Weka (*Gallirallus australis*) recovery plan

1999 - 2009

THREATENED SPECIES RECOVERY PLAN 29

Department of Conservation
Te Papa Atawhai

Recovery plans

This plan is one of a series published by the Department of Conservation stating the Department's intentions for the conservation of particular plants and animals over a defined period. In focusing on goals and objectives for management, recovery plans serve to guide the Department in its allocation of resources, and to promote discussion amongst a wider section of the community.

After the preparation of a technical report which was refined by scientists and managers both within and outside the Department, a draft of this plan was sent to the New Zealand Conservation Authority, and relevant conservation boards for comment. After further refinement, this plan was formally approved by the Director-General of Conservation in 1999. A review of the plan is due after ten years, or sooner if new information leads to proposals for a significant change in direction. It will remain operative until a reviewed plan is in place.

The Department acknowledges the need to take account of the views of the tangata whenua and the application of their values in the conservation of natural resources. While the expression of these values may vary, the recovery planning process provides opportunities for consultation between the Department and the tangata whenua. Departmental conservancy Kaupapa Atawhai Advisors are available to facilitate this dialogue.

A recovery group consisting of people with knowledge of weka and an interest in their conservation has been established to review progress in the implementation of this plan, and to recommend to the Department any changes which may be required as management proceeds. Comments and suggestions relating to the conservation of weka are welcome and should be directed to the recovery group via any office of the Department or to the Biodiversity Recovery Unit.

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NEW ZEALAND

This national recovery plan for weka has been prepared by A. J. Beauchamp, Whangarei; D.J. Butler, Nelson/Marlborough Conservancy and Dave King (Ed), East Coast/Hawke's Bay Conservancy based on drafts prepared for two of the four weka taxa, the buff weka (Bell 1992) and North Island weka (Ward *et al*, 1992).

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Cover photo: Western weka, Transit Valley.
Photo by C. R. Veitch.

Abstract

The weka (*Gallirallus australis*) is a large, endemic, flightless rail. It was formerly common on North (Te Ika a Maui), South (Te Wai Pounamu) and Stewart (Rakiura) Islands. Historically, weka were a significant resource for some iwi and their availability for mahinga kai (sustainable harvest) remains an important issue in weka conservation. Weka were absent from most outer smaller islands at the time of European settlement and they were placed on many of the smaller islands and Macquarie Island as food for shipwrecked sailors and muttonbirders over the past 200 years, where in some cases they have become a problem to other threatened wildlife. Weka have therefore been removed from Macquarie Island (Marchant and Higgins 1993) and islands around Stewart Island and in the Marlborough Sounds (Veitch and Bell 1990).

The variability in Weka morphology caused considerable problems in defining the number of forms in the 19th Century. Currently four sub-species are recognised, the North Island weka *G. a. greyi*, Western weka (South Island) *G. a. australis*, Buff weka (eastern South Island and latterly Chatham Islands) *G. a. hectori*, and Stewart Island weka *G. a. scotti* (Turbott, 1990). For the purposes of this plan the Western weka is further subdivided into two groups based on morphological differences, one in Fiordland and the other the west coast and northern South Island.

Between the 1880's and 1930's the size and integrity of weka populations declined in North and South Islands. The Buff Weka became extinct on the South island. The North Island's remaining population in Gisborne/Poverty Bay crashed again between 1983 and 1986, leaving a small residual population. This population failed to recover and the North Island weka was declared threatened in 1992 (Ward *et al.* 1992). Also in 1992 there was a proposal to remove Buff weka from Pitt Island, restricting the Buff weka to Chatham Island.

The size, status and density of weka populations in New Zealand is poorly known, and even the numerically stronger Western and Stewart Island populations may need management.

This recovery plan has to recognise the conflicts between the threatened nature of some weka sub-species and the problems that other populations are causing on offshore islands, and aim to ensure that the very high degree of morphological distinctiveness in the weka is preserved. This plan looks at each of the subspecies and defines the options for each to ensure management is based on best available knowledge. In addition the work plan is aimed at reducing the risk of catastrophic loss of all sub-species.

