foraging ranges • diving patterns • behavioural plasticity

the tawaki project

www.tawaki-project.org

a 5 year project to study the marine ecology, breeding biology and population dynamics of the world's most enigmatic penguin - the Fiordland penguin / tawaki

field report - year 4

16 September 2017 - 2 March 2018

Thomas Mattern &
Ursula Ellenberg

GPS
Global Penguin Society

Contents

The Tawaki Project so far

The fourth year of the Tawaki Project has been the most ambitious in terms of scope of research questions that were addressed. Over the first three years, the project slowly ramped up from working at one (Jackson Head/West Coast), then two (Milford Sound/Piopiotahi), and finally three sites (Codfish Island/Whenua Hou) simultaneously to study how breeding Fiordland penguins / tawaki interact with their diverse marine habitats.

Using GPS dive loggers, a total of 125 individual foraging trips were tracked on 41 tawaki in the first three years. Dive data recorded represents nearly 40,000 diving events. The data not only will allow us to compare foraging behaviour and success between the three sites, the project also was working with tawaki during years that were characterized by substantial environmental perturbations.

In 2015, the third-strongest El Niño on record forced penguins from Jackson Head to extend their foraging ranges substantially in an attempt to compensate for poor food conditions closer inshore; to no avail as many of the chicks that year died of starvation. At the same time, penguins from Milford Sound hardly ever left the cove their colony is located in and exhibited very good breeding success (see our 2015 report).

In 2016, the situation at sea appeared to have normalized again, but a stoat invasion resulted in predation of most eggs and chicks at Jackson Head. In Milford Sound and on Whenua Hou, however, breeding success was high and foraging effort moderate to low. Overall, it appeared as if tawaki were doing a lot better than thought and a population survey we conducted in Milford Sound found many more breeding pairs than previously estimated.

Funding & Support

This season, **Birds New Zealand** contributed significantly to the project through the BNZ Research Fund and ensured that we could continue our work in Milford Sound/Piopiotahi and Jackson Head, and a grant from Forest & Bird's **J S Watson Trust** helped us cover the GPS tracking work on Codfish Island/Whenua Hou.

The **Antarctic Research Trust** provided us with 12 satellite transmitters and 48 geolocation (GLS) loggers to study the pre-moult and winter dispersal of the penguins.

Additional funding through **Taronga Zoo Sydney** and **Wellington Zoo** allowed us to revisit our study sites in the late breeding season (November 2017) to deploy GLS loggers, and to return to all three sites again in February/March 2018 to download some of the GLS data and deploy satellite transmitters to study the penguins' winter movement.

The **Cardrona Ski Resort** not only donated the proceedings of a Trade Me auction for the first ride of their new 'Chondola', but also invited our team to the official opening in June 2017!

The **Global Penguin Society**, without which this project would have never seen the light of day, supported the study with travel funding.

As in the previous years, our work in Milford Sound/Piopiotahi was made possible by **Southern Discoveries** who provided logistical support and sent out their staff to help us in the field.

And a huge thumbs up to the **supporters of our Patreon campaign**, particularly our high-tier patrons **Andrea Faris**, **Joanna Lancester**, **Gary Wayne** and **Kiyomi Ogawa**. Your steady support helps more than you can imagine!

Dave Houston during tawaki nest searches on Whenua Hou, September 2017.

A male tawaki guarding its one week old chick, Whenua Hou, September 2017.

Sites & Dates

Jackson Head

16 September - 14 October 2017

After nest searches and marking on the first day, GPS dive logger occurred between 17 September and 12 October.

19 November 2017

The site was revisited for a day to weigh chicks that were about to fledge and to deploy GLS loggers on breeding adults.

17-19 February 2018

After the penguins completed the moult, Jackson Head was revisited once more to deploy satellite transmitters.

Harrison Cove, Milford Sound / Piopiotahi

25 September - 12 October 2017

Nest searches were conducted on the first two days and nests were marked with numbered stock-tags. GPS logger deployments were carried out between 26 September and 6 October.

20-22 November 2017

We returned to Milford Sound for two days to deploy GLS loggers on breeding tawaki and weigh chicks where possible.

