EUDYPTES ECOCONSULTING

monthly REPORT

To: **Igor Debski, Conservation Services Program**
From: **Thomas Mattern**
Project: **Hoiho Population and tracking: POP2018-02**
Date: **26 April 2019**

Monthly report for the period 21 Mar 2019 – 20 Apr 2019

Summary

As penguins all entered the moult phase, no logger deployments occurred in the past month; next deployments are scheduled for the first week of May.

The downtime was used to run comprehensive analyses of the recorded data.

The post-guard stage of the season 2018/19 started already in early December so that no chick-guard data could be obtained when field work commenced. The data outcome was very limited due to the problems with device recovery and damage as outlined in previous reports. GPS data was obtained for two penguins from the Catlins, one each from Te Rere and Penguin Bay. Foraging ranges between Te Rere and Penguin Bay differed (15.3 km vs 31.0 km) as did foraging trip durations (16.6 hrs vs 32.7 hrs). Dive data was recorded for three birds (2x Te Rere, 1x Penguin Bay). One of the Te Rere birds performed short, evening trips and showed high dive rates (no GPS data recorded); dive profiles suggest that foraged pelagically on 8 of its 9 trips. The other penguin fitted with a device at the same time left on one day trips (16.6 hrs) and foraged predominantly at the seafloor (70% of all dives benthic) which correlates with linear foraging observed (see January 2019 report). The Penguin Bay penguin predominantly foraged pelagically (65%) on its first trip while subsequent trips were characterized by benthic foraging again (see graphs on page 2).

During the pre-moult, device deployments occurred at Otapahi, Otago Peninsula (2 birds) and Aramoana (5 birds); except for one of the Aramoana penguins which lost its device package, all loggers were successfully recovered and yielded GPS and dive data. Trip durations differed significantly with Aramoana birds staying at sea for 2-13 days (mean 4.7 days), whereas Otapahi penguins stayed at sea for no longer than three days at a time (mean 1.0 day). This also reflected in foraging ranges (mean foraging range; Aramoana: 33.6 km, Otapahi: 19.2 km).

While the overall data outcome from Otapahi was too limited to draw general conclusions, the data sets of pre-moult movements of hoiho from Aramoana provided valuable, new insights. The combined GPS and dive data were used to model the penguins' habitat use utilizing procedures developed for a comprehensive spatial analysis recently conducted for MPI.

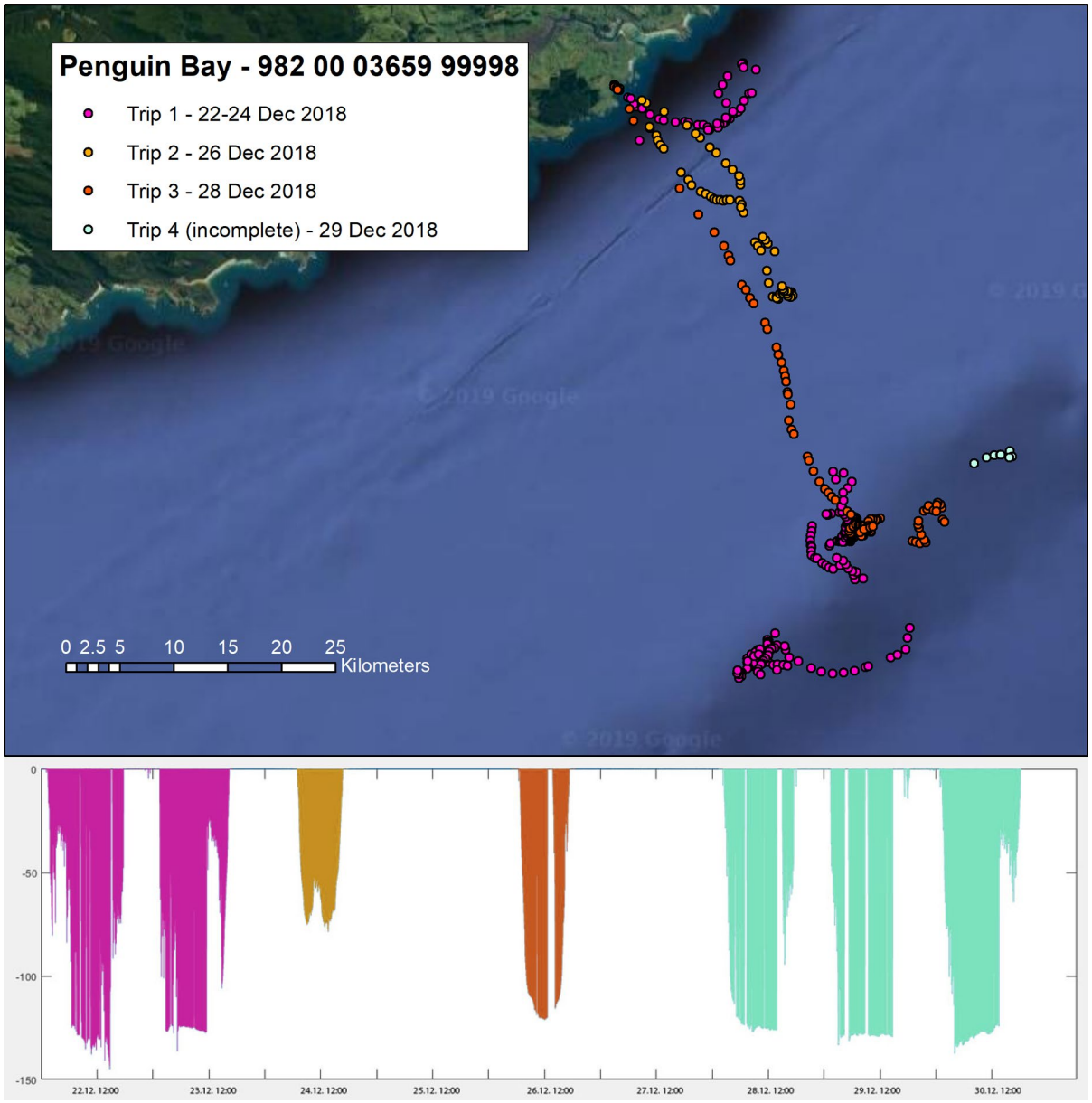
Hoiho from Aramoana foraged predominantly over sandy sediment at water depths of <70m (mean water depth: 35 m) between 5 and 30 km from the coast. A particularly frequent area lay 6-12 km off the coast of Karitane and Waikouaiti. Habitat use model indicate an area with a circumference of ca 200 km and an area of 1,750 km² ranging from the tip of the Otago Peninsula to the southern end of Barracouta Bay to be particularly suitable for hoiho foraging.

Positions of set net operations between 2009 and 2012 available for this analysis shows a significant overlap with hoiho penguin habitat. Hence, the risk of interactions between fisheries and penguins is substantially higher north of the Otago Peninsula than in South Otago and the northern Catlins and comparable with that of the Foveaux Strait.