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1. Introduction

DESCRIPTION AND SIGNIFICANCE

The weka is a large brown flightless rail (Rallidae – *Gallirallus* group) endemic to New Zealand. Human colonisation of the Pacific was associated with the probable loss of up to 1000 species of rails (Steadman, cited in McGlone *et al.* 1994 pg. 140). Three species of flightless rails of the *Gallirallus* group (Olson 1973) survived this process of which the weka is the only one found here. A further species, *Gallirallus minor* (little extinct woodhen) was identified in the past in New Zealand from sub-fossil bones, but it is now considered not to be distinct from weka (Olson 1975).
Weka are of particular significance to some iwi Maori. The two qualities that Maori admired in the weka, their incurable curiosity and feisty, bold personalities also led to them being relatively easy to catch. Weka were a source of food, perfume, oil to treat inflammations, feathers in clothing, lures to catch dogs etc. (Beattie 1995) and therefore a resource to be managed sustainably.
Weka were also frequently encountered and utilised by the early European explorers and settlers who gave them the name 'bush hen'. The legal harvest of buff weka continues to be a significant activity on the Chatham Islands.
While sustainable management practices were an integral part of the fabric of traditional Maori society, the decline in the suite of resources (including weka) on mainland New Zealand has inhibited the application of such practices in modern times. Some iwi Maori have indicated they would welcome the opportunity to participate in a/any project where an identified outcome were the restoration of this tradition. Others hold the view that the time for harvest has gone. The provision of a cultural harvest of weka (in those places outside of the Chatham Islands) is only briefly addressed in this recovery plan however debate will continue on this.
Weka can occupy a wide variety of habitats from rocky shore and sand dunes to subalpine grasslands. Their diet consists mostly of invertebrates and fruit but they also take lizards, snails, rodents, and the eggs and young of ground-nesting birds. Weka are generally territorial and can breed year-round if food is abundant. Up to 6 eggs may be laid in a clutch and one pair has been recorded raising 14 young in a year. Weka are one of the few remaining large birds that distribute the seeds of plants so that they are particularly significant as facilitators of forest regeneration.
There are currently 4 subspecies of weka recognised (Turbott 1990), but the taxonomic distinction and distribution of each subspecies except the North Island form has always been a matter for conjecture (Buller 1877, Newton 1896, Oliver 1955, Marchant & Higgins 1994). Recent electrophoretic investigations of populations throughout the species range have found enzyme allele differences between North Island and South Island/Stewart Island weka (Colin Miskelly, unpubl.) The most recent morphometric analysis of plumage (D. J. James in Marchant and Higgins 1993) considered the Western and Stewart Island (and offshore islands in these regions) weka together as three morphologies. Buff weka on Chatham Island and skins in museums also show considerable variation suggesting that environment may be important in morphometric colour expression (Beauchamp, unpubl.) The distinguishing features of each sub-species are given in Marchant and Higgins (1993) and expanded from further analysis in Appendix 1.

A conservative approach is adopted for this recovery plan distinguishing five weka taxa
with the expectation that the protection of these should conserve the key components of the genetic variation of the species as a whole. The five are North Island weka, Western weka 'Fiordland', Western weka 'northern South Island & West Coast', Buff weka and Stewart Island weka. Further research is proposed to clarify the taxonomy of the species.
The five proposed taxa are considered separately throughout most of this plan.

REVIEW DATE

This plan is intended to guide conservation actions for the 10 year period 1999 to 2009. Recommendations made by the weka recovery group at annual recovery group meetings are to be interpreted as updating this plan during the period of the plan's operation however.

ACKNOWLEDGEMENT

The authors of this plan on behalf of the weka recovery group wish to acknowledge the contribution to weka conservation made by Ann and Basil Graeme both as co-ordinators of the North Island weka breeders group and as tireless champions of weka throughout New Zealand.

2. Past distribution

The exact nature of the distribution and density of weka populations in most on New Zealand before and during European settlement is difficult to establish (Oliver 1955). At the time of European contact weka were found over much of the North Island, South Island and Stewart Island, but at differing densities (Turbott 1967). They were also found on some inner offshore islands, however they appear to have been lacking on many offshore islands in 1840 (Atkinson & Bell 1973). Weka were taken to some of the islands surrounding Stewart Island and Foveaux Strait by Maori muttonbirders as a source of food (Wilson 1982, Miskelly 1987), and the Government Steamer Hinemoa also transported weka to other islands as food supplies for shipwrecked sailors (Falla 1937, Brothers and Skira 1984). By the 1880's weka were still well established on the margin of European settlement but fluctuated wildly in numbers.

NORTH ISLAND WEKA

Weka initially appeared to benefit from the conversion of the original forests to mixed forest and grassland in the North Island (Buller 1876, Moncrieff 1928). However by the 1930s weka had declined to extinction in all but Poverty Bay and Northland (Table 1). Between 1939 and 1953 weka declined throughout Northland and after 1953 they were restricted to Poverty Bay and a recently released population on Rakitu Island. The Poverty Bay population expanded dramatically between 1953 and 1981, and then went into sharp decline.

