MOHUA

(YELLOWHEAD) *Mohoua ochrocephala*

NATIONALLY ENDANGERED SPECIES REPORT

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1.1 THE DECLINE

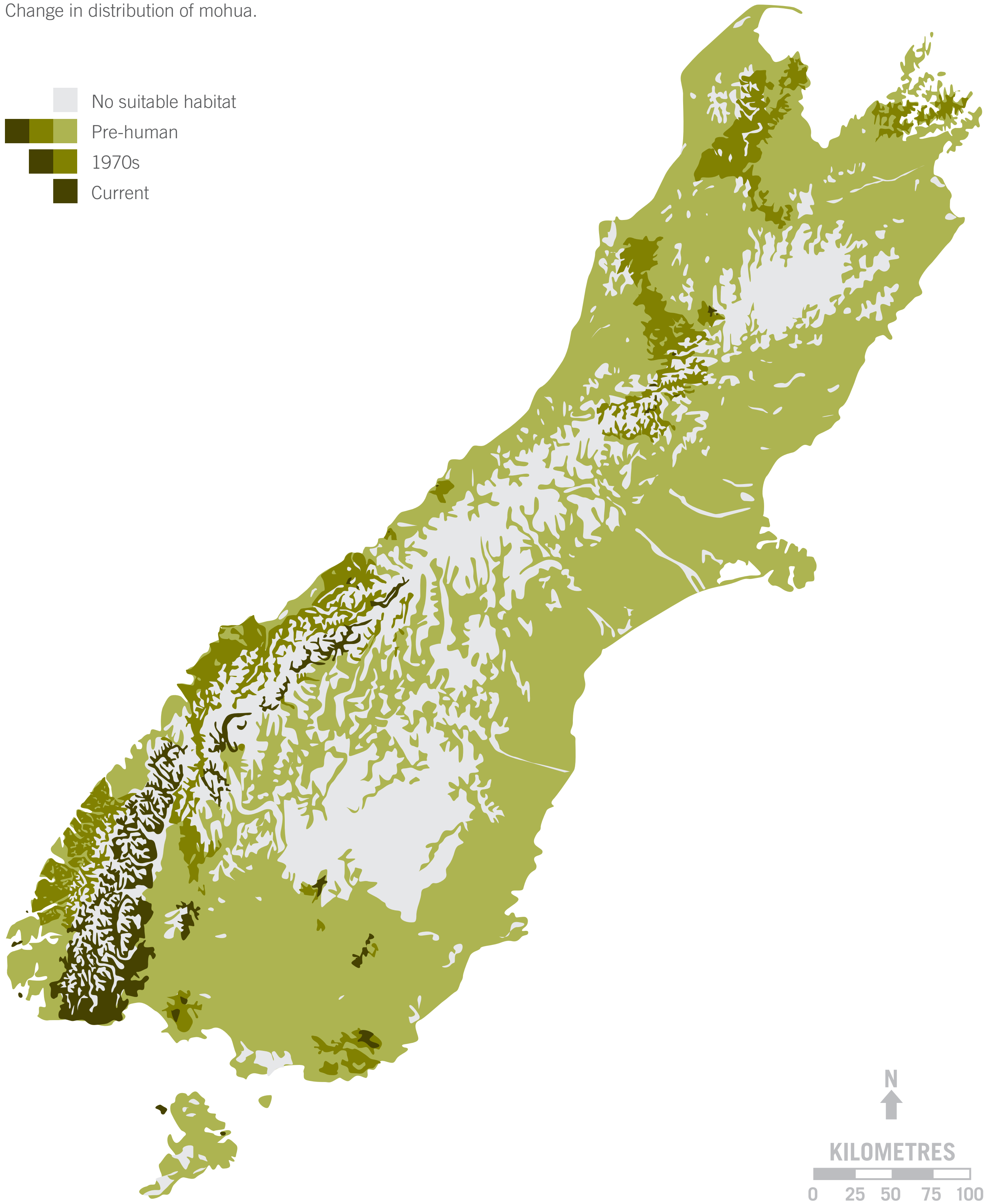
The mohua (yellowhead) is a small, insectivorous forest bird, endemic to the South Island of New Zealand. It was previously one of the most common and conspicuous forest birds, however it has been declining in both range and abundance since European settlers arrived in the 19th Century. Mohua were once present in all forest types in the South Island, but they are now confined only to beech forest. They are classified on the threatened species list as nationally endangered.

- Now present in 5% of its natural range.
- Population declined by 90% since European settlement.
- Range contracted by 70% since the 1970s.

The mohua is one of New Zealand's rarest forest birds that still occurs in mainland forests accessible to the public. It is also the bird which appears on the back of the New Zealand one hundred dollar note. However public awareness of the decline has not been as high as for some of the country's other endangered forest birds.

Figure 1

Change in distribution of mohua.



2.1 HABITAT LOSS

Since the arrival of European settlers, much of New Zealand's native forest has been cleared for logging and agricultural purposes. Within the forest that still remains, mohua's range is further restricted due to its very specific habitat preferences. Some of these preferences existed before European settlement, and some have developed since then (such as mohua's restriction to beech forest due to introduced predators).

2.1.1 MATURE FOREST

Mohua nest in mature trees, because the larger trunk diameters contain more suitable cavities for them to build their nests in. If forest is cleared but is then replanted, it will still take many years of growth to become a suitable habitat for mohua again. Currently, remaining populations of mohua are so small and patchily dispersed that logged forests will likely never see the return of mohua, even after they have re-grown.