Results

The following section presents graphs of true (i.e. not extrapolated) GPS fixes recorded during separate foraging trips of hoiho from the Catlins, Otapahi and Aramoana. Correspondingly coloured dive profile graphs and summary statistics (individual means) are given below the graph. Full statistics of trip and individual means can be found in the appendix as well as Google sheets for which links are provided.

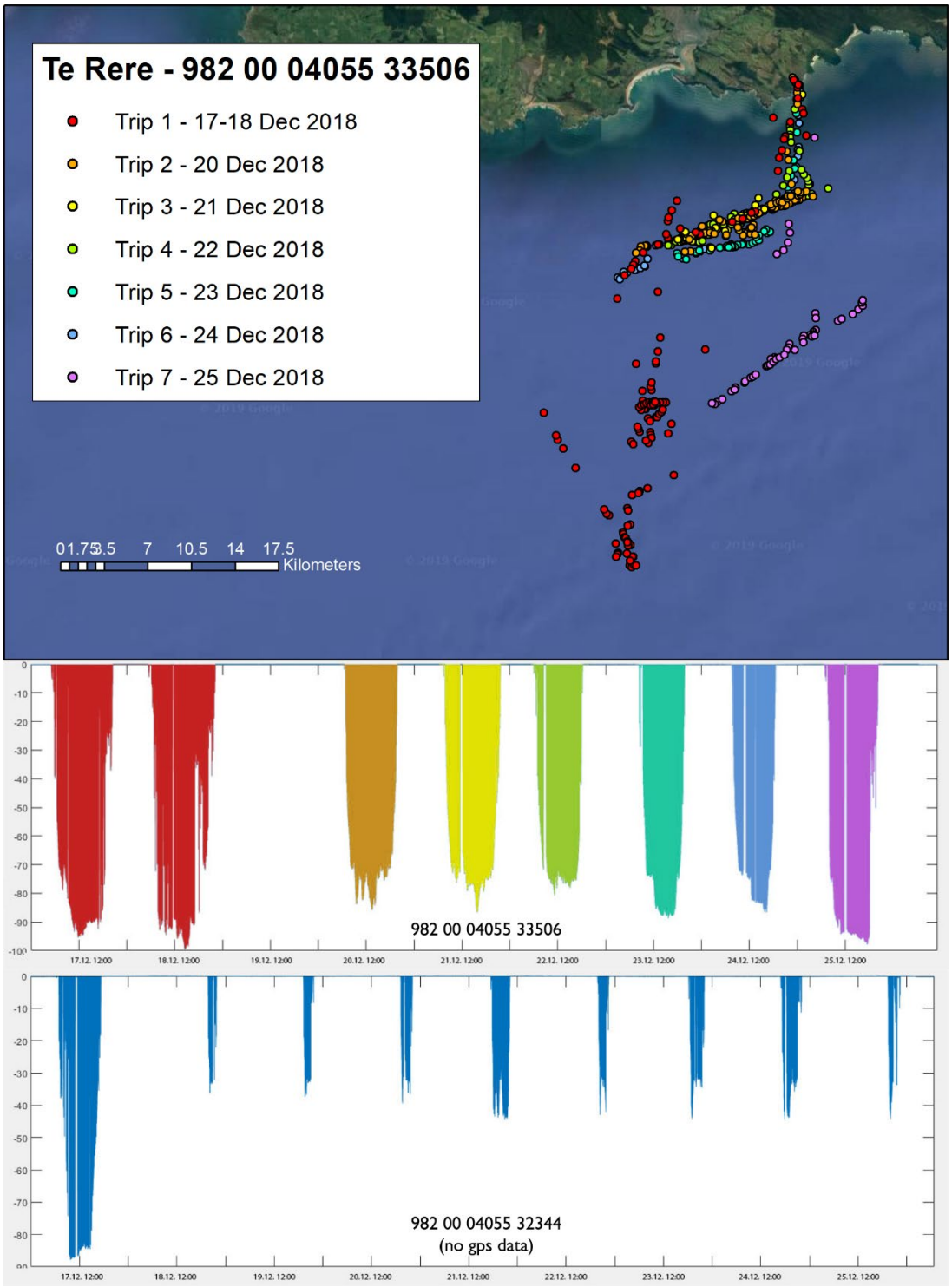
Post-guard – Penguin Bay



Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive events	Mean dive time	Mean max depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
4	30.9	82.0	4.2	31.9	16.6	395	161	65	54%

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1SQ2SU6TKfLQJzKNZmmeoTvebpL4AvOdYTjRnMxo16IE/edit?usp=sharing