21-22 February 2018

Another brief visit occurred in February to deploy satellite transmitters and read out the first GLS data sets.

Codfish Island / Whenua Hou

20 September - 4 October 2017

Nests searches were carried out during the first day before GPS logger deployments were carried out between 22 September and 2 October. GLS loggers were deployed towards the end of the visit.

28 February -2 March 2018

A revisit to the island was used to deploy satellite transmitters and read out GLS loggers.

Trail Cameras

Trail cameras were deployed at the three main study sites. All cameras were set up to record a still image of selected nests at a 5-minute interval to examine nest attendance patterns. The devices were set up to operate 24 hours a day.

Jackson Head

Seven cameras were deployed between September and November at nests. Deployments occurred in all study plots. Additional data was recorded by cameras operated by the West Coast Penguin Trust to assess predator impacts. All cameras were removed on 19 November.

Harrison Cove

Four cameras were installed in the core breeding area at the eastern end of Harrison Cove on 25 September. All cameras were recovered on 21 November 2015.

Codfish Island / Whenua Hou

Eight cameras were installed in the breeding area above and below Mephistopheles track on 21 September. All cameras were recovered on 3 October 2015.

Data outcome

At all three sites a total of 146,301 photos and videos were recorded representing nearly 12,200 hours of nest observations. The individual camera operating times ranged between 12 and 48 days (n=19 cameras).

Data analysis is planned to be conducted as part of the Penguin Watch crowd sourcing analysis project.

ZOONIVERSE
PENGUIN WATCH

Tawaki at the sub-colony Rock Arena in October 2018, Jackson Head, South Westland. Note the GLS logger attached to the left leg of the female penguins in the centre of the image.

Tawaki colony life in late October 2017 on Whenua Hou / Codfish Island

GPS/TDR deployments

As in the previous year, a device combination of GPS logger and time-depth recorder/ accelerometer was used to study at-sea movement and diving behaviour. Red adhesive tape was used to fit devices to the penguins' lower backs. In Milford Sound/Piopiotahi, tape of various colours were used to allow identification of individual birds that were spotted by tour boats.

Jackson Head

Between 17 September and 12 October, **8 penguins were fitted with GPS/TDR loggers**. All birds were chick rearing females that were handled for deployment at the nest. **Devices were recovered after an average 7 days (range: 4-10 days)**. Birds fitted with devices were recaptured on the beach as they returned from the sea.

Harrison Cove

Between 26 September and 12 October, **GPS/ TDR loggers were attached to 9 adult tawaki**. Two devices were fitted to females attending nests. **Devices were recovered on the beach after 2-6 days (mean: 4.4 days)**. All devices were successfully recovered; all recoveries were made on the beach as the birds returned from foraging trips.

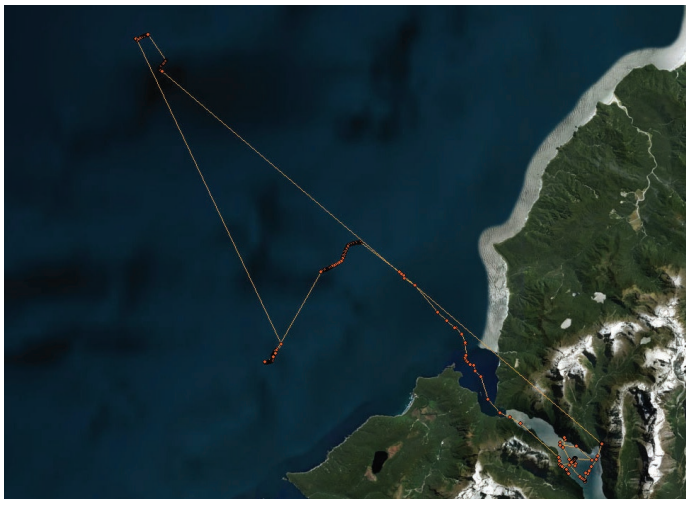
Whenua Hou

Logger deployments occurred between 24 September and 3 October. **14 adult penguins were fitted with devices** at their nest sites. Loggers stayed on the birds for a mean **3.8 days (range: 1-8 days)** before they were recovered along the penguin trail leading up into the bush from the shore or at their nest. All devices were recovered and yielded data.