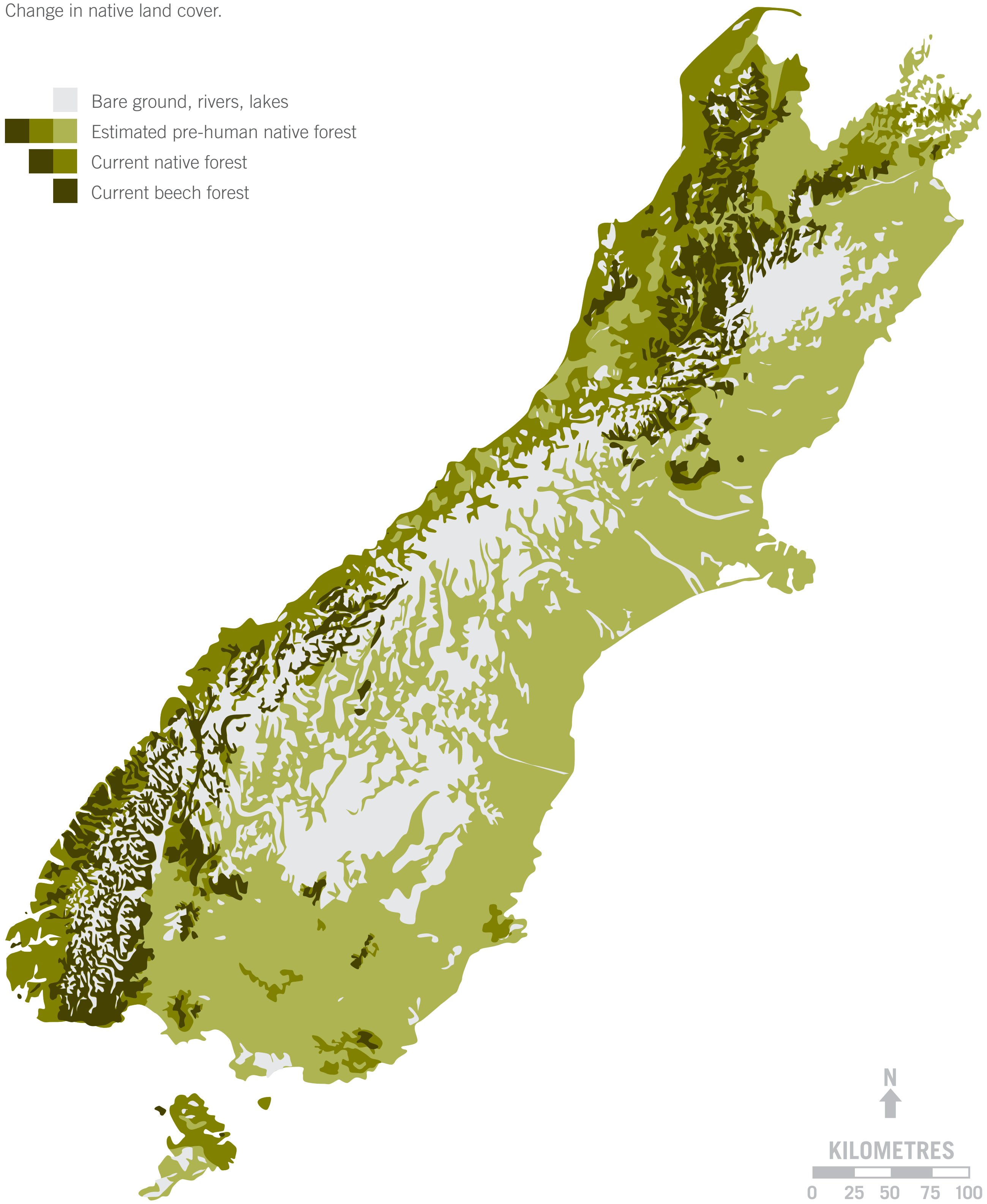
"Yellowheads do not survive in forests that are extensively cut-over for timber production, and did not return to logged forests for more than 25 years after they had been logged." (Spur, 1987.)

2.1.2 BEECH FOREST

Since the introduction of overseas predators, mohua have become further restricted to only one type of forest. In beech forests, predator numbers only rise dramatically after heavy beech tree seedfall (beech mast), which occurs infrequently. However, in podocarp dominated forests predator numbers tend to be high constantly due to food availability from the higher number of fruiting trees. Mohua are very vulnerable to mammalian predators, so can now survive only in beech forests because the low number of predators during times between the irruptions allow for mohua populations to recover.

Figure 2

Change in native land cover.



2.1.3 MOHUA HABITAT PREFERENCES

Mohua have very specific habitat requirements. The lack of suitable habitats has been a significant factor contributing to their decline. Fig. 3 shows a list of habitat preferences taken from the habitat suitability index Graeme Elliott developed for mohua (1992). Each characteristic tends to be caused by another; therefore they all exist simultaneously within a circular relationship. Tall trees and high invertebrate count are the only factors that directly relate to benefits for mohua. However, the other factors contribute to these characteristics and can still be used as indicators for suitable mohua habitats, despite being indirectly related to the benefits.

"The purpose behind the development of a habitat suitability index is the identification of factors likely to be important in the conservation of yellowheads." (Elliott, 1992.)

2.1.3.1 Explanation of habitat preferences

Mohua are more likely to be found in flat areas or gentle slopes, on valley floors, and at low altitudes. These landforms directly relate to each other, and dictate what types of vegetation are able to grow.

Soil fertility also affects the types of vegetation that exist, how large the trees will grow, and the number of invertebrates that are present. Higher fertility soil is found at lower altitudes and these areas support larger trees for mohua to nest in and more invertebrates for them to eat.