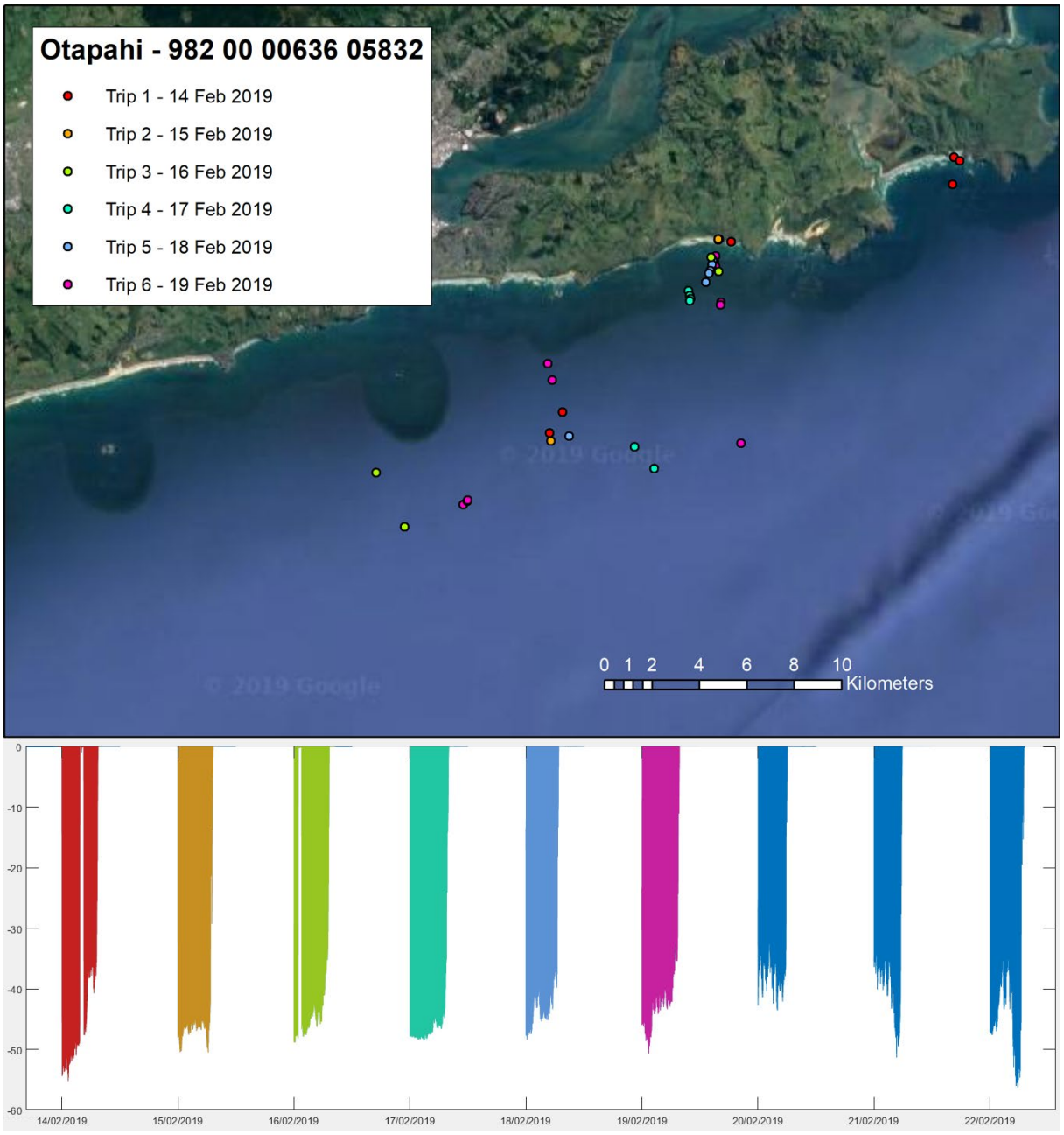
Post-guard – Te Rere



Bird ID	Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean dive events	Mean dive time	Mean max depth	Mean max Depth
	[n]	*[days]*	*[km]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
33506	7	16.6	48.9	15.3	8.0	287	122	52	0.70
32344	9	5.4	*no gps data*	*no gps data*	*no gps data*	114	78	23	*no gps data*

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1SQ2SU6TKfLQJzKNZmmeoTvebpL4AvOdYTjRnMxo16IE/edit?usp=sharing

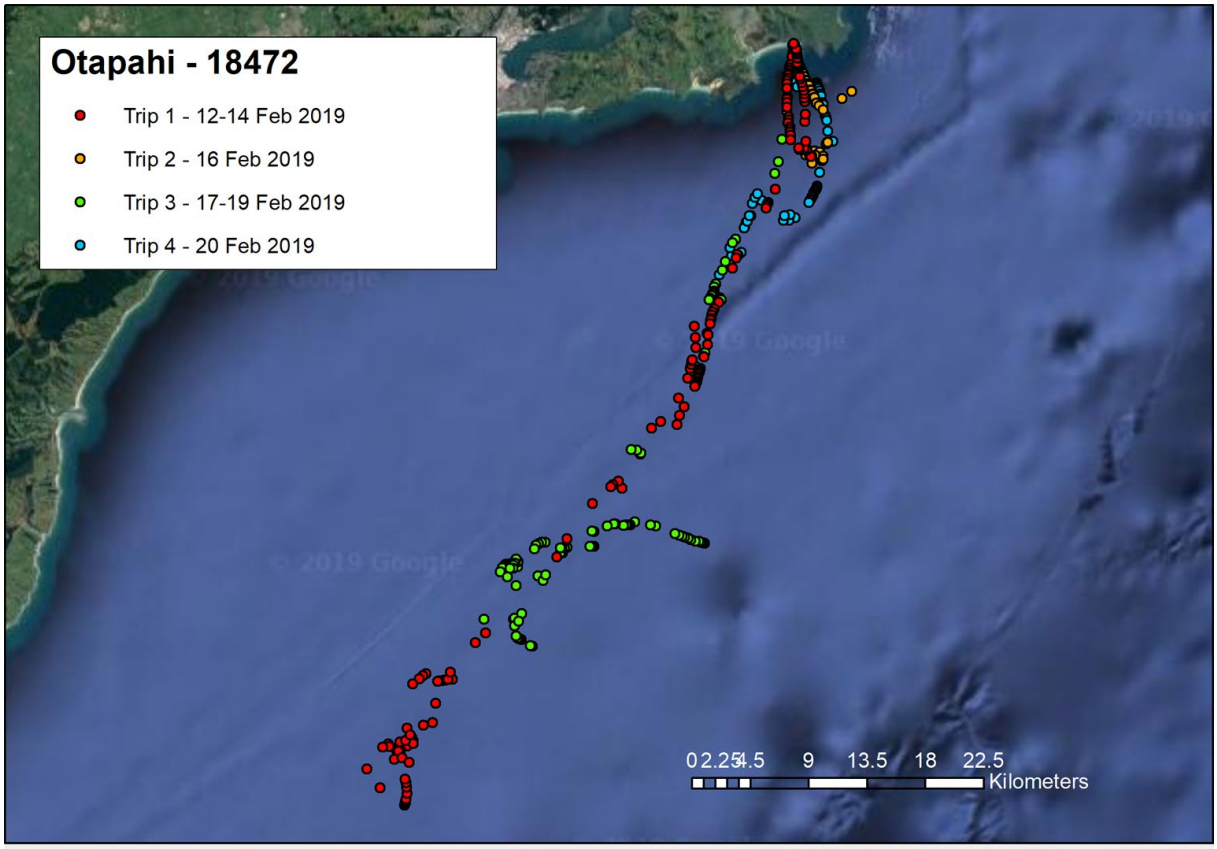
Pre-moult - Otapahi

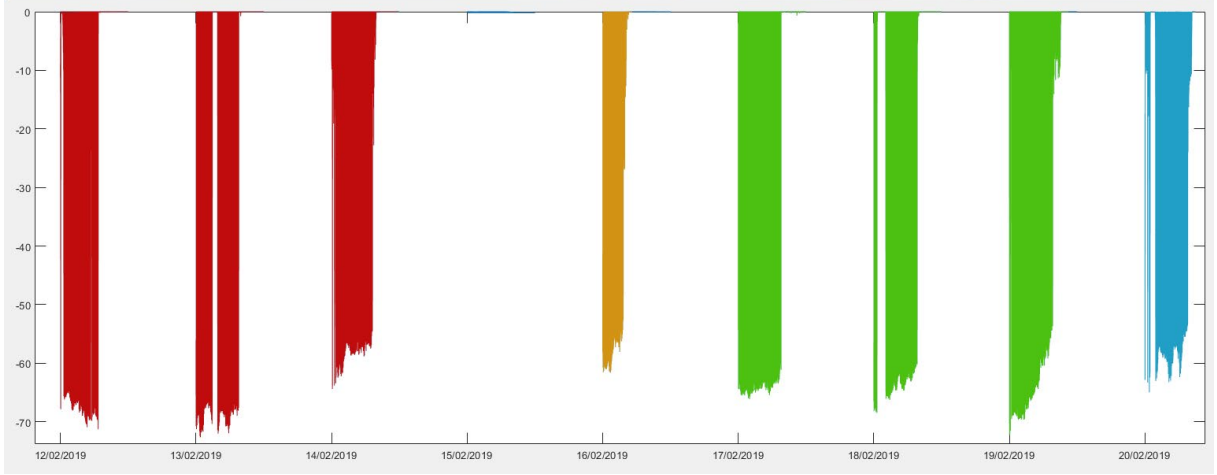


Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive events	Mean dive time	Mean max depth	% benthic dives
[n]	*[h]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
9	13.0	*15.9*	*1.24*	*13.2*	*9.1*	263	131	37	84%

Note: GPS data was of poor coverage so that parameters that are based on spatial data are not likely to reflect actual movement behaviour correctly. These values are given in italic font.

