

# Biodiversity 2018 research Bid - *Kiwaia* 'Cloudy Bay'



Figure 1. *Kiwaia* 'Cloudy Bay' at Canterbury Gully. Photo:Robert Hoare

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## 1.1 Project overview:

The small flightless moth *Kiwaia* “Cloudy Bay” was discovered by John Dugdale in 1999. It was thought to be confined to one small location endemic to the Cloudy Bay foreshore within South Marlborough.

After annual monitoring failed to find the species for three consecutive years, operational staff sought advice from the Terrestrial Ecosystem Unit and funding was secured from the Biodiversity 2018 pool to increase the research into this species. Wildlands Ltd. were contracted to carry out concentrated survey and collate existing knowledge on the genus, habitat state & trend and potential pressures. This work also failed to find any extant population, and it was suggested that *Kiwaia* ‘Cloudy Bay’ may have become extinct at Rarangi - its only known location. During this survey, extreme drought was observed to cause ~30% die off in the mat daisies which *Kiwaia* relies on as a host and Asian paper wasps were abundant, harvesting insects in the habitat and nearby vegetation. Also of concern was the absence of records of other Lepidoptera species previously recorded in the area, including the locally endemic and endangered moths *Notoreas* ‘Cape Campbell’ and *Dicromodes* ‘Cloudy Bay’.

Given the high risk of *Kiwaia* extinction and level of threat to the wider coastal ecosystem, further funding was sought to address five elements of research, particularly to determine if a mat-daisy jumper population remains, and to trial new tools and methods to mitigate some of the pressures.

The scope of work included:

1. More extensive investigation of other possible habitats where *Kiwaia* may exist;
2. Systematic survey and monitoring of *Kiwaia* in relation to the above action.
3. Investigate techniques for propagating the primary *Kiwaia* host plant (*Raoulia australis*); with the view that habitat enhancement will provide a future management technique to aid *Kiwaia* recovery given observations that the moth’s primary habitat has been reduced markedly;
4. Develop a drought contingency plan;
5. Suppress paper wasp numbers;

This work package has now been completed and is reported below.



## 2. Investigation of other possible habitats where *Kiwaia* may exist and Systematic survey and monitoring of *Kiwaia* at these sites

The entire coastline of Cloudy Bay (from Rarangi to the White Bluffs) was surveyed for *Raoulia australis* on foot in June 2019 (Previously reported in [DOC-6675787](#)), and areas further south were targeted selectively where communications with council staff, land owners and personal observations indicated *Raoulia* was present.

In addition to the original known site at Rarangi, this identified three new sites of possible *Kiwaia* habitat within Cloudy Bay, and six areas of possible habitat between Cape Campbell and Kekerengu. These are further detailed in Appendix 1.

The Biodiversity 2018 research funding allowed these sites to be thoroughly searched for *Kiwaia* in 2021 during the *Kiwaia* adult emergence period (February- April), which is the only time the species can be detected. A casual staff member (Inga Booiman) was employed for the duration of this period to complete the searches.

Inga searched all host plants at the Cloudy Bay sites weekly, and searched sites further south at least once during peak emergence season. Searching was conducted only in dry weather with light winds. This was done by moving slowly through *Raoulia* patches, tapping mats gently with fingertips or a stick. When disturbed by tapping, *Kiwaia* have a distinctive jumping response which can be easily detected by an experienced observer. To ensure Inga was confident at detecting and identifying *Kiwaia* moths, she spent two days at Kaitorete Spit in Canterbury at the beginning of the season, where a similar and closely related *Kiwaia* species occurs.

The dates each site was surveyed are tabulated in Appendix 2.

### Results

Despite weekly searches for the entire emergence period, no *Kiwaia* were detected at any of the four Cloudy Bay sites. We now have a high degree of confidence that *Kiwaia* has gone locally extinct from Cloudy Bay, including the site at Rarangi where it was first discovered.

Fortunately, surveys further south were successful, and *Kiwaia* was detected at four of the 6 locations between Cape Campbell and the Waima river mouth. These were Cape Campbell, Canterbury Gully, Needles point and Lulworth. No moths were located in areas of similar habitat near Deadmans Stream or at Long Point.

In total 26 adults were seen at Canterbury gully, 40 at needles point, 3 at Cape Campbell and 8 at Lulworth. It is thought the species occupies much of the potential habitat at these sites, which collectively contain roughly 5ha of habitat. Densities appeared higher at the Needles and Canterbury Gully sites than at the Lulworth or Cape Campbell areas, however our survey was designed to detect presence/absence rather than abundance, so this is difficult to quantify.