Mohua are now found only in beech forests, which are comprised mainly of three species; silver beech, red beech and mountain beech. At low altitudes red beech dominates. It is the largest of the three, and on valley floors can achieve diameters of 2m and heights of 40m. Closer to the treeline vegetation becomes more stunted.

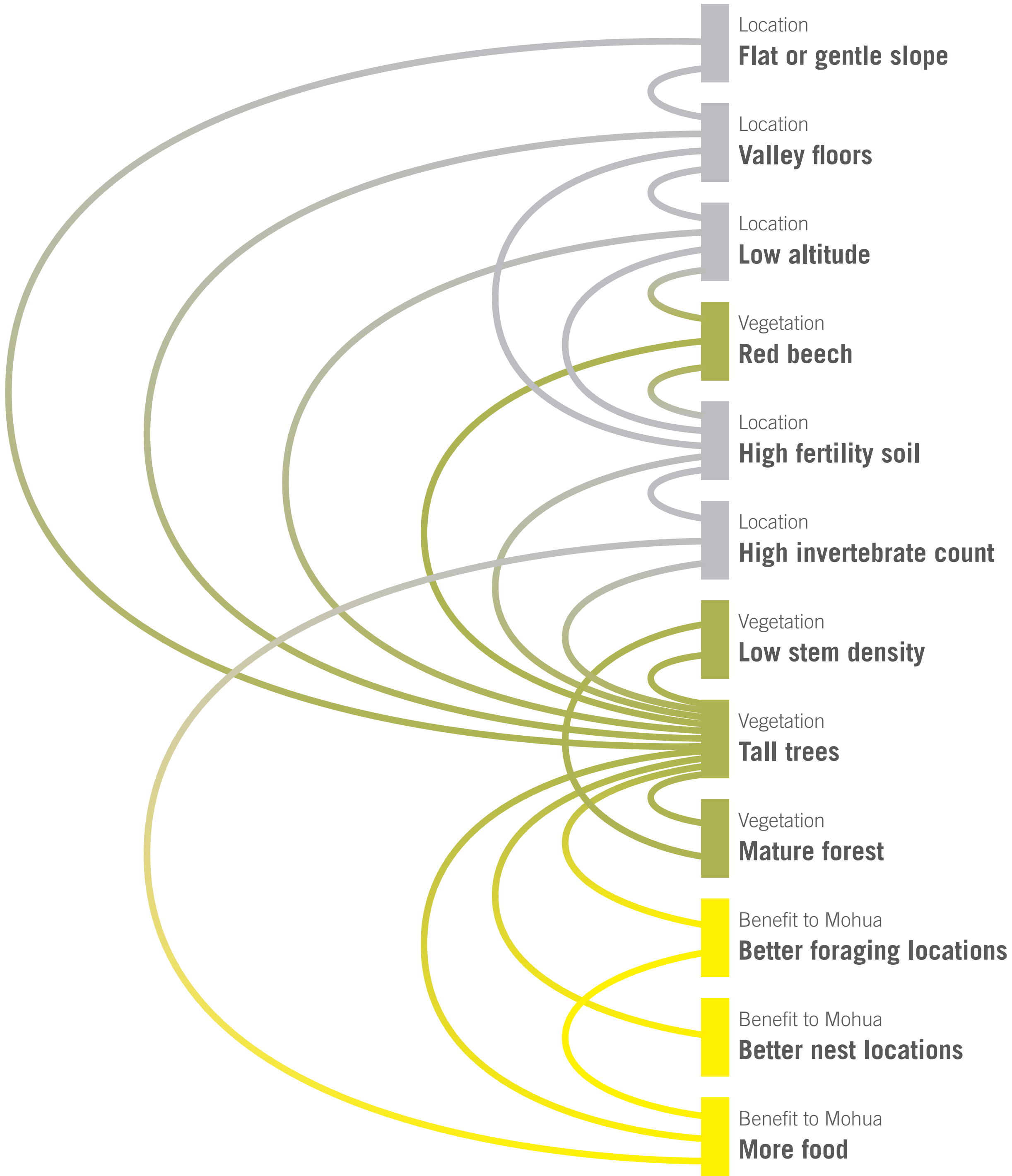
Observations have shown that mohua are tall forest/large tree specialists, because these types of forest are most suited to their foraging and nesting behaviour. Mohua generally forage amongst accumulations of leaf litter in the crooks of large branches. This feeding method can only be employed in large trees, since only large trees have such sites. Likewise, only large trees will contain suitable cavities for mohua to build their nests in.

Large trees need sufficient space between them, so tall forests also tend to be lower density. Stem density refers to the number of trees within a particular area (low stem density = less trees per m^2).

"About 44% of New Zealand's land area is covered by native vegetation, most of which is hill country and alpine areas. Less native vegetation remains in lowland areas; this has implications for species that need this type of habitat to survive." (Ministry for the Environment, 2007.)

Figure 3

Relationships between mohua habitat preferences.



2.1.3.2 Habitat preferences and breeding

Mohua are capable of raising two broods in one season, however it has been observed that they only do this in good habitats. Currently there are only a few remaining habitats where Mohua will raise two broods. Maintaining good Mohua habitats is important because it affects their rate of reproduction and can help to build up populations.

Generally, double-brooded populations have a higher survival probability (fig. 4). However, during years where stoat plagues occur, it has been observed that double-brooded populations are no better off than single-brooded populations. This is because pairs that attempt to raise two broods during stoat irruptions never succeed in raising more than one, but are vulnerable to nest predation for a long time. Pairs that attempt to raise only one brood during a stoat irruption produce the same number of chicks as two-brood pairs but are vulnerable to nest predation for less time.