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing

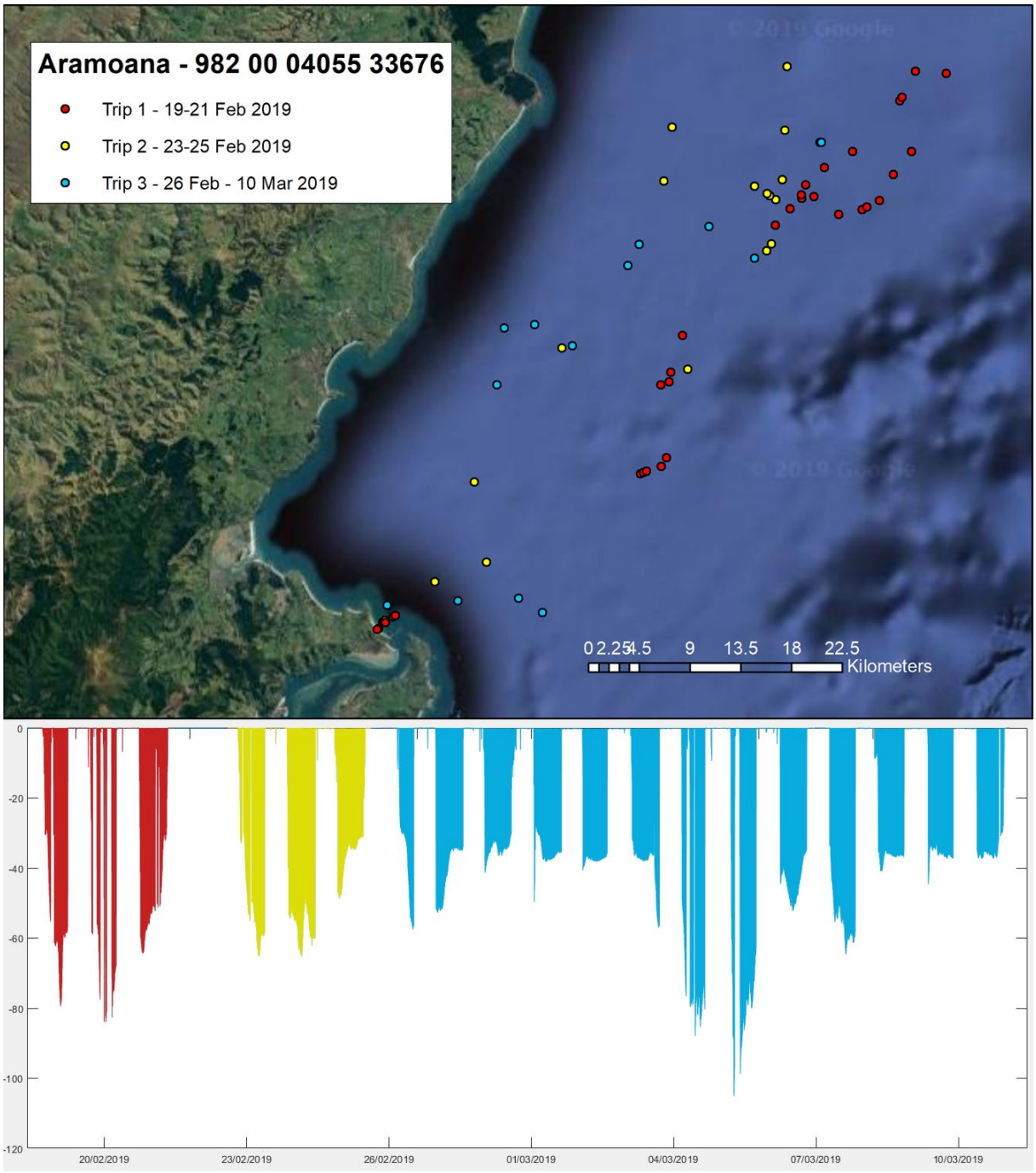




Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive events	Mean dive time	Mean max depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
4	1.5	72.6	2.14	25.2	14.2	464	133	38	84%

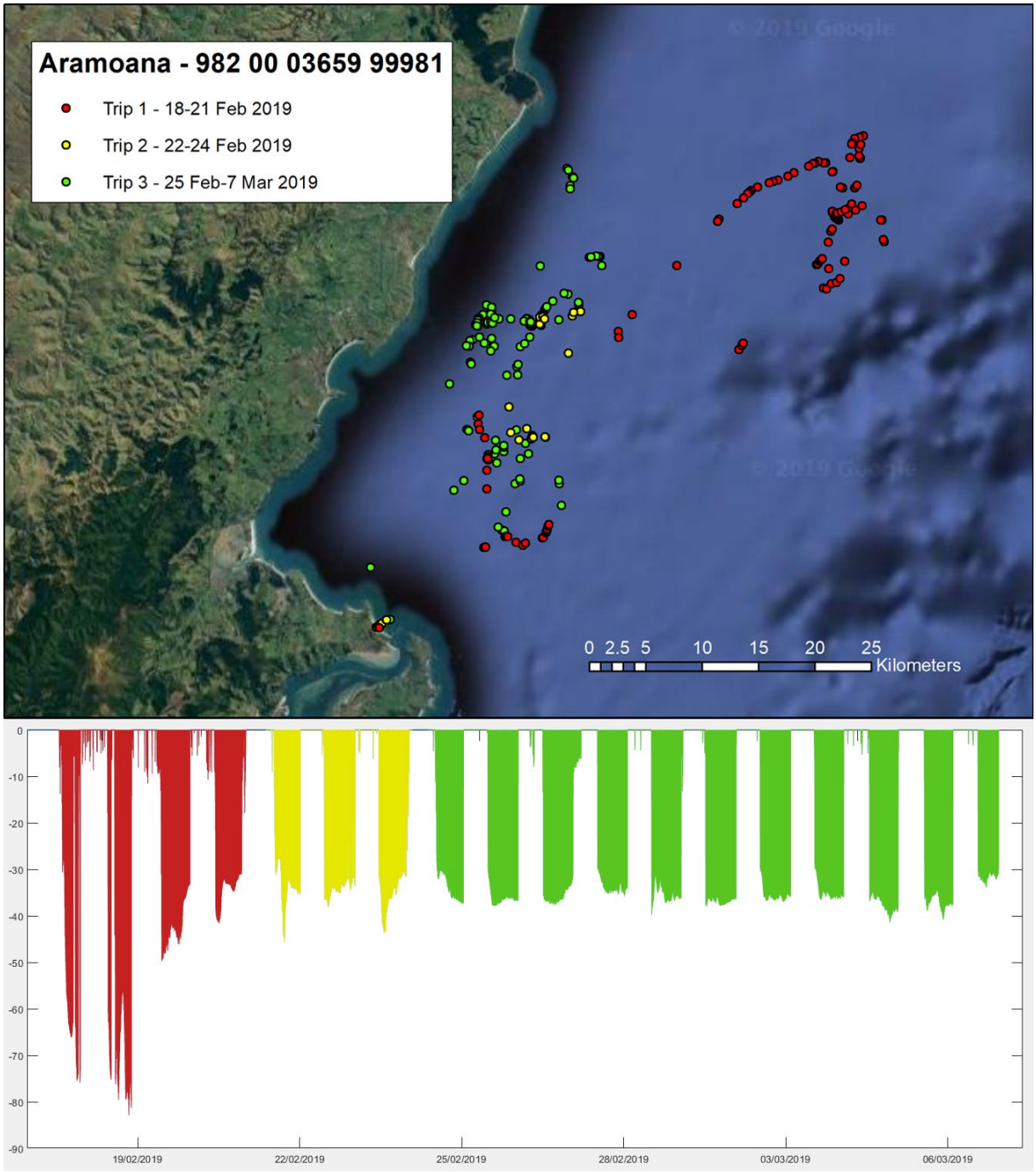
Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing

Pre-moult – Aramoana



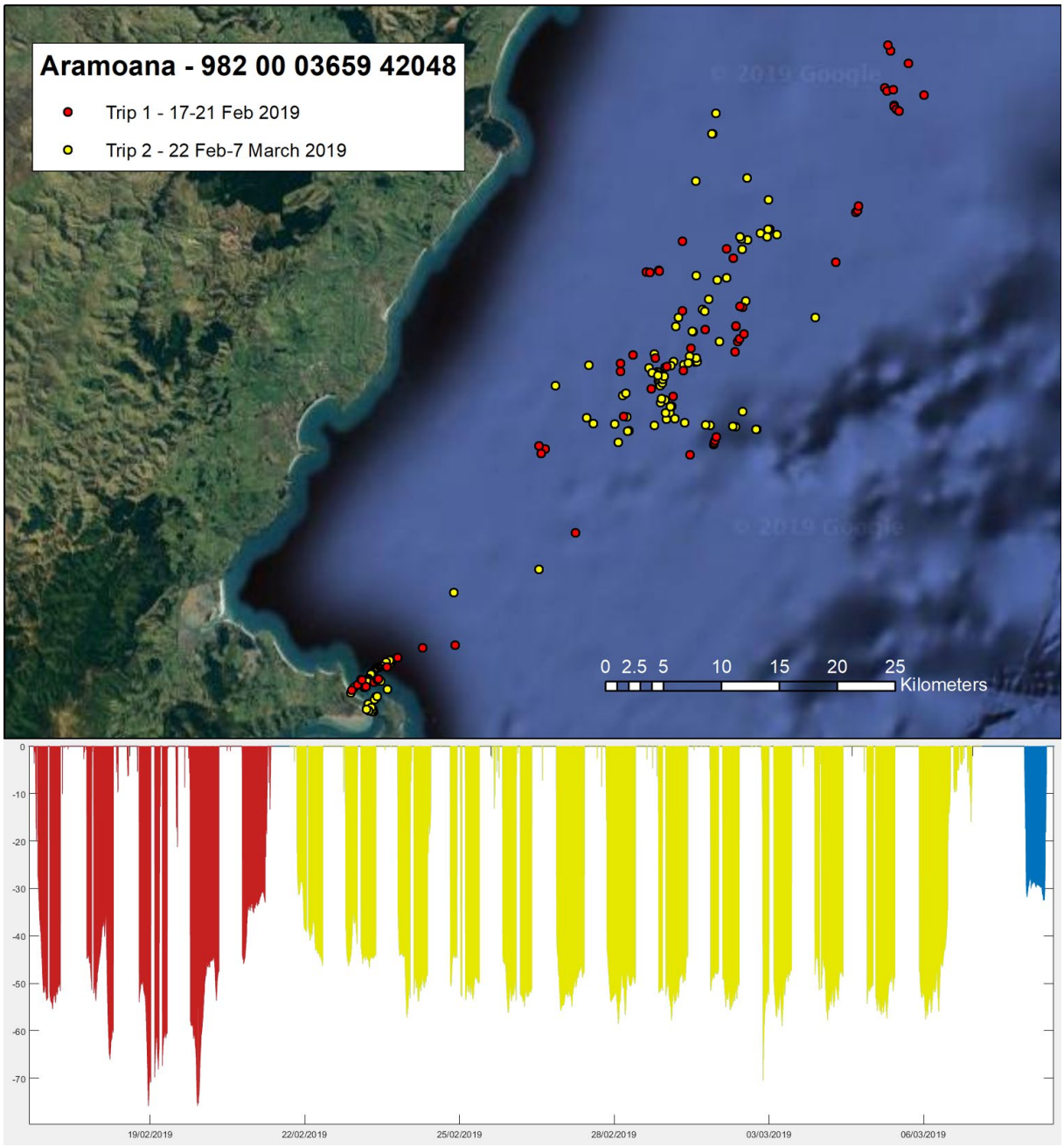
Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive events	Mean dive time	Mean max depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
3	5.8	123.7	1.30	45.2	22.0	263	147	38	67

