:

- Trip and dive analyses (% benthic dives)
- Local daily trips vs. multi-day trips
- Adaptive local convex hull (a-LoCoH) utilisation distribution
- More data to be collected at pre-fledge in 2018

ADULT WINTER FORAGING RANGES

Raw data preview



DEPLOYMENTS

Bushy Beach (2 males)

Bobby's Head (1 male, 1 female)

Aramoana, North of Dunedin (3 males, 2 females*)

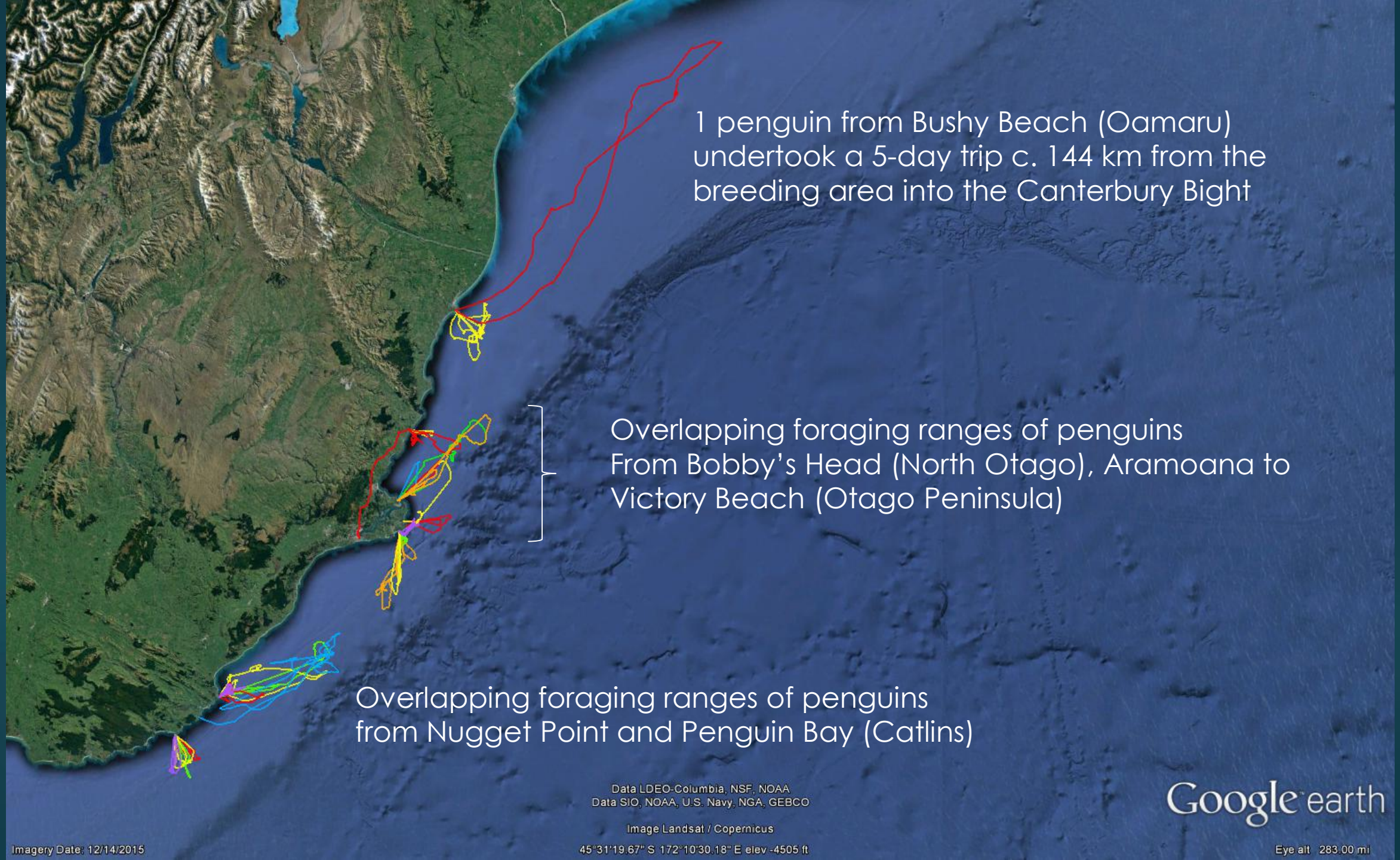
Victory Beach (1 male, 1 female*)