Double-brooded populations are faster at recovering after stoat irruptions, therefore these populations will be better off than single-brooded populations so long as there are several years between each stoat irruption to allow for recovery time (which is usually the case). However, if stoat irruptions were to occur every year, leaving no recovery time, then double-brooded populations are worse off (fig. 6).

Preserving good habitats so that mohua populations are able to raise two broods will increase their survival probability, but this should be combined with predator control if irruptions are occurring frequently.

"Unfortunately most remaining mohua populations are single-brooded, because the majority of lowland forests where mohua raise two broods have been cleared for farming or logged." (O'Donnell, 1993.)

Figure 4

Extinction probabilities of mohua populations suffering no stoat irruptions.

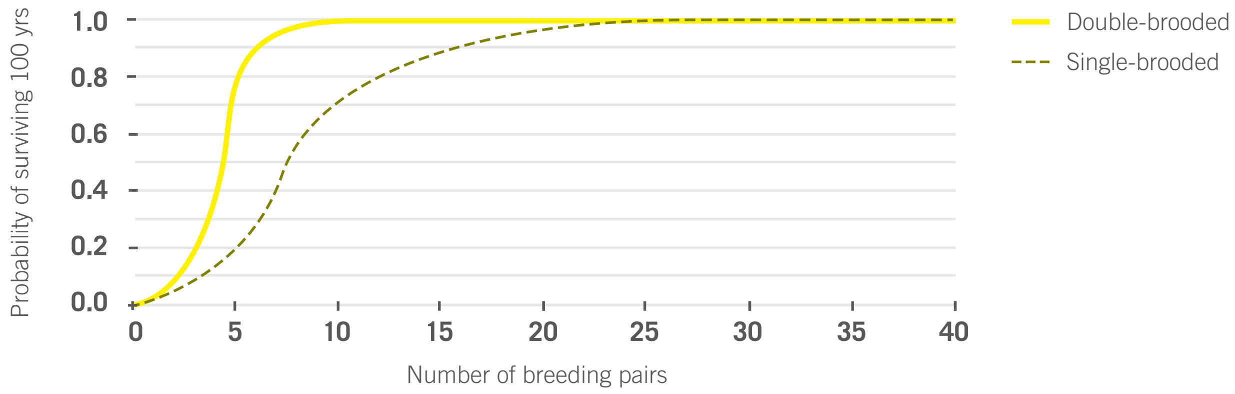


Figure 5

Extinction probabilities of mohua populations suffering stoat irruptions every 5 years.

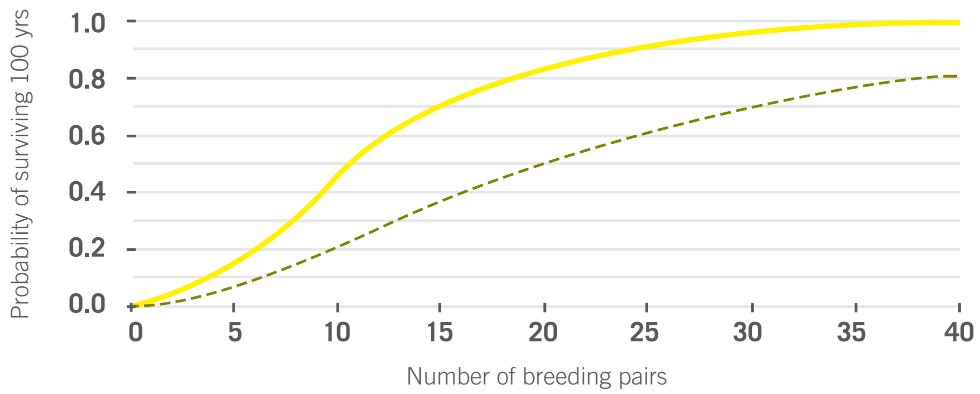
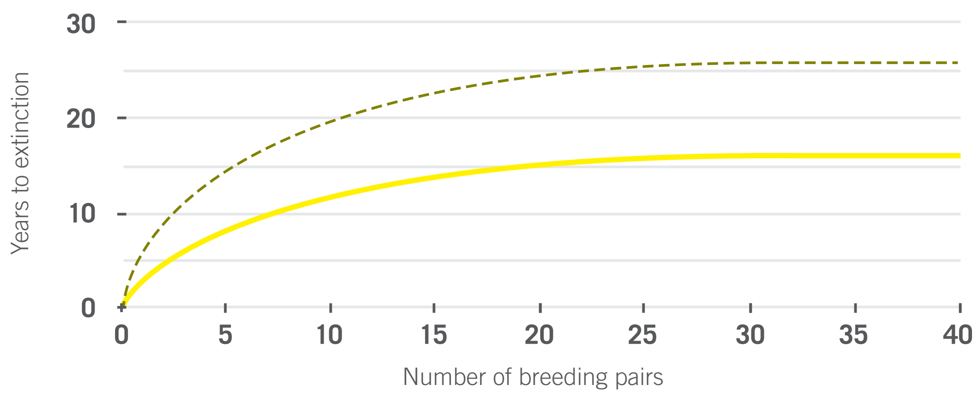


Figure 6

Time to extinction of mohua populations suffering stoat irruptions every year.



2.2 INTRODUCED PREDATORS

Stoats and ship rats are the main predators of mohua, and both usually prey on the birds while they are nesting in tree cavities. Stoats eat mohua eggs and chicks, and also kill the adult birds.