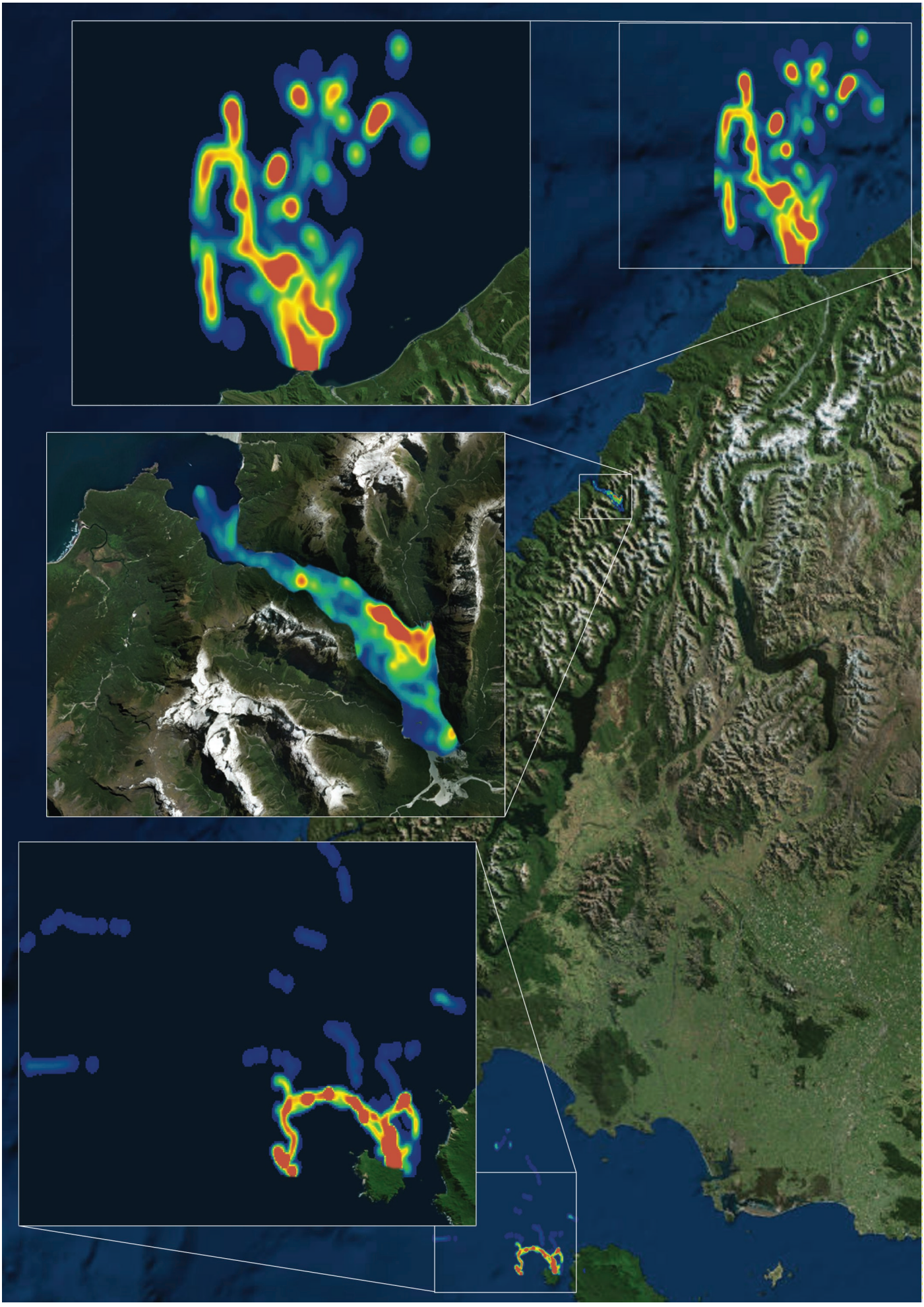
Preliminary results

At **Jackson Head**, **30 foraging trips** were recorded performed by **8 different birds**. Foraging ranges were **around 60 km**, thus, greater than what was observed in the previous year (~40 km), but still shorter than during the 2015 El Niño (>80 km). **13 of the trips were overnight trips** some of which were up to four days long. The penguins foraged north and north-west of Jackson Head.

