



## Tawaki monitoring, South Westland, 2019-2021 seasons

### Introduction

Tawaki or Fiordland crested penguins (*Eudyptes Pachyrhynchus*) are one of the rarest penguins in the world. Unlike kororā/ Little Penguins (*Eudyptula minor*), which breed around the entire country and often in close proximity to humans, dogs, and roads (and resulting threats), tawaki breed in some of the least inhabited parts of the country; their range extends from Bruce Bay southwards through South Westland, Fiordland, and around parts of Stewart Island. Their preference for breeding in rugged, inaccessible terrain makes a full population census difficult but surveys have been carried out in recent years and are providing improved information as to total population<sup>1</sup>. However, evidence suggests that the tawaki population is declining<sup>2</sup>. The conservation status of tawaki in New Zealand is Threatened- Nationally Vulnerable, and they have an IUCN classification of Near Threatened. Population estimates range from 12,500–50,000 mature individuals (BirdLife International, 2021)<sup>3</sup>.

The West Coast Penguin Trust has been conducting research on tawaki since 2014, largely focused on the threats that they face whilst on land. This has shown us that stoats are likely to be the main land-based predator for tawaki. Another threat tawaki face is starvation in years when food is hard to come by. For example, in the second year of the Trust's study (2015 season), El Niño conditions off the West Coast resulted in almost complete nest failure at Jackson Head as chicks starved and adults swam up to 100km for little food and poor nutrition.

The current study aimed to build on our previous research. By setting up a nest-monitoring program, we hoped to be able to correlate various factors (environmental and ecological) with breeding success, and further our knowledge of threats to tawaki in order to ensure appropriate conservation management.

### Methods

#### Study area

Three colonies were chosen for this study, all of which have been used by the Trust for previous research. The colonies have varying levels of predator control and are separated by around 100 kilometres. From North to South, the colonies are in the following areas:

- Knights Point, which receives landscape-scale predator control as part of DOC's Tiakina Ngā Manu (TNM) programme within the Abbey Rocks control area.
- Jackson Head, which sits on a headland and has a community trapping programme, with traps along the Wherakai Te Kou Walk and extending along the peninsula.

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<sup>1</sup> [https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2021/09/2021-09-Notornis-Stewart-Island-tawaki-survey-LongLitchwark\\_68\\_183-187.v3.pdf](https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2021/09/2021-09-Notornis-Stewart-Island-tawaki-survey-LongLitchwark_68_183-187.v3.pdf)

<sup>2</sup> [https://www.westcoastpenguintrust.org.nz/wp-content/uploads/Tawaki-trend-paper\\_NZ-J-Ecology\\_2018-Otley-et-al.pdf](https://www.westcoastpenguintrust.org.nz/wp-content/uploads/Tawaki-trend-paper_NZ-J-Ecology_2018-Otley-et-al.pdf)

<sup>3</sup> [Fiordland Penguin \(\*Eudyptes pachyrhynchus\*\) - BirdLife species factsheet](#)

- Gorge River, which receives no predator control other than a few stoat traps set by the Long family who live at the river mouth. The area immediately north of this colony (on the true right of Gorge River) receives landscape-scale predator control as part of DOC's TNM programme within the Hope-Cascade control area. We are expecting that this control area will be extended to include the true left of Gorge River down to Longridge Point, following discussions between the Trust and DOC's Principal Advisory Scientist, Dr Graeme Elliott.

## Nest Monitoring

Between 15-30 tawaki nests were chosen from each of the three colonies to be monitored. Nests were chosen based on ease of access, proximity to other nests, and to minimise the risk that tawaki could be disturbed whilst monitoring. The variation in the number of nests monitored relates to the different size of each of the colonies.

Monitoring was undertaken from outside the nest, and care was taken not to disturb tawaki in the process. Monitoring started in July, and nests were checked fortnightly until chicks had fledged in November. Several important points of the breeding cycle were being recorded, in chronological order: presence of adult(s) in the nest, presence of eggs, eggs hatching, number of chicks, how long the chick(s) was under the guard of a parent, crèching of chicks, and chicks fledging; with the aim of determining breeding success at these colonies. Due to logistical constraints, Jackson Head nests were not monitored by the Trust in 2019, however NZ Penguin Initiative conducted monitoring there in September with a follow up visit in November. Due to COVID-19 restrictions in 2021, monitoring was not able to start at Jackson Head and Knights Point until September, by which point most chicks were already large and mobile.