Landcare research taxonomist Robert Hoare collected several specimens from the Canterbury Gully and the Needles sites, which he confirmed to be *Kiwaia* 'Cloudy Bay' based on matching forewing pattern, size of hindwing, and lack of male androconia (a feature of *K. jeanae*), and as far as can be seen without dissection, male genitalia. Specimens collected will be added to the NZ arthropod collection.

The flighted and more common *Kiwaia* species *K. lithoides* was also observed at Canterbury Gully, Cape Campbell and Lulworth sites.

### 3. Propagating the primary *Kiwaia* host plant (*Raoulia*) to enhance habitat in future.

The *Raoulia australis* patches at Rarangi have been in steady decline since *Kiwaia* monitoring began in 2000. This decline is characterised by large die offs of adult plants during drought years, with no observable recruitment of seedlings, even when conditions are more favourable.

Following the 2019 drought, it is now unlikely that remaining habitat at Rarangi is sufficient to maintain a stable population of *Kiwaia*. Should *Kiwaia* be managed at this site in future, the host plant population will likely need to be enhanced.

Establishing plants in free draining beach gravel, in a hot dry climate such as Marlborough is expected to be problematic.

#### 3.1 Natural recruitment

Observations on natural recruitment were made during investigation of other sites, with the idea of potentially modifying the environment to enhance natural recruitment, if optimal conditions could be determined.

At natural sites, there was high variation in recruitment. At the Rarangi sites, no natural recruitment was apparent and adult plants were in poor condition. In contrast, the Wairau boulderbank/ Te Pokohiwi site had strong natural recruitment with many seedlings and young plants observed. This is possibly due to rock groynes which the council has constructed at the Wairau bar to stabilise the river channel and confine it to a fixed river mouth. This has resulted in the accumulation of beach gravels at the tip of the Wairau boulder bank. The healthy populations of *Raoulia*, with young plants and seedlings were found on these recently deposited surfaces.

Similarly, there was lots of recruitment observed along the Cape Campbell coastline, where *Raoulia* is rapidly colonising areas uplifted in the Kaikoura earthquake. Most of the sites visited south of Cape Campbell had bands of *Raoulia* seedlings growing between the old dune systems and the new high tide mark. In some places, such as Long Point, these uplifted surfaces contained very large populations of *Raoulia*, larger than the parent populations responsible for seeding them. It is noted that marram and other invasive weeds are also invading this uplifted strip, potentially threatening the new habitat.

It is likely that historic uplift events similar to the recent Kaikoura earthquake have played a significant role in the biogeography of *Kiwaia*, with bands of continuous habitat created in the uplift zone forming dispersal corridors along the coast, allowing the flightless *Kiwaia* moths to spread between otherwise isolated fragments of habitat.

#### 3.2-Seed collection and ex-situ cultivation

Seed was also collected from the local *R. australis* population at Rarangi, with the view that this could be grown on *ex-situ* in a nursery, then planted back at the sites once plants are established.

Seed was observed to be mature in December 2019 (*Raoulia* has small, fluffy seeds which release from flowerheads to be wind dispersed when mature). Two staff members spent a day collecting seed - picking seed by hand from releasing flowerheads. This resulted in roughly a cup of seed and fluff collected. This was then handed over to Morgans Rd nursery who agreed to grow it on until ready for planting.

The seeds collected had an extremely low strike rate. All up, only four plants were produced from the seed collected, which was insufficient to complete planting trials. It is unclear whether this low strike rate was due to poor seed fertility or inadequate conditions during germination. The plants that did sprout grew and survived well in the nursery, indicating that if either more or higher quality seed could be collected in future, this may be a viable option for enhancing the population, assuming plants can be successfully planted out.

It is recommended that, given observations of abundant natural recruitment occurring on uplifted surfaces south Cape Campbell, protecting these naturally recruiting sites from threats such as vehicles and weed invasion would be a more realistic option than growing plants *ex-situ*. If plants are to be nursery grown in future, a more effective means of seed collection, such as a hand-held vacuum would be worth trialling.

#### 4. Develop a drought contingency plan

The *Raoulia australis* population at Rarangi is very susceptible to drought conditions. A major drought in 2001 caused major dieback in the *Raoulia* population, which corresponded with a large retraction in the range of *Kiwaia*: prior to 2001, it was widespread between Bluegums corner and the diversion mouth. Following 2001, it has only been located in low numbers at a couple of localised sites. A second major drought in 2019 resulted in more than 30% mortality of remaining *Raoulia* plants, and more than a 60% reduction in *Raoulia* biomass with most surviving plants also dying back to only a few live stems.

Given the apparent vulnerability of this *Raoulia* population to drought conditions, it was decided intervention should be undertaken to prevent die-off in future droughts.

Following discussions with an advisory group of technical advisors, it was decided the most effective way to do this without risking harm to *Kiwaia* larvae on the plants was to water plants delicately with a hand-held hose, only during periods of severe drought.