At **Harrison Cove, 37 foraging trips** performed by **9 birds** were recorded. As in the previous years, the penguins foraged inside the fjord performing half to full-day trips. **The birds spent most of their time around Williamston Point, some 3 km from their colony**. However, for the first time, one bird was tracked performing a 3-day trip during which it left Milford Sound/Piopiotahi (see graph below). But the penguin resumed day-trips inside the fjord after its return.



14 penguins from **Whenua Hou** returned with foraging data representing **25 trips**, 5 of which were two-day (n=4) or three-day trips. Foraging ranges varied greatly with some birds foraging close inshore in the Sealers Bay area **within 5 km of their breeding colony**. Roughly one third of the trips saw penguins foraging 10-15 km north-west and west of the island.



Tawaki home ranges at Jackson Head, Milford Sound / Piopiotahi, and Whenua Hou in September and October 2017

Geolocator/GLS logger deployments

To study the movements of tawaki outside the breeding season, **we deployed GLS loggers on a total of 48 birds**. These devices record light ambient light intensity and temperature at regular intervals. By determining exact sunrise and sunset times it will be possible to estimate the geographic position for each day the penguin is carrying the device.

The devices a very small (mass ~3g) and are fitted to the penguins' legs using flexible plastic bands. At **Jackson Head** and **Harrison Cove, 15 birds** were equipped with GLS loggers. On **Whenua Hou, 18 devices** were deployed on breeding tawaki.

Tawaki fitted with GLS logger (see also photo on page 7).

The birds will carry the devices until the next breeding season, providing us with the opportunity to reconstruct their pre-moult and winter dispersal once the devices have been recovered.

Recorded data can only be accessed after the device has been retrieved from the birds; there is no transmitting function. **Devices are expected to be recovered during the upcoming 2018 field season**.

First data was downloaded from four birds during the satellite transmitter deployments in February 2018 (see page 12).

PIT tagging, blood & feather sampling

Jackson Head

At Jackson Head, a **total of 27 penguins were marked with subcutaneous transponders**. This included all birds that were handled for GPS dive logger (n=8 birds), GLS logger (n=15) and satellite transmitter deployments (n=4).

Ten birds were blood sampled, five of which were caught on the beach. The remaining birds were sampled during logger deployments/ recoveries. **Feather samples were taken from all handled birds (n=27)**.

Harrison Cove

In Milford Sound, **14 birds were marked**. Combined with another 14 birds marked in the previous two seasons, 28 marked birds now reside in Harrison Cove. With 20 nests estimated at the site, more than two-thirds of the local population is now marked. Blood samples were obtained from 14 birds. Feather samples were taken from all handled birds (n=17).

Whenua Hou

Twenty birds handled for GPS logger deployment and/or blood and feather sampling were injected with transponders. Four birds were marked when fitted with satellite tags.

All blood and feather samples collected over the past four seasons have been sent to **Marshall University, WV, USA** (Jeff White) in June 2018 for stable isotope analysis.

Fecal samples

A total of 94 tawaki fecal samples collected opportunistically at Jackson Head, Gorge River, Milford Sound and Whenua Hou over the past four years have been submitted to the **Australian Antarctic Division** (Julie McInnes) for prey DNA analysis.