## Trail cameras and tracking tunnels

In the 2020 and 2021 seasons, trail cameras were placed facing the entrance of 10 of the tawaki nests at each colony ('nest cameras'), with the aim of recording any movement into the nests – of tawaki, and predators such as stoats (*Mustela erminea*), rats (*Rattus sp.*), and possums (*Trichosurus vulpecula*). This is the same method we have used in previous studies of predators in tawaki colonies. In 2020 these motion-triggered cameras were set to record a 30 second video. After weighing up the benefits of video versus the time spent analysing the video footage, it was decided that in 2021 the cameras would take 3 photographs when triggered, with half a second between each photo. Once these 3 photos were taken, there was a 30 second delay before the camera could be triggered again. These cameras were serviced every two weeks to check that the cameras were still working, and to replace batteries and SD cards. Due to logistical constraints caused by COVID-19 restrictions in 2021, these cameras were not used at Jackson Head and Knights Point that year.

In addition to these 10 cameras at each colony, 2 cameras were deployed specifically to look for the presence of stoats at each colony ('camera traps'). In 2020 these cameras were faced toward a lure of an anchored hard-boiled egg and a drip-fed egg-based mayonnaise lure dispenser. In 2021 these cameras were faced towards a cage containing a piece of salted rabbit meat. These cameras were also serviced every two weeks.

In 2020 and 2021, tracking tunnels were also deployed to record the presence and density of stoats at each colony. Five tunnels were set at each colony, lured with salted rabbit and collected after 21 days. This was completed in August, and again in November. This was not able to be completed at Gorge River in 2021 due to an injury.

Due to various factors, the people conducting the research varied year-to-year at both Jackson Head and Knights Point. At Gorge River the same person conducted the research each year.

## Results

### Nest Monitoring

Breeding success was similar at all three sites across all three years of the study to date, as was the number of nests monitored at each colony. Although tawaki lay two eggs, generally adults will only raise one chick. Thus, breeding success is measured as the number of nests where eggs were laid (number of chicks raised per monitored nest). Thus, if a breeding pair successfully raises one chick to fledging stage, it is counted as a successful nest. Within the colonies there are empty nests, or nests where adults are seen occasionally; these are not counted as a 'monitored nest'. As noted earlier, in 2021 chicks were already large and mobile by the time monitoring started at Knights Point and Jackson Head.

Site	No. of nests monitored 2019	Breeding success 2019	No. of nests monitored 2020	Breeding success 2020	No. of nests monitored 2021	Breeding success 2021
Knights Point	15	0.8	15	1	17	0.94
Jackson Head	Not measured	Not measured	25	0.88	19	0.90
Gorge River	30	0.9	24	0.83	28	0.82

### Trail cameras and tracking tunnels

On trail camera imagery, rats and possums were seen in each year at all three colonies. Low numbers of stoats were seen at Jackson Head in 2020, and a single juvenile stoat was seen at Knights Point in 2021. Stoats were seen at Gorge River in 2021 entering tawaki nests. No sign of stoats was present on the tracking tunnel cards.

Site	Mammals observed 2020	Mammals observed 2021
Knights Point	Possum, Rat	Possum, Rat, Stoat
Jackson Head	Possum, Rat, Deer, Stoat	Possum, Rat, Deer
Gorge River	Possum, Rat, Deer	Possum, Rat, Stoat

Daily monitoring was carried out by the NZ Penguin Initiative at Jackson Head in 2019 from 18 to 26 September for 38 nests. Their report<sup>4</sup> notes:

<sup>4</sup> [https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2018/11/NZ\\_Penguin\\_initiative\\_ReportQ1\\_2020.pdf-002.pdf](https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2018/11/NZ_Penguin_initiative_ReportQ1_2020.pdf-002.pdf) pp8-11

“The nine days of daily nest checks coincided with covered the crucial period of late guard, early post-guard period, where chicks are becoming more mobile and start to venture out of their nests, making them particularly vulnerable to stoat predation.

“Throughout the survey period three chicks died, all of which were the smaller, first-hatched chicks that usually do not survive the first week after hatching. There was no indication of predator presence apart from an eggshell that may have been scavenged by a possum after rolling out of a nest. There was no evidence for stoat presence.

“A final direct visit was conducted on 17 November 2019 during which 22 nests were visited. 13 of these nests were empty, although the remaining 9 nests contained a total of 13 chicks some in crèches of up to three chicks. Moreover, most chicks were fully moulted to the juvenile plumage and, thus, ready to fledge. It can be assumed that several chicks from monitored nests had fledged in the days prior to our visit.”

## Discussion

Although these were the first three years of this study, we have specifically monitored breeding success of tawaki, and therefore have no quantifiable baseline as to what constitutes a good breeding season at the three colonies, it would appear that breeding success was high for all three years of the study. This is based on several factors.