Otapahi, Otago Peninsula (2 males, 2 females)

Nugget Point/Tokata, Catlins (2 males, 2 females)

Penguin Bay, Catlins (1 male*, 1 female*)

Long Point/Irahuka, Catlins (2 males, 2 females)


1 penguin from Bushy Beach (Oamaru) undertook a 5-day trip c. 144 km from the breeding area into the Canterbury Bight
Overlapping foraging ranges of penguins From Bobby's Head (North Otago), Aramoana to Victory Beach (Otago Peninsula)
Overlapping foraging ranges of penguins from Nugget Point and Penguin Bay (Catlins)
Data LDEO-Columbia, NSF, NOAA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Imagery Date: 12/14/2015
45°31'19.67" S 172°10'30.18" E elev -4505 ft
Eye alt 283.00 mi
Google earth

Further analyses:

- Descriptive statistics
- Trip and dive analyses (% benthic dives)
- Adaptive local convex hull (a-LoCoH) utilisation distribution
- Comparison with previous studies (Bushy Beach, Long Point)
- More data to be collected in winter 2018

POST-FLEDGING DISPERSAL OF JUVENILES

Preliminary results

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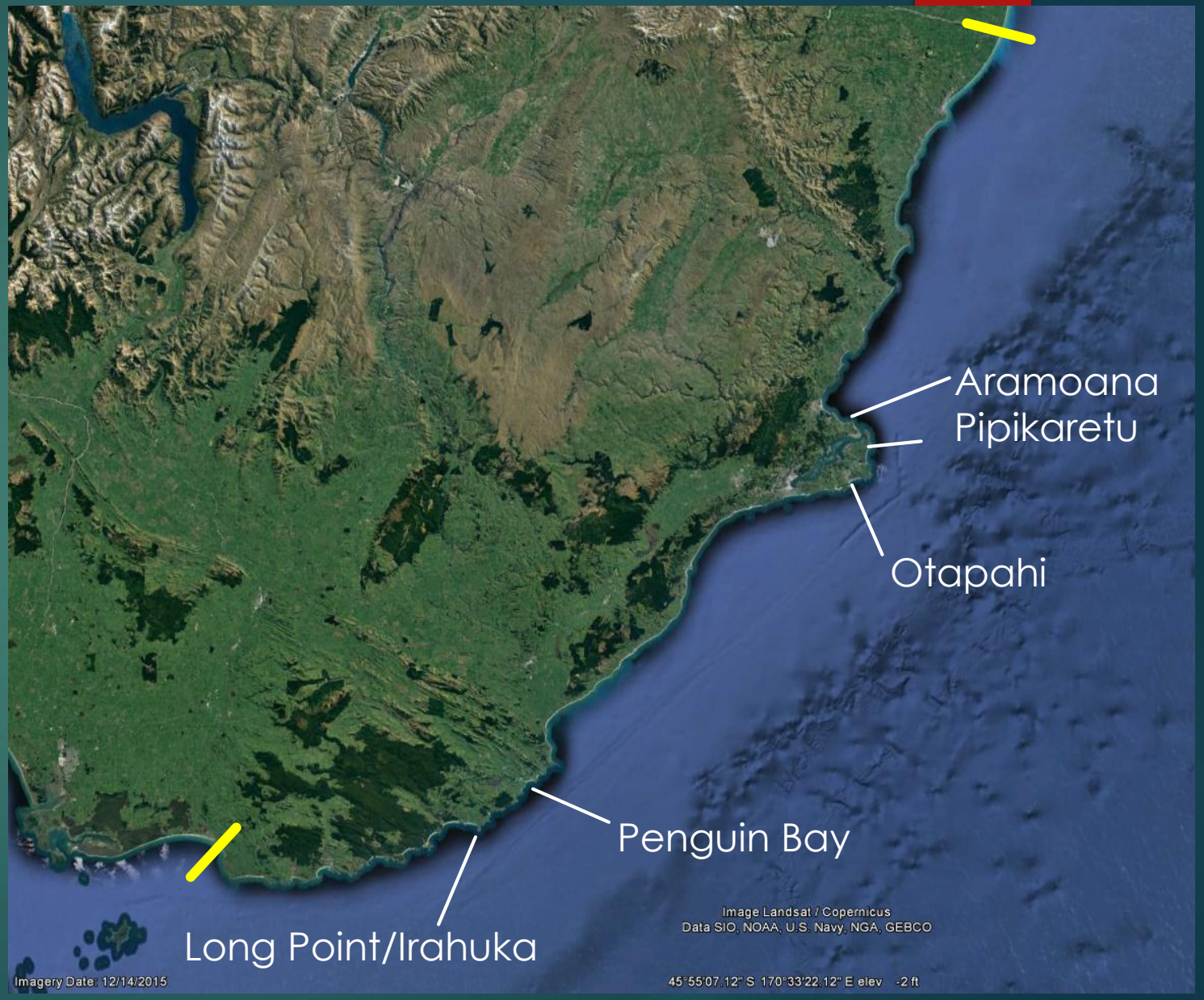
Device selection