In urban Gisborne where in the 1960s and 1970s there were so many birds that they were causing problems and some were shifted away, the population declined in the 1980s to a few birds. Resident pairs were breeding at higher than the required recruitment rate, but the young weka were not surviving beyond 3-4 weeks of age (Bassett, pers. comm.)

In the 1950-70's at least 107 liberations of weka took place in the North Island. Most of these were unsuccessful in the long term, and limited information on the reasons for failure were gathered. However populations in the Bay of Islands at Rawhiti (transfers 1976-81) and Opua (transfer 1978) survived well until 1990-94, but have since declined (Beauchamp et al, 1998). At Opua three young birds established in the area during the three years of recent study, however they either established at the expense of one of their parents, or survived for too short a period to establish additional breeding pairs.

The transfer to Kawau Island of 31 North Island weka in 1976 was successful. The Rakitu Island transfer of 13 weka in 1951 has also established a stable population (Beauchamp *et al.* 1993). The transfer of 13 weka to Mokoia Island in between 1952 and 1958 has resulted in a significant current population (100 weka, Keith Owen pers. comm.) Transfers to Mt. Taranaki, Lake Waikaremoana and the Gwavas Forest may also have produced small populations (Ward *et al.* 1992). Most recently attempts have been made to establish a new population at Karangahake by releasing captive-bred birds by the Royal Forest and Bird and Bird Protection Society (Graeme 1994). After initially showing promise this attempt has currently failed due to high levels of predation.

TABLE 1: THE DISAPPEARANCE OF WEKA FROM THE NORTH ISLAND 1880-1960

REGION	POPULATION OBSERVATIONS	DISAPPEARANCE
Wellington/Manawatu	Plentiful throughout 1880, in Hutt Valley 1885, in Manawatu 1890, in Rangitikei 1897. Local 1907.	Gone 1922
Wanganui/Waitotara	Bounty on weka heads 1888. Sudden decline 1919 Rare 1922	Gone 1928
Wairarapa – Southern – Northern	Decline in 1890s Present 1928	Gone 1895 Gone 1930s
Hawke's Bay	Plentiful 1884-1914	Gone 1922
Taranaki	Decline 1918 Holding 1928	Gone 1935
Volcanic Plateau	Common 1894	Gone 1928
Gisborne/Poverty Bay	Absent 1884 Increase 1914. Increase and outward expansion 1950s-1980	(Present now)
Bay of Plenty	Present 1895	Unknown
Coromandel	No details	Gone 1928
Waikato	Rare in 1860s Plentiful 1890s	Unknown
Auckland	Plentiful 1880s	Gone 1900 approx.
Northland – Lower – Central – Far North	Present 1900-1920 Good numbers 1890-1937 Good numbers 1897-1945	Gone 1920 Gone 1960s Gone 1960s

This table ignores the translocations of Gisborne weka to other parts of the North Island in the late 1950s, 1960s and 1970s.
Sources: Compiled by A.J. Beauchamp from various published and oral sources.

WESTERN WEKA – 'FIORDLAND' AND 'NORTHERN SOUTH ISLAND/WEST COAST':

The western weka has historically been distributed over the western part of the South Island from the Marlborough Sounds to Southland. They died out in South Westland in the 1930s and 1940s except for a population that survived in the Copland Valley. There is some debate as to the taxonomic status of the weka south of the Copland and on the Open Bay Islands. In the mid 1980s the weka expanded down the West Coast, while further north a 'catastrophic' decline occurred between 1986 and 1988 in the coastal Golden Bay region (A. Beauchamp, unpubl.) Western weka have also been introduced or have naturally established on islands in the Marlborough Sounds (Appendix 2).

There is debate as to the origins of some of the weka populations in Foveaux Strait (Big Slander Island, Oliver 1955), but it appears they may have come from the southern South Island (Wilson 1982) or are South Island (Western and Buff)/Stewart Island hybrids.

STEWART ISLAND WEKA

Stewart Island had a viable population of weka up until 1960's, but this population had been in decline since before 1948 (W. Martin, in Classified summarised notes Notornis 2(7) 161) and before 1955 in the region north of Patterson Inlet (Oliver 1955). Over 1000 Stewart Island weka were liberated from Codfish Island to Stewart Island in 1980, but the release did not establish a viable population. Populations are recorded as having been removed from Codfish, Herekopare and Kundy Islands (Veitch & Bell 1990) although weka were reintroduced to Herekopare by muttonbirders (Andy Roberts pers comm.)