In the months following this decision, Marlborough was hit by yet another severe drought with only 220mm of rain falling in the first 6 months of 2020. This was 44% below the long term average rainfall for the period, making it the 5<sup>th</sup> driest autumn on record.

In February 2020, the decision was made to enact the drought response plan, and begin watering the plants. A 500L water tank was fitted to the deck of a DOC Hilux, and connected to a garden hose, fed by gravity pressure. Two rounds of watering were conducted in mid-late February, roughly 2 weeks apart.

This watering regime was then halted in March 2020, as NZ went into national lockdown to help prevent the spread of Covid 19. By the time lockdown ended, temperatures had dropped and soil moisture increased significantly, even though rainfall was still well below average.



Despite the watering regime being halted by lockdown, and rainfall being lower in 2020 than in 2019, there was little dieback in the *Raoulia* population. Summer temperatures were much cooler in 2020, which may have reduced desiccation of the plants and it is also likely that the 2019 drought impact was exacerbated by an extremely wet summer the previous year and a loss of drought tolerance in the plant community.

As *Kiwaia* now appears have become extinct at Rarangi, and the newly discovered sites south of Cape Campbell are much more remote with limited vehicle access, watering of plants is not likely to be a feasible management tool in the future.

## 5. Suppress paper wasp numbers

### Background

Asian and European paper wasps are very efficient predators, specialised at hunting caterpillars. Asian paper wasps were accidentally introduced to NZ in the 1970s, rapidly establishing in Auckland. Curiously, they had a very slow natural rate of spread and were not recorded in Blenheim until 1995. By the late 1990s, they were common in Blenheim. Closely related European paper wasps have also recently been recorded in the top of the South Island, and both species are now common at Rarangi.

The arrival of paper wasps in Blenheim was at the time noted to correspond with a rapid decline in many common moth and butterfly species, including monarch and white cabbage butterflies. Little is known of the paper wasp impact on native Lepidoptera communities, however comparison of current field observations to Lepidoptera surveys in 2000 indicate that many species common at Rarangi in 2000 are now absent or very rare, including charismatic copper butterflies and the endangered moths *Notoreas* '*Cape Campbell*' and *Dicromodes* '*Cloudy Bay*'. The paper wasp incursion at Rarangi is suspected as a possible cause of this decline.

As paper wasps only target live prey and will not consume Vespex or other toxic baits, there are no established methods for their control. A core part of this Biodiversity 2018 research funding was to trial manual control of paper wasp nests, as a tool to protect *Kiwaia* and other range restricted threatened moth species from this threat.

### Methods

Paper wasps were controlled using a search and destroy technique targeting individual nests. Simon Litchwark and Rowan Hindmarsh Walls spent two days searching for nests in late November, and a single day was spent searching in late February, prior to the *Kiwaia* emergence period. Searching was targeted in an area within 500m of the original *Kiwaia* site north of the Wairau diversion, as this is approximately the distance foraging worker wasps will travel from a nest.

### Results

In total 70 nests were destroyed within the search area, showing wasps were at very high density prior to the control. Of the nests found 52% were Asian (*P. chinensis*) and 48% European (*P. dominula*) wasps.

Unfortunately, as Kiwaia 'cloudy bay' was not detected during monitoring in Cloudy Bay this emergence season and is thought to have become locally extinct before the wasp control was completed, it was not possible to quantify any impact of this control on our Kiwaia.

Interestingly, circumstantial observations during our march Kiwaia monitoring noted that another threatened moth species (*Dichromodes* 'Cloudy Bay') was common in the area where paper wasps were controlled, but rare elsewhere on the beachfront. This species had been flagged as a species of concern and its local absence noted by entomologists (Brian Patrick and Eric Edwards) in the two previous summers. Records show it was recorded frequently during initial surveys in 1999/2000 before the paperwasp invasion.

While no statistically robust data was collected, this anecdotal evidence indicates a strong possibility that local lepidoptera are being heavily suppressed by paperwasps, and that localised manual control of nests is an effective management tool to protect threatened species on a small scale. Further research into this would be strongly recommended.



## Appendix 1- Sites of possible habitat

### Cloudy Bay sites

#### **North of Wairau Diversion** – historic *Kiwaia* location

Historically *Raoulia* mats and *Kiwaia* were common between the Thomas Rd carpark and bluegums corner. Host plants are now more sparse, but several patches remain, particularly on the coastal side of the 4wd track.

#### **South of Wairau Diversion** –

This patch of *Raoulia* extends in a strip for approximately 1 km south of the diversion mouth. Plants are denser at the northern end, becoming increasingly scattered further south.