Mohua are more vulnerable to predation than other forest birds because they are small, nest in holes, have long incubation periods, and the timing of their nesting coincides with peak predator numbers.

"The isolated evolution of New Zealand's native species means many of them lack strategies to co-exist with or defend themselves against introduced competitors and predators." (Atkinson in Ministry for the Environment, 2007.)

2.2.1 HOLE NESTING

It has been suggested that mohua's hole nesting is an acquired trait that they developed in response to avian predators. In pre-human New Zealand there were no mammalian predators, and the main predators of mohua would have been other birds. Hole nesting protects mohua from avian predators that rely on sight. However, introduced mammalian predators rely on smell, and can find mohua even in their holes. Once found, mohua have no way to escape if the entrance to their nest is blocked by a predator. Predators eat eggs and chicks but also kill incubating adults. Since only female mohua incubate, nest predation results in a biased sex ratio, which decreases their breeding potential (fig. 7).

2.2.2 BEECH MAST

It is possible for reasonable sized mohua populations to remain stable with normal predator numbers. However, beech mast (the infrequent flowering and seedfall of beech trees) causes higher than usual predator numbers, and mohua populations decline significantly during these times. More mice are present during the seedfall because of the increased food supply, causing other animals that prey on mice (stoats in particular) to also increase to plague proportions. In mohua populations with low productivity, the period between stoat irruptions is usually insufficient for them to fully recover. Consequently, without any predator control, these populations will continuously decline.

Figure 7

Numbers of mohua in a simulation of a double-brooded populations suffering stoat irruptions every 5 years.

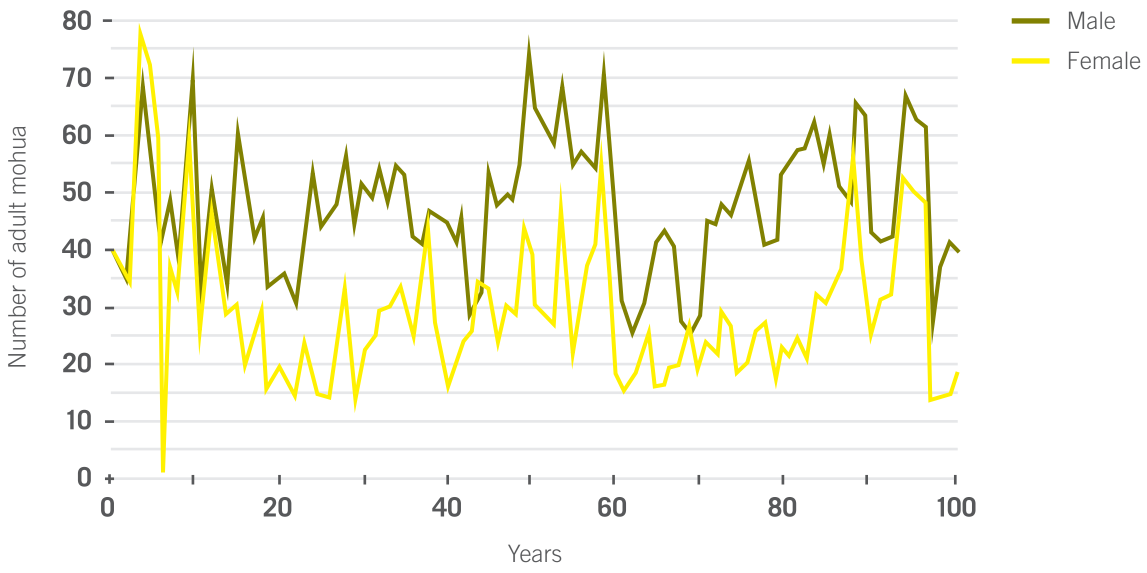
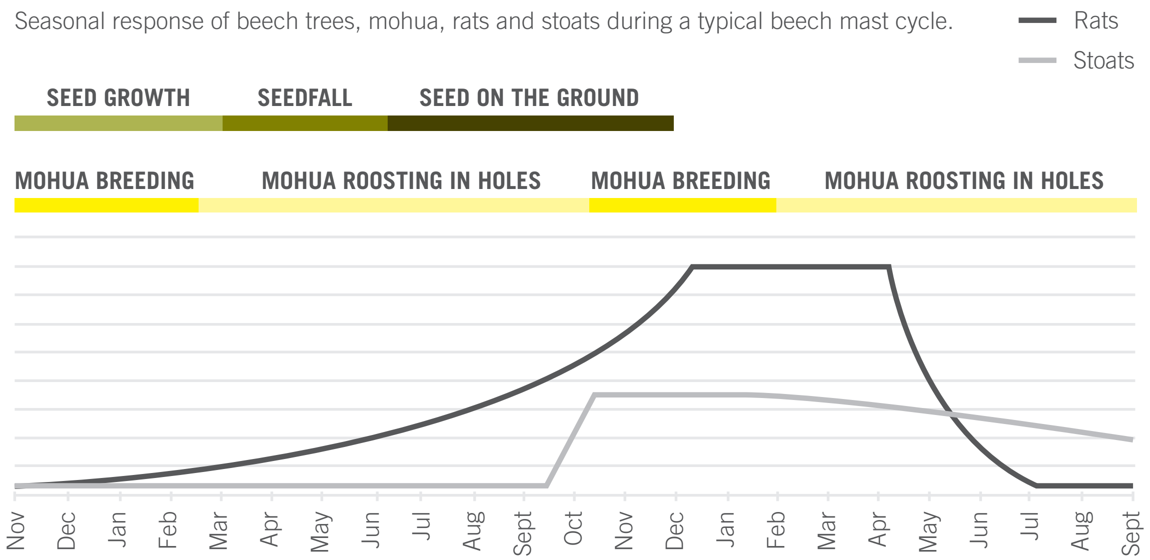


Figure 8

Seasonal response of beech trees, mohua, rats and stoats during a typical beech mast cycle.