Table 1a. *Tawaki tagged with subcutaneous transponders at Jackson Head, Harrison Cove & Whenua Hou*

Tag ID	Date	Location	Sex	Age	Weight	Tagger
982 000365999868	21.09.2017	Jackson Head	F	adult	-	Mattern
982 000365941916	22.09.2017	Jackson Head	F	adult	2650	Mattern
982 000402100886	29.09.2017	Jackson Head	F	adult	-	Mattern
982 000402100903	29.09.2017	Jackson Head	F	adult	2800	Mattern
982 000402100740	30.09.2017	Jackson Head	F	adult	3050	Mattern
982 000365999768	02.10.2017	Jackson Head	F	adult	2900	Mattern
982 000365941669	02.10.2017	Jackson Head	F	adult	2800	Mattern
982 000405533106	09.10.2017	Jackson Head	F	adult	3000	Ellenberg
982 000365999890	12.10.2017	Jackson Head	F	adult	3250	Mattern
982 000405534078	12.10.2017	Jackson Head	M	adult	2500	Ellenberg
982 000405533152	12.10.2017	Jackson Head	M	adult	3200	Ellenberg
982 000405532465	12.10.2017	Jackson Head	M	adult	3050	Ellenberg
982 000405533430	12.10.2017	Jackson Head	M	adult	3100	Ellenberg
982 000405533158	12.10.2017	Jackson Head	M	adult	2750	Ellenberg
982 000365999890	12.10.2017	Jackson Head	F	adult	-	Ellenberg
982 000365999838	13.10.2017	Jackson Head	M	adult	3100	Mattern
982 000365999788	13.10.2017	Jackson Head	F	adult	2800	Mattern
982 000405534029	13.10.2017	Jackson Head	M	adult	2950	Mattern
982 000365999894	13.10.2017	Jackson Head	M	adult	3350	Mattern
982 000365941863	13.10.2017	Jackson Head	F	adult	2750	Mattern
982 000365941706	13.10.2017	Jackson Head	M	adult	3250	Mattern
982 000365999766	13.10.2017	Jackson Head	M	adult	3100	Mattern
982 000365942063	13.10.2017	Jackson Head	F	adult	2600	Mattern
982 000402100910	13.10.2017	Jackson Head	M	adult	3750	Mattern
982 000405532324	13.10.2017	Jackson Head	M	adult	3450	Mattern
982 000402100832	19.02.2018	Jackson Head	F	adult	2800	Mattern
982 000405532975	19.02.2018	Jackson Head	M	adult	2900	Mattern
982 000365941751	27.09.2017	Harrison Cove	F	adult	2550	Mattern
982 000002119393	27.09.2017	Harrison Cove	F	adult	2650	Mattern
982 000365999832	06.10.2017	Harrison Cove	F	adult	2850	Mattern
982 000365941759	06.10.2017	Harrison Cove	F	adult	2450	Mattern
982 000365942059	07.10.2017	Harrison Cove	M	adult	2800	Mattern
982 000402100708	07.10.2017	Harrison Cove	M	adult	2800	Mattern
982 000365941856	08.10.2017	Harrison Cove	M	adult	2650	Mattern
982 000365999747	08.10.2017	Harrison Cove	M	adult	3100	Mattern
982 000402100815	08.10.2017	Harrison Cove	F	adult	3300	Mattern

Satellite transmitter deployments

Following the successful satellite tracking of tawaki from Gorge River during the pre-moult period of the previous field season (find the resulting publication here), we again teamed up with the **Antarctic Research Trust**, to conduct another satellite tracking study, this time with the aim to track penguins during the winter period, i.e. after completing the moult.

We obtained **a total of 12 satellite transmitters** allowing us to deploy four devices at each of our three study sites. The main aim was to record supplementary data to the GLS logger study and to validate position estimates from geolocator data.

We used SeaTag satellite transmitters from Desert Star, a company based in the United States. The devices were believed to be a better choice than the Kiwisat devices we used last season, as the Desert Star trackers are powered by solar panels, which provide a much longer transmission time than purely battery-powered units.

A male tawaki equipped with a Desert Star satellite transmitter, Harrison Cove, Milford Sound/Piopiotahi

The device delivery was delayed and the units only arrived three days before the transmitters were to be deployed in late February. This prevented us from thoroughly trialling the devices prior to attaching them on penguins.

The devices were fitted using a combination of Tesa-tape and 2-component epoxy, a technique identical to last seasons satellite tags deployments (see our 2016 report).