- Satellite tags (Sirtrack KiwiSat 202)
- Weight 32 grams
- Programmed to transmit every 45s in a six-hour window from 12:00 to 17:59 NZST

- "Petrek 3G" GSM-GPS tags
- Weight 30 grams
- Programmed to transmit every 2 hours until battery runs out (4-5 days)

METHODS

Site and individual selection
Sample size
Device selection



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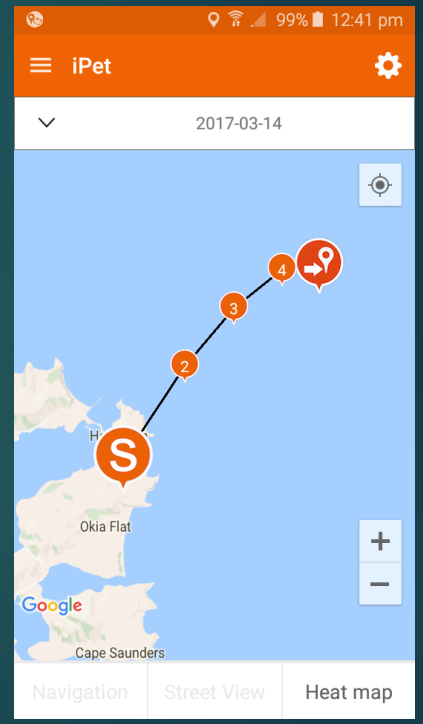
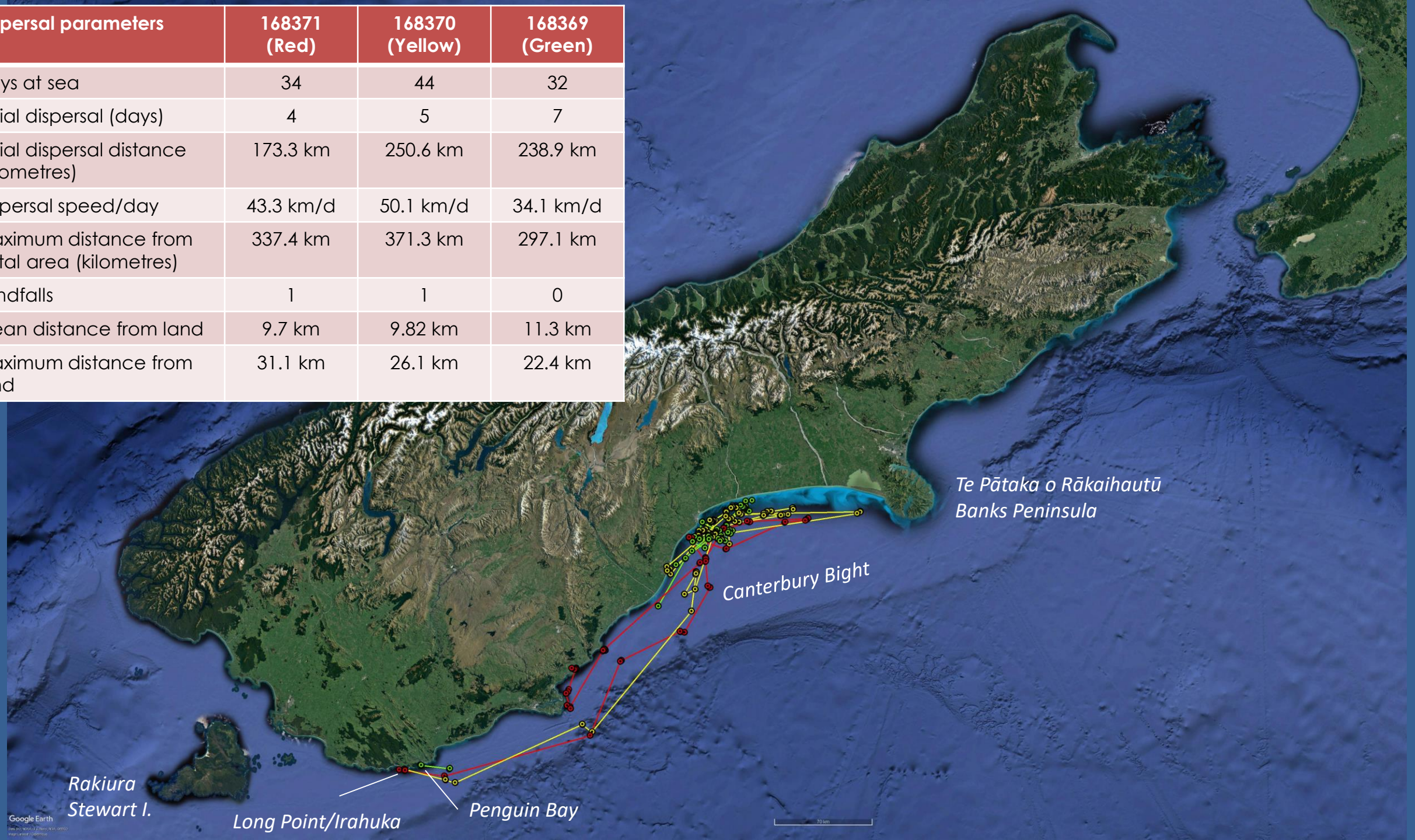
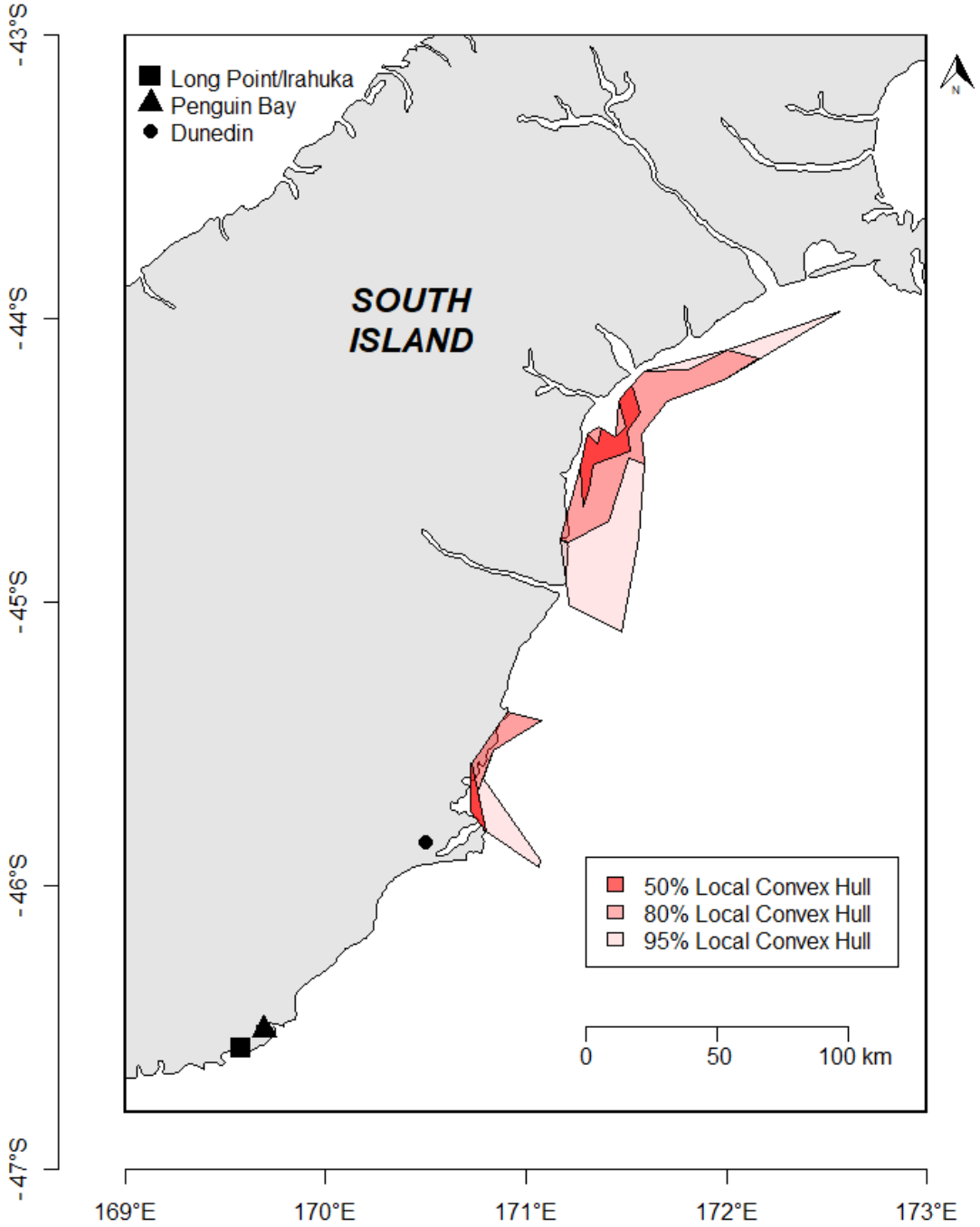
RESULTS