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing



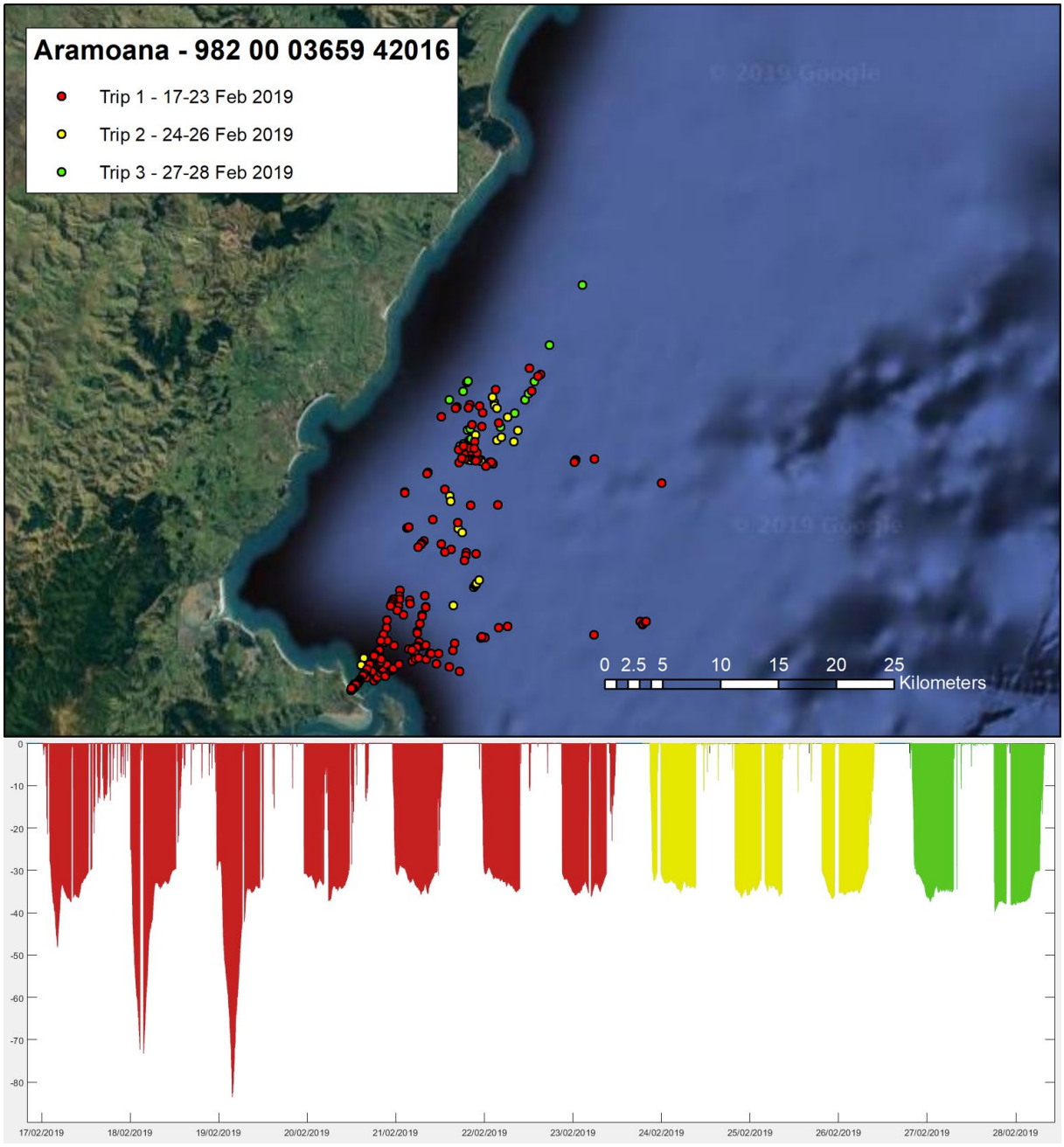
Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive Events	Mean dive Time	Mean max Depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
3	5.4	118.3	0.91	32.3	15.9	1588	133	31	73

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing



Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive Events	Mean dive Time	Mean max Depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
3	6.0	147.9	1.03	34.0	18.7	1588	15.5	35	73

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing



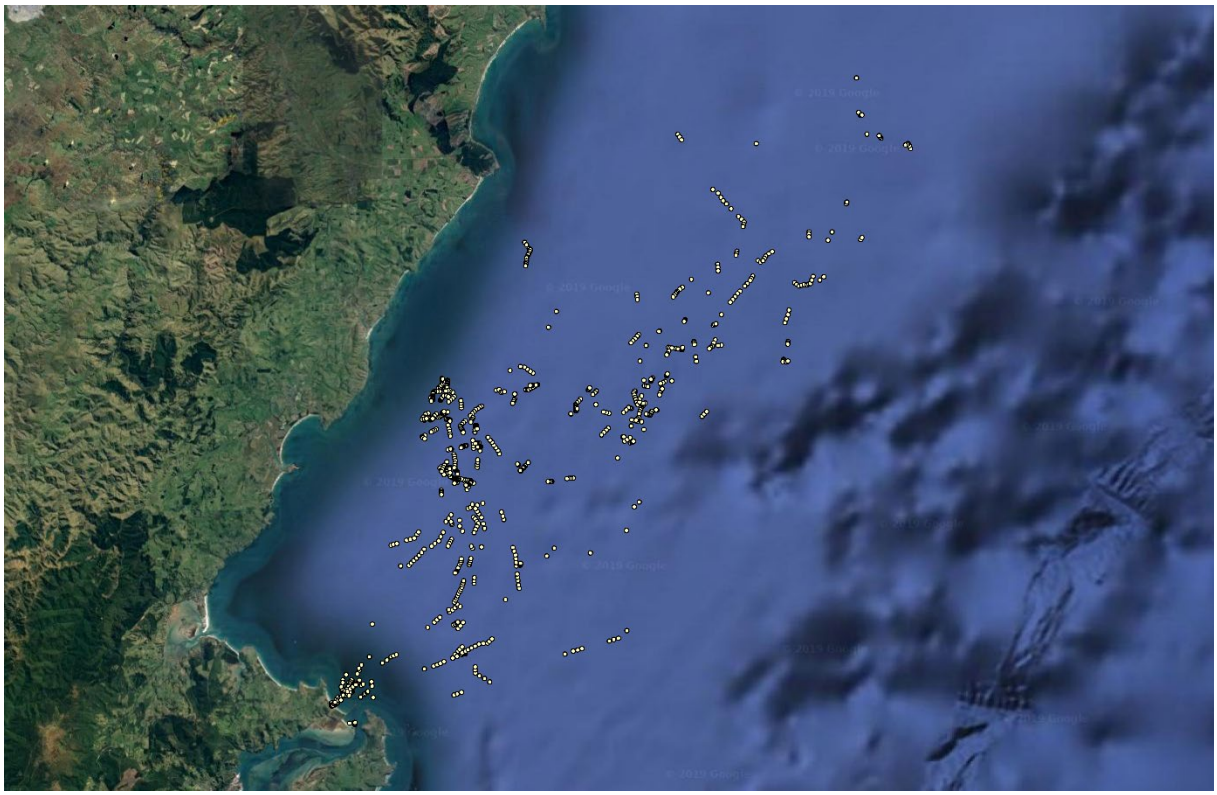
Trip number	Mean trip duration	Mean distance travelled	Mean travel speed	Mean maximum range	Mean range	Mean dive Events	Mean dive Time	Mean max Depth	% benthic dives
[n]	*[days]*	*[km]*	*[km/h]*	*[km]*	*[km]*	*[n]*	*[s]*	*[m]*	
3	2.6	100.8	1.60	23.0	12.8	895	116	28	76

Full dive analysis results see appendix or
https://docs.google.com/spreadsheets/d/1Tm262UJQ6Sgpob_FEYVc36jJqzR8gVe2mvPZHjxuAGs/edit?usp=sharing