This area would have been contiguous with the historic known *Kiwaia* site north of the diversion, until the construction of the Wairau diversion channel in 1963. While no *Kiwaia* have been sighted south of the channel there is a high probability that this site was once populated.

#### **Wairau River North** –

Several patches of *Raoulia* occur just north of Wairau bar road. These are small, with only a couple of dozen plants, but several plants are very large and in good condition, indicating the population has been stable for a considerable time period.

#### **Wairau River South/Boulder Bank** –

This site, accessible only by boat or kayak from Wairau Bar Rd, is on the tip of the Wairau boulder bank. This site is primarily on gravel surfaces which have accumulated following the Council's river stabilisation and groyne construction work. These surfaces are much younger than sites around the diversion, but contain healthy *Raoulia* populations, including a mix of old plants and young seedlings.

### Sites further south

#### **Cape Campbell**

This site is roughly 1km south of the Cape Campbell light house, on the western side of the road. This site is big, with lots of *Raoulia*.

#### **Canterbury gully**

This small site, is roughly 100m south of where the cape campbell site meets the coast.



### **Long Point**

Two distinct *Raoulia* populations are present at Long Point. A reasonable number of plants are present on old gravel and silt surfaces behind the dunes. These are primarily old stunted plants showing a fair bit of dieback.

A large new population has also appeared on surfaces exposed by uplift in the Kaikoura earthquake, and this appears to be rapidly expanding with many young seedlings recruiting.

### **Needles Point**

A large gravelly flat on the south side of the point, and two sandy dune blowouts just north of the point all contain large areas of *Raoulia*. The flats south of the point also host a large *Pimelea* population. The gravelly flat is primarily on Council coastal reserve, and the dune blowouts are on private land.

### **Lulworth**

A series of swales and windswept dunes on Lulworth farm north of the Waima river contain large areas of *Raoulia*. These are predominantly on private land.

### **Deadman creek.**

This large site, visible from SH1 is on railway land in the hind dunes north of Deadmans Creek. At least a thousand *Raoulia* plants are present, primarily on exposed cobble surfaces of a historic beach

## Appendix 2- Search dates and results

Site	Dates checked	People involved	Results
Rarangi north of diversion (original site)	2 <sup>nd</sup> March	Simon, Inga, Pam	Nothing found
	8 <sup>th</sup> March	Inga	Nothing found
	15 March	Inga	Nothing found
	24 <sup>th</sup> March	Inga, Simon, Robert Hoare	No Kiwaia found. Dichromodes abundant.
	30 March	Inga + Pam	Nothing found
	7 April	Eva	Nothing found
	12 April	Eva	Nothing found
	23 April	Eva	Nothing found
Rarangi south of diversion	2 <sup>nd</sup> March	Simon, Inga ,Pam	Nothing found
	8 <sup>th</sup> March	Inga	Nothing found
	15 March	Inga	Nothing found
	24 <sup>th</sup> March	Inga, simon, Robert Hoare	Nothing found
	30 March	Inga + Pam	Nothing found
	7 April	Eva	Nothing found
	12 April	Eva	Nothing found
	23 April	Eva	Nothing found
Wairau bar	2 <sup>nd</sup> March	Simon, Inga ,Pam	Nothing found
	8 <sup>th</sup> March	Inga	Nothing found
	15 March	Inga	Nothing found
	24 <sup>th</sup> March	Inga, Simon, Robert Hoare	Nothing found
	13 April	Eva + Simon	Nothing found
	23 April	Eva	Nothing found
Wairau boulder bank/Te Pokohiwi	9 <sup>th</sup> March	Inga +Simon	Nothing found
	18 March	Inga + Simon	Nothing found
	29 March	Simon + Eva	Nothing found
	8 April	Eva + Jan	Nothing found
	13 April	Eva + Simon	Nothing found
Cape Campbell	17 March	Inga and Eva	Nothing found
	23 March	Rowan Hindmarsh walls, Jan Clayton Greene, Rob Peters	3 moths seen
Canterbury gully	17 March	Inga and Eva	6 moths seen
	23 March	Inga, Simon, Robert Hoare, Jan Clayton-Greene, Rowan Hindmarsh-Walls, Rob Peters, Andy Wiltshire	20 moths seen
Needles	19 March	Inga + Simon	20 moths seen
	23 <sup>rd</sup> march	Inga, Simon and Robert Hoare	20 moths seen
Long point	26 <sup>th</sup> March	Jan, Simon, Inga	Nothing found. Quite windy
Lulworth	25 <sup>th</sup> March	Simon, Inga, Jan	8 moths seen with wide distribution-

			confirmed presence at patches then moved on, rather than surveying thoroughly.
Deadmans creek	10 <sup>th</sup> March	Inga	Nothing found