3.1 RESEARCH AND MONITORING

Mohua suffered a significant decline during the 1970s, and up until then little research had been conducted on the species. Extensive research began during the 1980s when it was realised that mohua numbers were becoming dangerously low. The findings of this research have strongly contributed to the ability to develop strategies to help mohua.

3.1.1 PREDICTING PREDATOR IRRUPTIONS

It has been discovered through population monitoring that predator plagues are currently the biggest factor contributing to mohua decline. Mohua populations have benefited significantly when intensive predator control has been undertaken during irruption times. It is possible to predict when these irruptions will occur by monitoring the beech tree seedfall which causes mouse, stoat and rat plagues.

In 1993 a monitoring system was set up as part of the Mohua Recovery Plan. This consists of setting up trays to catch beech tree seedfall, and collecting the seedfall in autumn each year. The seeds are then counted, and numbers recorded. Combined with the quarterly monitoring of mouse numbers, this enables the prediction of when stoat and rat irruptions are likely to occur. Once predicted, intensive trapping and/or poisoning can be utilised in order to stop predator populations reaching plague proportions.

"The mohua recovery programme is important because it addresses conservation problems being faced by many endemic forest birds. The mohua is an indicator of on-going processes and threats in New Zealand forests, and successful recovery has implications for the whole forest bird community."
(O'Donnell, 1993.)

3.1.2 MOHUA POPULATION MONITORING

Detecting change in mohua abundance is important in order to determine whether predator control methods are having a positive effect, and how strategies might be improved in the future. Previously mohua monitoring had been undertaken erratically in various locations, but in 2002 the Department of Conservation conducted a study in order to decide the best method for detecting population changes. It was concluded that mohua were to be counted along 1km transects, and that at least 10 different transects were required to produce reliable data. The surveys were to be repeated four times in each location every October and then analysed to detect population change. This type of monitoring has not yet been going for long enough to review the long-term trends, but it is hoped that in the future this research will be useful for developing further conservation strategies.

Figure 9

Relationship between beech seedfall, mouse and stoat numbers, and mohua productivity in Hawdon Valley.

Year	1989/90	1990/91	1991/92	1992/93	1993/94
Beech seeds per m^2	183	7987	44	157	1986
Mice per 100 trap nights	0	19	0	0	0
Stoats caught during peak mohua breeding (Dec-Jan)	19	30	14	11	8
Number of mohua breeding pairs, beginning/end of summer	5/7	7/0	0/1	1/1	1/1

Figure 10

Relationship between beech seedfall, mouse and stoat numbers, and mohua productivity in Eglinton Valley.

Year	1990/91	1991/92	1992/93	1993/94
Beech seeds per m^2	4345	2	0	260
Mice per 100 trap nights	22	1	0	0
Stoats caught during peak mohua breeding (Dec-Jan)	49	10	4	11
Number of mohua breeding pairs, beginning/end of summer	9/3	3/3	7/7	6/8

3.2 PREDATOR CONTROL

Predator control work has already been underway around the country for many years, and has intensified over the last decade. This aids not only mohua but also many of New Zealand's other native species. Increasing priority has been given to controlling pests in the habitats of the most threatened native species, like the mohua, and stopping unwanted species coming into the country.

"The maintenance of mohua numbers in predator-controlled areas through the 2006-07 rat plague was a major success. Further localised extinctions were prevented by the control programmes that were used." (Elliot & Suggate, 2007.)

3.2.1 TRAPPING

Trapping is the most common method of predator control currently being used. Tens of thousands of stoat and rat traps have been set along permanent trap lines in the South Island. However it is difficult to maintain cost effective trapping methods, and more funding is required in order to expand the areas that are protected by traps. Traps require on-going maintenance, and the more area that is covered by traps, the more money and time is needed to maintain them. The positive effect of trapping on stoat control at South Branch Hurunui, where a small mohua population exists, can be seen in fig. 11.

3.2.2 POISON

Aerial 1080 has been shown to be an essential tool to knock down growing rat numbers, to almost undetectable numbers, in plague situations where baited traps are not preventing an increase. It is also effective to use as a starting point, to get rat numbers to manageable levels so that it can then be followed up with the use of 1080 bait stations on the ground. Although aerial drops are generally more effective and require less time and man-power to implement, they should only be used when necessary because of the effect toxic chemicals can have on the environment. Sometimes species that aren't targeted can be effected, or 1080 can get into water supplies.

Various types of poison are being experimented with in bait stations to determine which will have the most impact. Fig. 12 shows the effect of poison on rats in the Eglinton Valley. Between June 2006 and March 2007 1080 pellets and Racumin poison were used, which reduced rat numbers but not to the near zero levels that are desirable. In April 2007 Racumin was replaced with diphacimone paste and rat numbers finally decreased significantly.

The impact of poison on predators is partly to do with the type of poison used, but also partly due to varying what type is used, in order to stop predators becoming accustomed to it.

Figure 11

Stoat tracking in South Branch Hurunui.