Pre-moult – Use of the marine habitat of hoiho from Aramoana

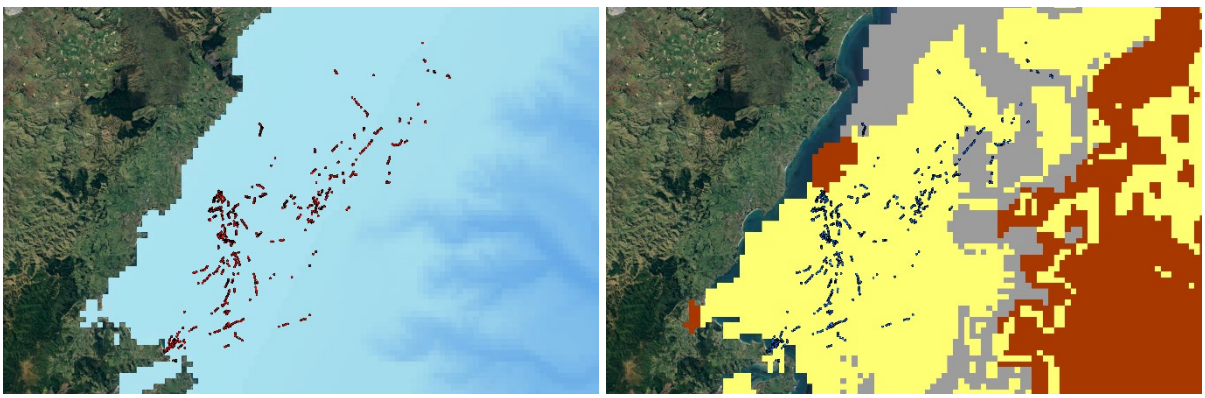
To determine habitat characteristics that determined the foraging movements of hoiho during the pre-moult phase, GPS data recorded on penguins from Aramoana was used in models developed for MPI ("PRO2017-06 Characterization of yellow-eyed penguin / fishery interaction"). These models assess habitat suitability using a probabilistic presence approach.

Firstly, filtered GPS positions of foraging dives (i.e. benthic dives) are plotted in ArcGIS. Filtered positions consist of true GPS fixes, i.e. fixes recorded by the device prior to a dive event, and extrapolated locations of dives that occurred within 10 minutes of a true GPS fix.



Filtered GPS positions used for habitat utilization model

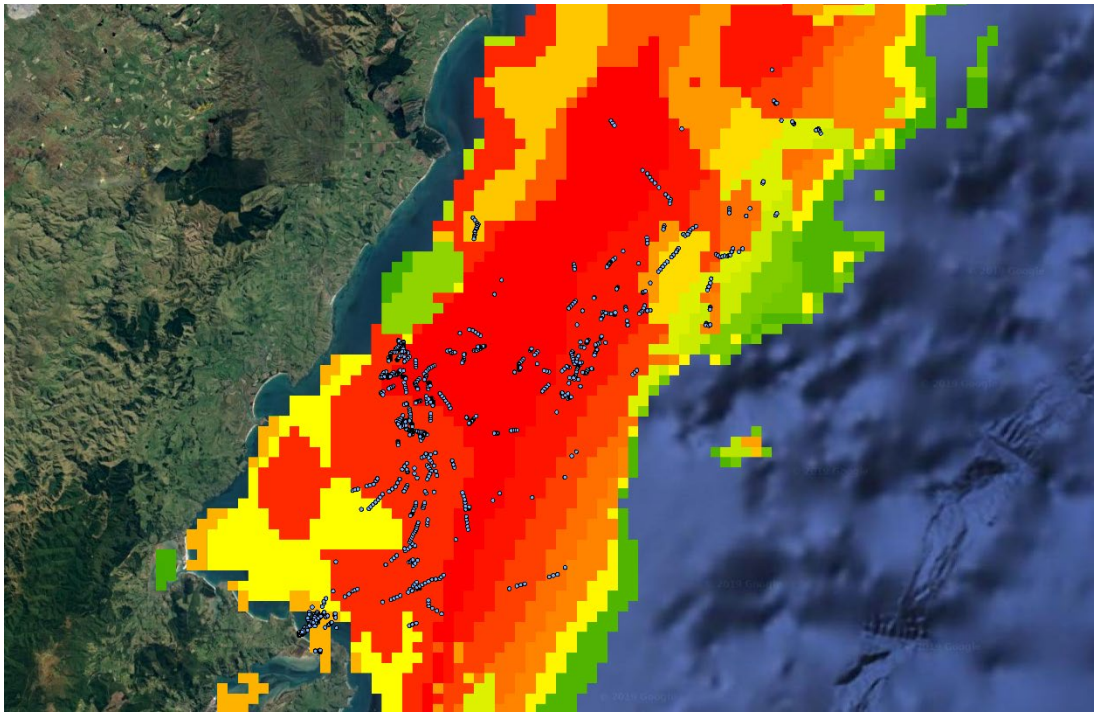
Secondly, gridded (1x1km) habitat data are added as background layers to the plot.



Hoiho GPS positions in relation to bathymetry (left) and seafloor sediment grids (right; yellow: sand, grey: gravel, brown: mud)

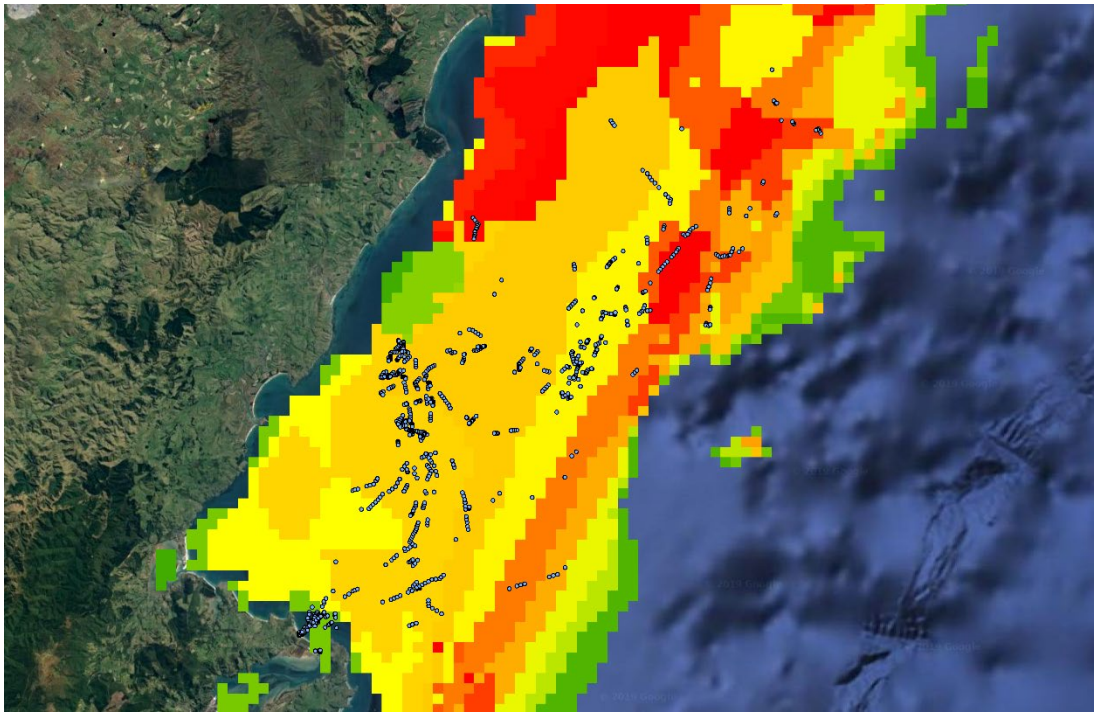
Other variables tested were distance from origin (i.e. colony) and freshwater source (i.e. river mouths) but both variables had minor to no effects on the penguins' spatial distribution. Main factors were water depth (<70m) and sandy and, to a lesser, extent gravel sediments.