Firstly, no large-scale predation events were observed in the colonies during the study period. Based on previous observation, in certain years stoats can run rampant through a colony, killing eggs, chicks, and possibly adults (although we have no evidence of the latter), such as occurred at Jackson Head in 2016 (see Trust report of 2014-2017 study<sup>5</sup>). During this current study, stoats were captured on trail cameras at all three colonies, albeit in low numbers. Likely stoat predation was observed at Gorge River in September 2021, with a stoat seen on camera entering a tawaki nest numerous times. At the next nest visit (11 days later), the nest was found abandoned. Four other nests also failed around the same time. However, the number of stoats and predation levels during this study were lower than have been observed in the past, especially comparing with Jackson Head in 2016. As previously noted, nest monitoring at Jackson Head and Knights Point in 2021 was not able to start until September. Thus, it is possible that nests may have failed prior to monitoring beginning, which would result in lower breeding success than we recorded.

As noted in previous research, stoats seem to be the major land-based predator for tawaki<sup>5</sup>. Although each of the three colonies has a different level of predator control, there were no obvious or significant differences in breeding success between the colonies during the study period. Based on the results of this study and on previous research, it would seem that in years when stoat numbers are low, they present only a small threat to tawaki. However, when stoat numbers are high, they present a major and devastating threat. We initially hypothesised that in the years following a beech mast event, when stoat numbers would be expected to be highest, we would see this reflected by a poor tawaki breeding season. See Figure 1 below illustrating lag times between mast events and rodent and mustelid populations. However, as our results from the 2020 season show, the year after the biggest beech mast in 40 years in 2019, this was not the case. The exact reason for this is unclear; it could be that rat numbers were low or still increasing (with a corresponding lag-time for stoat numbers to increase), or that rat numbers were high and therefore there were plenty of rats for stoats to prey on. This second scenario seems unlikely to be the case as

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<sup>5</sup> <https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2019/01/Tawaki-report-2018-Final.pdf>

shown by the low number of stoats seen on the trail cameras and tracking tunnels. The exact intricacies of mast years, rat and stoat numbers, and their effect on tawaki is still unclear, and an area where further research and discussion is needed. Our research will continue to seek answers to this question and to review predator control methods when stoat numbers are forecast to be high.

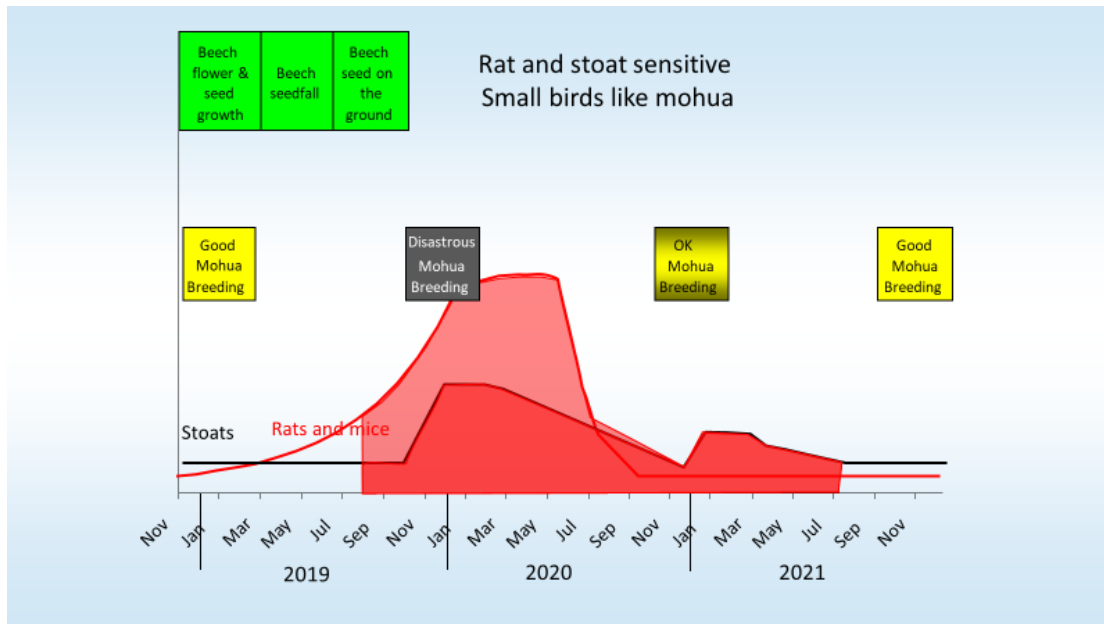


Figure 1: DOC graphic illustrating rodent and mustelid population growth patterns and impact on mohua following mast events