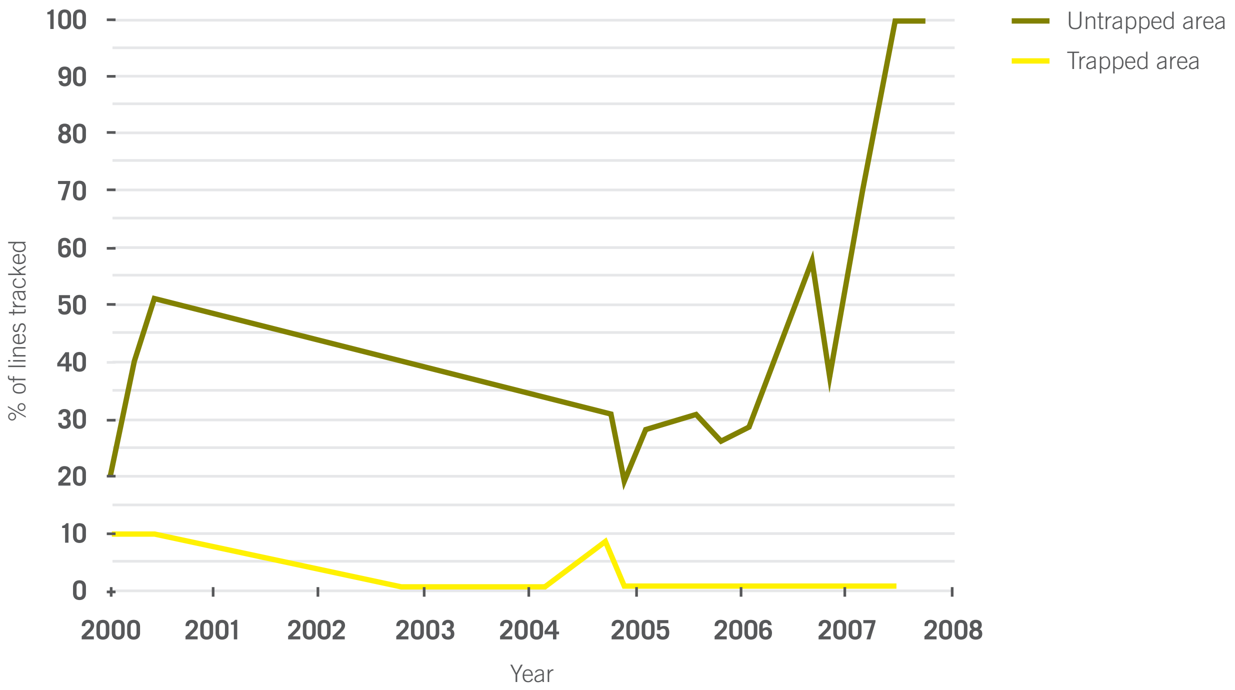
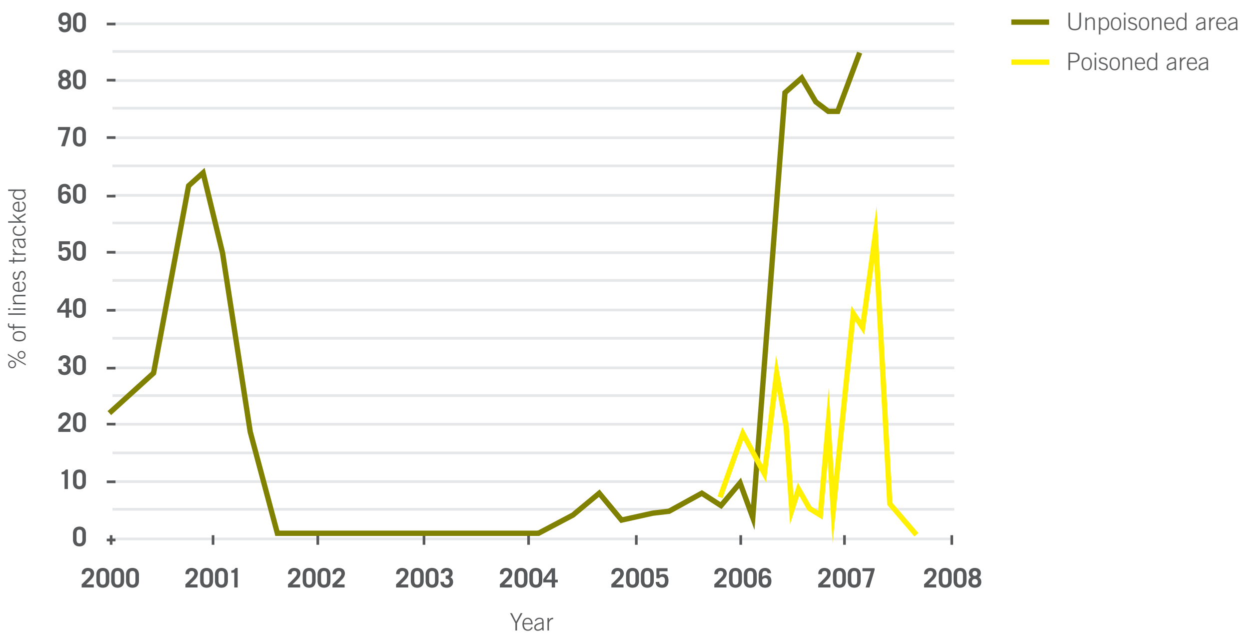


Figure 12

Rat tracking in the Eglinton Valley.