Counting of hoiho GPS positions within each grid cell allowed it to determine relative importance of factor values. Subsequently a grid analysis was performed where all cells (i.e. including those not visited by hoiho during this study) were assessed on their suitability for penguins based on their factor values.



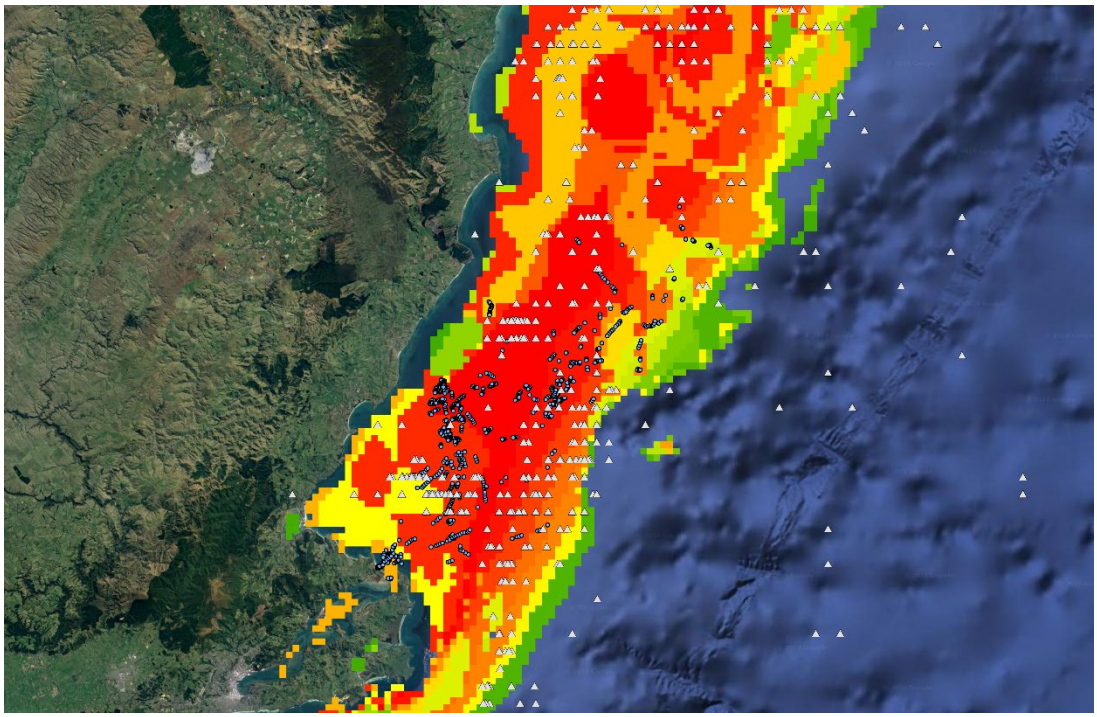
Modelled habitat suitability for hoiho from Aramoana. Orange and red areas represent grid cells where penguins are most likely to forage at the seafloor (20-100% occurrence probability based on water depth and sediment type). Yellow, green and empty cells are of lesser to no interest for the penguins.

This is a considerably improved model output compared to that based on foraging data available during the original modelling exercise, where foraging preferences of penguins from Oamaru were used to assess habitat utilization:



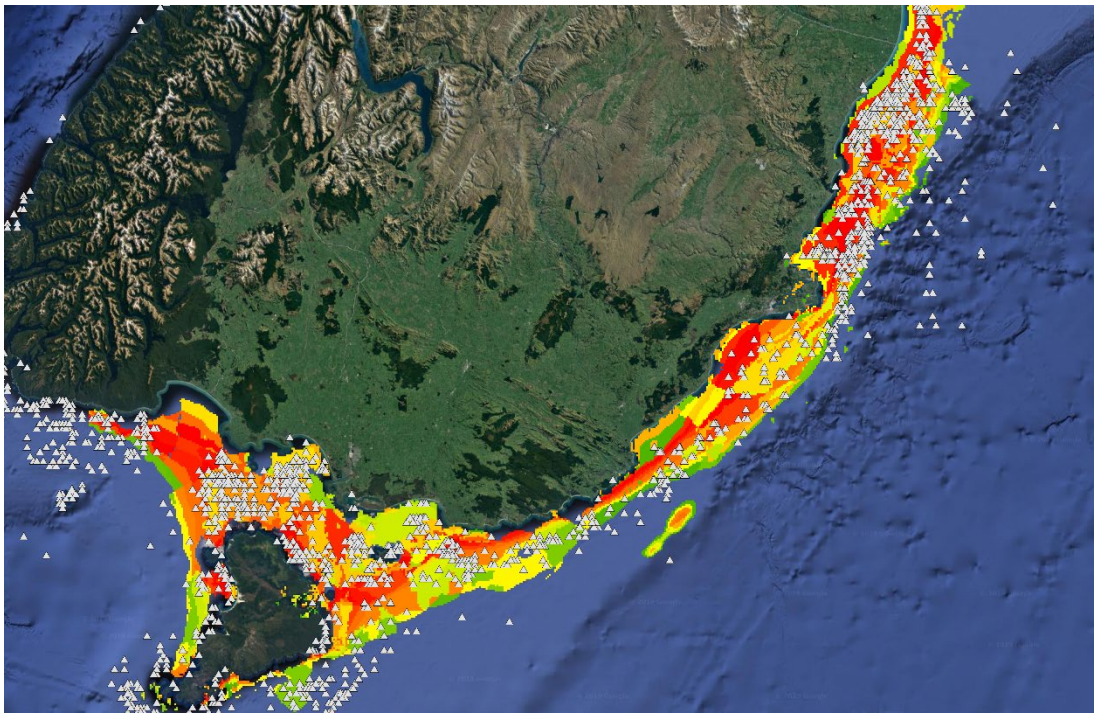
Modelled habitat suitability using foraging data of hoiho from Oamaru.

Clearly, extrapolating habitat preference from different regions misrepresents actual habitat suitability for the Blueskin Bay to Shag Point region. Moreover, these revised habitat models highlight substantial overlap of hoiho foraging activity with set netting activities.



Habitat utilization of hoiho from Aramoana in relation to set netting operations (fisheries data from 2009 to 2012).

Clearly, both penguins and set net fisheries target similar habitats so it can be assumed that birds from the region are considerably more susceptible to set netting when compared to hoiho from the southern Otago Peninsula or northern Catlins. The level of likely interaction with set netting operations is comparable to that of hoiho in Foveaux Strait.



Habitat utilization of hoiho in relation to set netting operations (fisheries data from 2009 to 2012).

Next steps

Monitoring of hoiho foraging movements and behaviour will resume in the first week of May in the Catlins. These activities will be continued throughout the winter and into the pre-breeding and incubation stages of this year. The range of operation is planned to be extended to sites in North Otago and Stewart Island from October onwards.