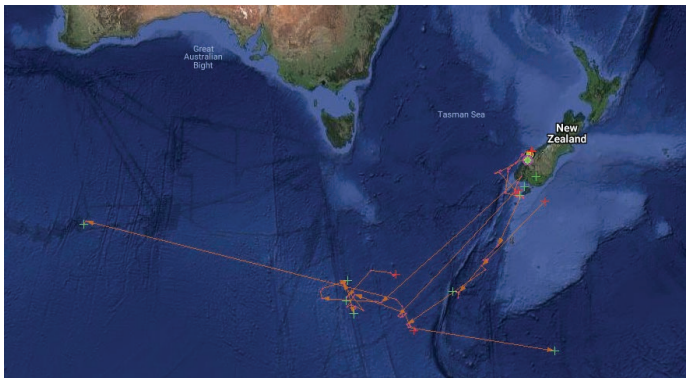
All device deployments were carried out in late February 2018, starting at Jackson Head (19 February), followed by Harrison Cove (22 February), and finally Whenua Hou (28 February).

Preliminary Results

Unfortunately, only after completion of the field work it became apparent that Desert Star had supplied us with the wrong device type. The units supplied to us only contained two instead of four solar panels. As the penguins will be traveling to the sub-Antarctic, i.e. a region with a limited amount of daylight throughout the winter, this means that the solar panels do not suffice to charge the devices for successful data transmission.

As a result, the data yield is extremely limited and all devices ceased to transmit positions by early May 2018. At the time of this writing (June 2018) five devices are still active but their signal is now too weak to calculate positions.

Still, the limited data suggests that the tawaki travel towards the sub-Antarctic Front some 2000 km south-west of the New Zealand mainland (see graph below).



Satellite data recorded between March and May 2018.

Table 1b. *Tawaki tagged with subcutaneous transponders at Jackson Head, Harrison Cove & Whenua Hou (cont.)*

Tag ID	Date	Location	Sex	Age	Weight	Tagger
982 000365941730	08.10.2017	Harrison Cove	F	adult	3300	Mattern
982 000365999797	08.10.2017	Harrison Cove	F	adult	2700	Mattern
982 000365941994	11.10.2017	Harrison Cove	F	adult	2450	Mattern
982 000405532881	22.02.2018	Harrison Cove	M	adult	2700	Mattern
982 000405532646	22.02.2018	Harrison Cove	F	adult	2500	Mattern
982 000365999829	23.02.2018	Harrison Cove	M	adult	2700	Mattern
982 000405533781	23.02.2018	Harrison Cove	F	adult	2500	Mattern
982 000365941729	22.09.2017	Whenua Hou	F	adult	2750	Ellenberg
982 000405532431	22.09.2017	Whenua Hou	F	adult	2800	Ellenberg
982 000365941703	22.09.2017	Whenua Hou	F	adult	2550	Ellenberg
982 000365999821	22.09.2017	Whenua Hou	F	adult	2900	Ellenberg
982 000405533048	23.09.2017	Whenua Hou	F	adult	3250	Ellenberg
982 000405533864	24.09.2017	Whenua Hou	F	adult	2750	Ellenberg
982 000405533094	27.09.2017	Whenua Hou	F	adult	2350	Ellenberg
982 000405533899	27.09.2017	Whenua Hou	F	adult	2400	Ellenberg
982 000405532330	27.09.2017	Whenua Hou	F	adult	2750	Ellenberg
982 000405533952	29.09.2017	Whenua Hou	F	adult	2850	Ellenberg
982 000405532816	30.09.2017	Whenua Hou	M	adult	2850	Ellenberg
982 000405532382	30.09.2017	Whenua Hou	M	adult	2950	Ellenberg
982 000405533281	30.09.2017	Whenua Hou	F	adult	2700	Ellenberg
982 000405532196	01.10.2017	Whenua Hou	M	adult	2750	Ellenberg
982 000405533179	01.10.2017	Whenua Hou	F	adult	2950	Ellenberg
982 000405532212	29.10.2017	Whenua Hou	M	adult	3050	Ellenberg
982 000405533982	29.10.2017	Whenua Hou	M	adult	2700	Ellenberg
982 000405532526	29.10.2017	Whenua Hou	M	adult	3200	Ellenberg
982 000405533902	29.10.2017	Whenua Hou	M	adult	2900	Ellenberg
982 000405534056	29.10.2017	Whenua Hou	M	adult	2400	Ellenberg
982 000405534069	29.10.2017	Whenua Hou	M	adult	2600	Ellenberg
982 000365942076	28.02.2018	Whenua Hou	M	adult	3100	Mattern
982 000365999791	28.02.2018	Whenua Hou	F	adult	2600	Mattern
982 000405532668	28.02.2018	Whenua Hou	F	adult	4200	Mattern
982 000405533070	28.02.2018	Whenua Hou	F	adult	4150	Mattern