3.2.3 OPERATION ARK

Operation Ark is a predator control programme that was launched in the South Island during 2004 targeted at helping the orange-fronted parakeet, mohua, whio (blue duck), and the short and long-tailed bats. Mohua and orange-fronted parakeet populations nearly halved following rat and stoat plagues in 2000, and this highlighted the need for increased predator control. Operation Ark includes 10 sites in the South Island, covering a total of 200,000 hectares of forest. Eight of these sites contain mohua populations:

- South Branch Hurunui (Canterbury)
- Hawdon-Poulter (Canterbury)
- Landsborough (South Westland)
- Dart-Caples (Western Otago)
- Clinton, Arthur, Cleddau (Fiordland)
- Eglinton (Fiordland)
- Blue Mountains (Southland)
- Catlins (South-East Otago)

The strategy of Operation Ark is to treat these sites like "mainland islands", focussing energy and resources on intensively managing pests in a concentrated area, rather than spreading the same pest management over a larger area, which is less effective. More funding is required before Operation Ark can expand its range.

3.2.4 FUTURE STRATEGIES

Recent studies have shown that in some locations predator trapping has become less effective when mouse numbers are extremely high. Stoats prey on mice, so therefore stoat numbers will also be high during these times, however it was noted that stoat trapping rates were decreasing. It was assumed that this was because, with food availability so high, the bait in traps held insufficient appeal for the well fed predators.

New methods will need to be developed to deal with predators during times of extremely high prey availability. It has been suggested that halting reproduction by removing female stoats will be the most plausible strategy. Using trained dogs to find breeding dens is a proposed solution, although it will be very labour-intensive.

Figure 13
Operation Ark sites where mohua are present.

3.3 OTHER STRATEGIES

Predator control is the most widely used strategy to help mohua because it is more cost effective since it also benefits other species. However there are also other strategies in place specifically targeted at helping mohua, including translocations and captive breeding.

"It has been demonstrated that stoat predation on mohua can be prevented by intensive trapping, however, at present this technique is used to protect relatively small mohua populations and all techniques available to assist birds need to be investigated." (Dilks, 1993.)

3.3.1 TRANSLOCATION

Mohua have been introduced to predator-free islands, where their numbers have increased rapidly. Translocation is a promising method, but relies on existing populations being stable enough to have birds taken from them to be relocated. There are also only a limited number of islands available for use, so control of predators on the mainland needs to be a priority, with the goal being that translocated mohua could eventually be reintroduced to mainland populations.

3.3.2 CAPTIVE BREEDING

Captive breeding is a more recent development in mohua recovery, because a large amount of research was required before it could be undertaken. Extensive knowledge of capture techniques and timing, holding and transport methods, aviary requirements and mohua diet was required to ensure that captive breeding would be successful. It is a risky method, and a captive breeding attempt in 2004 resulted in two out of eight birds dying due to transportation trauma, and another five deaths caused by an outbreak of avian malaria.

3.3.3 RAISING PUBLIC AWARENESS

Media releases, displays, public talks, summer programmes and videos are methods used to raise public awareness and appreciation for mohua. Already long hours of voluntary work by members of the public have gone into the study of mohua and contributed to its recovery. The public can be involved in surveying and trapping projects, and can help to raise additional funding for conservation initiatives.

Figure 14

Mohua translocations to pest-free islands in Fiordland.

REFERENCES

Dilks, P. J. (1993). *Mohua captive management plan*. Wellington: Department of Conservation.

Elliott, G. (1992). Habitat relationships and the conservation of the yellowhead. *New Zealand Journal of Ecology*, 16(2). 83-89.

Elliott, G. & Suggate, R. (2007). *Operation Ark: three year progress report*. Christchurch: Department of Conservation.

Ministry for the Environment. (2007). Chapter 12: Biodiversity. In *Environment New Zealand 2007*. (pp. 346-396). Wellington: Ministry for the Environment.

O'Donnell, C. (1993). *(Mohua) yellowhead recovery plan*. Christchurch: Department of Conservation.

Spur, E. B. (1987). Beech management: its effects on bird populations. *What's new in forest research*, 146. 4.

DATA SOURCES

Figure 1

Ministry for the Environment. (2007). Chapter 12: Biodiversity. In *Environment New Zealand 2007*. (p. 386). Wellington: Ministry for the Environment.

Figure 2

Shephard, J. D. , Ausseil, A. G. & Dymond, J. R. (2005). Ecosat forests: map of indigenous forest classes in New Zealand. Lincoln: Manaaki Whenua Press.

Ministry for the Environment. (2007). Chapter 12: Biodiversity. In *Environment New Zealand 2007*. (p. 354). Wellington: Ministry for the Environment.

Figure 3

Elliott, G. (1992). Habitat relationships and the conservation of the yellowhead. *New Zealand Journal of Ecology*, 16(2). 83-89.

Figures 4, 5 & 6

Elliott, G. (1996). Mohua and stoats: a population viability analysis. *New Zealand Journal of Zoology*, 23. 239-247.

Figure 7

Elliott, G. (1996). Mohua and stoats: a population viability analysis. *New Zealand Journal of Zoology*, 23. 239-247.

Figure 8

Elliott, G. & Suggate, R. (2007). *Operation Ark: three year progress report*. Christchurch: Department of Conservation. (p. 19).

Figures 9 & 10

O'Donnell, C. & Phillipson, S. M. (1996). Predicting the incidence of mohua predation from the seedfall, mouse, and predator fluctuation in beech forests. *New Zealand Journal of Zoology*, 23. 290-291.

Figures 11 & 12

Elliott, G. & Suggate, R. (2007). *Operation Ark: three year progress report*. Christchurch: Department of Conservation. (pp. 40, 65).

Figure 13

Elliott, G. & Suggate, R. (2007). *Operation Ark: three year progress report*. Christchurch: Department of Conservation. (p. 18).

Figure 14

Department of Conservation. (2009). *Fiordland's pest-free islands*.
Retrieved March 21, 2010, from http://www.doc.govt.nz/upload/64422/pest-map-580.jpg