Secondly, no mass starvation events were observed. Based on previous research, when foraging conditions are poor, adult tawaki spend longer off-shore feeding, often doing so further away from the coastline than they would in years where foraging conditions are good. This is likely to be a large energy expense for the adults. If an adult tawaki has to guard the eggs/ chicks for too long (to the point of starvation) whilst its mate is foraging, then it will abandon the nest. As tawaki chicks are wholly reliant on food from the adults to survive, this inevitably leads to starvation of the chicks. Although we are not continuously monitoring tawaki nests throughout the monitoring period and no foraging study was completed at our sites during the 2019-2021 seasons, it would appear that food supply and ease of foraging was not a major factor affecting tawaki during these breeding seasons. Adult tawaki were observed foraging close to shore, and chicks were seen to be generally large, healthy, and mobile for their age. Although this is only anecdotal evidence, the lack of starving chicks, or adults abandoning nests gives us reasonable confidence in this not being a factor during the study period.

Monitoring tawaki breeding success comes with certain challenges, for both the individuals doing the monitoring, and for the Trust.

Once chicks are of a certain size, usually around three weeks after hatching, they will begin to move around the colony, with multiple chicks often inhabiting a single nest or choosing a gathering site - this is known as crèching. This makes monitoring exact numbers (and therefore breeding success) difficult, since it becomes almost impossible to determine which chicks come from which nest.

In addition, in the Jackson Head and Gorge River colonies, chicks are able to hide in small crevices amongst tree roots and boulders where they may remain hidden during the day. Although colonies often seem deserted during a daytime visit, at night when adults return with food, chicks

reappear as if from nowhere and the colony comes alive again. It may be reasonable to conclude that a nest has been abandoned in such cases and breeding success results could be lower as a result. Knights Point is a smaller area and there are comparatively few underground places for chicks to hide. Chicks are more easily counted in this colony, and this may contribute to relatively higher breeding success results when compared to the other two colonies.

One way around this is to microchip the chicks with a passive integrated transponder (PIT tag), in order to be able to identify individual birds. However, the use of PIT tags for tawaki is not part of the Trust's work at this stage.

Trail cameras, whilst a great monitoring tool, have their own set of challenges. There appears to be a slight lag between a camera being triggered and a video/ photo being recorded, with a slightly smaller lag when using photos. Whilst fine for large, slow moving animals (which they are designed to capture), a small, fast moving animal such as a stoat can slip out of frame during this small lag period and thus avoid detection. As noted earlier, we changed to recording photos in 2021, which made processing of the data more efficient, however there is still a significant amount of time needed to process the images; 10 nest cameras within a colony take approximately 30,000 images throughout the season. The change to photos also reduced the strain on batteries and SD cards.

Vegetation in front of the camera was trimmed to minimise the chance of cameras being triggered by moving vegetation, however there were numerous instances where a camera was triggered but nothing was observed on the photo or video. It is impossible to determine the exact cause of this, but it could be the result of vegetation, a small insect or mammal moving quickly through the frame, or something moving in the background. In addition, non-target species often triggered the camera, with a single blackbird accounting for almost 1000 consecutive photos on one of the camera traps. This quickly takes up space on the SD cards and means that data is unobtainable during the 30 second delay before the camera can be triggered again.

The background logistics of monitoring tawaki is also challenging. The nearest town is Haast (permanent population ~200), which makes finding staff for the monitoring work difficult. If there is not staff continuity from year to year, then time must be spent training and familiarising staff with the sites. Gorge River is accessible by two days of walking, or helicopter. Fortunately, our ranger there lives on site; however getting materials there (cameras, batteries etc) can be challenging. As noted earlier, lockdowns and injuries made it impossible to complete some of the work at all three of the sites.

The aim of this study was to monitor breeding success and create the foundation for a longer term dataset, and as well as to continue to learn about the threats posed by stoats and the relationship of such a threat with mast events. The Trust will continue to monitor breeding success and ideally stoat presence as well as any predation where possible. The Trust will also continue to work with DOC to anticipate and understand the effects of mast events and to collaborate on improving the conservation management of tawaki.

## Summary and conclusions

1. Tawaki nests were monitored at three distinct colonies in South Westland for three years.
2. The aim was to determine breeding success at these colonies; determine if there were any trends year to year, or between the colonies; and to better understand the link between mast events and stoat populations and predation as well as to methods of predator control.
3. Trail cameras and tracking tunnels were used to determine the presence of predators (especially stoats) within the colonies.
4. Breeding success was high at all three colonies for all three years, with no obvious differences or trends between years or between colonies.
5. Stoats were present at all three colonies at different times, however at low numbers, and are likely responsible for a few tawaki nest failures.
6. The mast event of 2018-19 did not result in any observable increase in stoat numbers in the colonies in either the 2019 or 2020 seasons.
7. Lack of food did not appear to be an issue for breeding tawaki during the study period.