- **Satellite tags (Sirtrack KiwiSat 202)**
- 2 failed, 3 transmitted for 32-44 days
- **“Petrek 3G” GSM-GPS tags**
- 2 failed, 2 transmitted for 6-12 hours



Dispersal parameters	168371 (Red)	168370 (Yellow)	168369 (Green)
Days at sea	34	44	32
Initial dispersal (days)	4	5	7
Initial dispersal distance (kilometres)	173.3 km	250.6 km	238.9 km
Dispersal speed/day	43.3 km/d	50.1 km/d	34.1 km/d
Maximum distance from natal area (kilometres)	337.4 km	371.3 km	297.1 km
Landfalls	1	1	0
Mean distance from land	9.7 km	9.82 km	11.3 km
Maximum distance from land	31.1 km	26.1 km	22.4 km





Local Convex Hull Utilisation Distribution

50% volume contour (= probable foraging area)
Timaru to Rangitata Mouth
Taiaroa Head to Pleasant River
Probable foraging area c. 420 km^2

95% volume contour
Otago Peninsula to Kātiki Point
Waitaki River to Lake Ellesmere

Further research recommended:

- Increase sample size and representation of fledglings from across Otago/Southland for 2017/18 breeding season (n = 10)

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Summary of rogress to date:

- Pre-moult tracking complete, 10 individuals successfully tracked (34 trips); analysis to be completed by September 2017;
- Winter tracking complete, 24 individuals successfully tracked (55 trips); analysis to be completed by September 2017;
- Post-fledging dispersal tracking complete, 3 individuals tracked (up to 44 days); analysis complete but sample size is small.

Thank you

Department of Conservation
Te Papa Atawhai

University of Otago
Te Whare Wānanga o Otāgo
New Zealand

Sponsors:

Pohatu Penguins
pohatu plunge
New Zealand

Birds New Zealand

Blue Penguin Colony
Est 1992
Oamaru NZ

Penguin Place
Conservation Reserve
Dunedin, NZ

Yellow-eyed Penguin Trust

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