Outlook for breeding season 2018

In its fifth year, the Tawaki Project will continue its GPS/TDR tracking study at the three study sites to investigate how annual variability reflects in the penguins' foraging behaviour.

GLS loggers will be recovered throughout the breeding season, data downloaded and loggers prepared for further deployments. We have obtained funding and permits to repeat the satellite tracking study of tawaki during the winter dispersal. This time we will be using satellite tags from Wildlife Computers which are the most reliable brand of devices.

We will also plan to trial new camera loggers on tawaki from Harrison Cove. This trial was intended to take place in 2017 already, but technical difficulties prevented this.

Sites

GPS tracking work will be carried out at three sites:

- **Jackson Head, South Westland**
  After completion of the coming field season we will have data for five consecutive years which include the strongest El Niño (2015) and La Niña (2017) events on record providing us with a unique opportunity to examine the impact of environmental perturbations on the species.
- **Harrison Cove, Milford Sound / Piopiotahi**
  After three years, foraging hot spots within the fjord start to crystallize. This season we will try to examine the reasons behind unusual dive profiles we recorded so far.
- **Whenua Hou, Foveaux Strait**
  The third season on the island will help us to understand how important the inshore kelp forest are for tawaki foraging - and to what extent set net fisheries may pose a risk to tawaki populations in Foveaux Strait.

Dates

The **GPS/TDR tracking study** will take place at three sites around the same dates as in the previous seasons:

- Field work for the chick-guard and early **post-guard GPS tracking study (up to 20 birds per site)** will occur between **17 September and 17 November 2017**
- A feasibility study for **camera loggers on up to 6 penguins from Harrison Cove** will be conducted in the last week of September and the first week of October
- **Re-deployments of GLS loggers** are planned for the end of the breeding season's field work (i.e. October/November)
- **Satellite tag deployments (6 birds per site)** are scheduled for late February 2019.

Research team

The Tawaki Project will be continued by the core research team consisting of **Thomas Mattern** (University of Otago), **Ursula Ellenberg** (La Trobe University), **Dave Houston** (DOC), **Robin Long** (West Coast Penguin Trust), and **Klemens Pütz** (Antarctic Research Trust). Field assistants will involve post-graduate students from the University of Otago and Marshall University, USA.

Funding & Donations

The **Bird NZ Research Fund**, the **Antarctic Research Trust** and our **Patreon supporters** and private donors all generously continue to support the project in 2017.

patreon

https://www.patreon.com/TawakiProject

Thomas Mattern & Ursula Ellenberg

Acknowledgments

We could not realise the Tawaki Project without tremendous help from a great number of people and organisations.

At the Department of Conservation, **Bex Wilson** and **Hannah Edmonds** (DOC Te Anau) found us a place to stay in the Milford settlement and helped us out in the field. **Jacinda Amey** (DOC Haast) as always readily shared information and West Coast insights with us. **Rhuaridh Hannah** (DOC Invercargill) and **Sharon Trainor** helped our Whenua Hou teams to pass the rigorous quarantine procedures with flying colours and get to the beautiful island. Bruce McKinley (DOC Otago) facilitated the research committee meetings and helped with permitting.

The success of the field work was based on the dedication of our co-investigators and field helpers. Teaming up with Ursula, **Dave Houston (DOC)** formed one half of our Whenua Hou team. In Milford Sound / Piopiotahi, **Robin Long** (West Coast Penguin Trust) and Thomas took care of the Fiordland portion of the project. **Giselle Clarkson** took over from Thomas when he had to go back to the West Coast. **Jeff White** from Marshall University proved to be an exceptional first-timer with regard to tawaki field work. **Horst Mattern** (Düsseldorf) once again held the fort at Jackson Head. **Kerry Jayne-Wilson** (West Coast Penguin Trust) joined the Harrison Cove team for a week and managed to do the impossible by spotting a very elusive logger bird return. **Pablo 'Popi' Garcia-Borboroglu** (Global Penguin Society) managed to return to help with field work. **Richard Seed** bravely endured brutal assaults by tawaki chosen to be fitted with satellite transmitters.

In Milford Sound, our teams received phenomenal support from **Andrea Faris** and the whole crew at Southern Discoveries. **Klemens Pütz** (Antarctic Research Trust) once more avoided to be directly involved in the strenuous field work but was instrumental in getting us GLS and satellite transmitters as well as access to the data.

We are particularly thankful to **Ingrid Hutzler** and the **scientific committee from Birds New Zealand** for the generous support we received this season.

Jen Houltham from Cardrona Alpine Resort came up with the great idea for a ski related fund raiser for the Tawaki Project. Not to mention that Cardrona have adopted tawaki as their new mascot!

All our **supporters on Patreon** helped us cover costs that we did not budget for when applying for funding. And we should not forget the people who donated through our website (or purchased Tawaki Project t-shirts (https://shop.spreadshirt.com.au/tawakiproject/).

And, of course, once again our greatest thanks go out to the **tawaki from Jackson Head, Harrison Cove, and Whenua Hou** who collaborated marvelously (for most of the time). You have helped us to learn so much about your species, information we promise to use to improve how we treat you and your environment in the future.

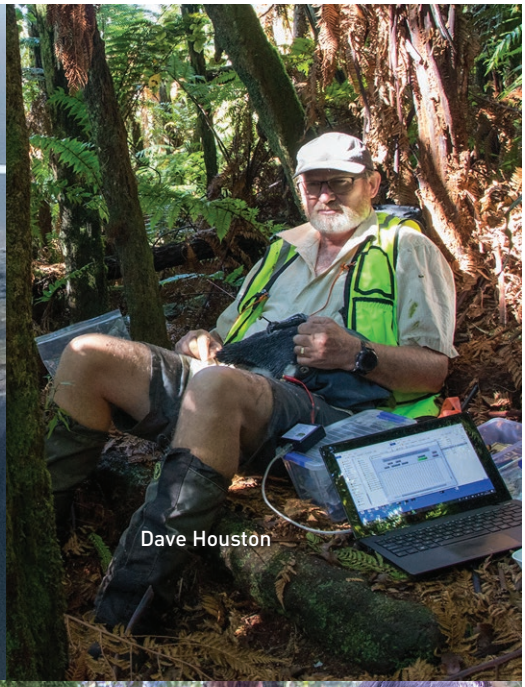
Further information

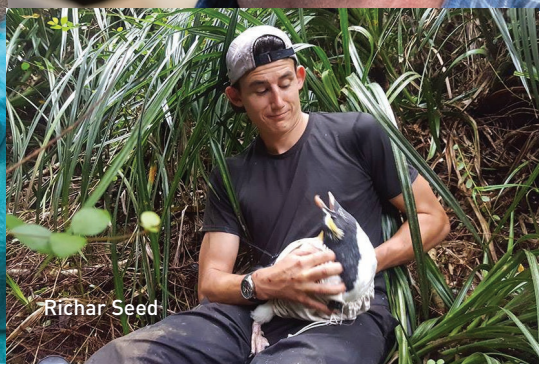
http://www.tawaki-project.org

https://facebook.com/TawakiProject

https://twitter.com/TawakiProject

https://youtube.com/c/TawakiProject





Thomas Mattern & Ursula Ellenberg

The Tawaki Project has been support by:

Birds New Zealand

Antarctic Research Trust

GPS
Global Penguin Society

Department of Conservation
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