BUFF WEKA

The historical distribution of the buff weka was never clearly defined, but is generally considered to have extended east and north from Dunedin to the Waiau River/Lake Te Anau and to the Wairau River mouth in Marlborough (Bell 1992). Birds showing some buff characteristics may still exist on the margins of this zone. However the main population suffered badly in the conversion of tussock grasslands to European pasture in Canterbury and Otago. The weka's main decline in 1918, coincided with a major snowfall (Stead 1927). However the weka persisted until at least 1924, and were being encouraged in enclosures in 1927. They had also disappeared from eastern and central Southland around 1914 (Phillpott 1914). Luckily 12 weka had been released at Te One, Chatham Island in 1905 where they flourished. In c.1961 buff weka were also released on Pitt Island (Bell 1992). Three transfers back to the South Island, at Arthur's Pass in 1962, Mackenzie Basin and Peraki Bay (Banks Peninsula), were unsuccessful (Bell 1992). In 1994, 8 pairs of weka were released into a Gallagher predator-exclusion-fenced enclosure on Banks Peninsula though the number remaining there is uncertain.

3. Present distribution and status

N.I. WEKA

Northland

The Opua population seems to be just hanging on in 1997 (Beauchamp, pers. comm.) and the Rawhiti population has declined to circa two weka (from c. 400 in 1987) (Beauchamp *et al* 1988). A few birds were reported from the base of Cape Brett though their presence was not confirmed by a recent survey (Beauchamp, pers. comm.)

Hauraki Gulf

The Rakitu Island (328 ha) population is stable at cc. 135 adults, and the Kawau Island (2200 ha) population is up to 2000. Twenty-nine birds reared in captivity in a programme co-ordinated by the Royal Forest & Bird Protection Society were released on Pakatoa Island (24 ha) on 3rd August 1996, following the abandonment of the release at Karangahake due to problems with predation. By mid 1997 the weka on Pakatoa had breed successfully with over five pairs breeding in the first 6 months after release, and over ten sub-adults had been seen. (Beauchamp, pers. comm.)

Coromandel

22 weka (nine males and 13 females) from the Forest and Bird sponsored captive rearing programme were released on the 15 July 1997 to Whanganui Island in the Coromandel Harbour. This island is large enough and with a diverse enough habitat to be considered a back-stop island.

East Coast

The Poverty Bay population continues to decline to levels less than 5% of its peak in 1981, and birds are now most numerous in the Toatoa and upper Whitikau valleys – c1000 birds (Beauchamp, 1997a). Results from a postal survey in 1995 and other work suggested there is a very scattered and declining population of about 1400 birds in the Gisborne pastoral country and increasing numbers at higher density in forest/rough farmland in the Motu/Toatoa hill country (c2000 birds) (Ward, pers. comm.)

A small number of birds persist in urban Gisborne (Bassett, unpubl.) but their long term prospects look bleak with little or no recruitment occurring. Young are being killed in their first couple of months and the adult population is gradually being reduced by factors like traffic kills, dog kills, disease and injuries (blindness). It appears that historically this urban population, and the one at Opua, Northland, benefited from recruitment outside of the towns. Now there is no surrounding population near Gisborne.

Bay of Plenty

The current population on Mokoia Island (140ha), probably originated with releases of 12 weka in 1956 and 13 weka in 1958 (there was a previous release of four in 1952) (Keith Owen unpublished report). The population was over 100 in mid-1996, when 34 birds were collected from about a sixth of the island and transferred to captivity ahead of a poison drop to eradicate mice (K. Owen, pers. comm.) This drop killed many weka, but the survivors were re-joined by 32 of the birds returned from captivity in December 1996.

Wellington

Weka on Kapiti Island are of uncertain origin and genetic status. They contain a genetic marker found only in North Island weka, yet they are morphologically distinct from all birds further north and show characteristics consistent with hybridisation between North Island and Western weka which are also known to have been introduced there. The population on the island was significantly reduced (Raewyn Empson, pers. comm.) by an aerial rat-poisoning operation. However, 100 birds were held in pens on Kapiti during the operation and later released. Fifty birds were transferred to captivity at Karori Sanctuary in Wellington and forty-three were returned (Raewyn Empson, pers. comm.) Eighty birds were transferred to pens in the Tararua Forest Park. and c.60 were released from their pens on 7th September 1996 (S. Collings, unpubl.) These birds quickly dispersed up-river and the number of survivors is currently unknown.

Conservation status

The North Island weka is listed as Category B ('Second priority... for conservation action') in the Department's ranking system (Molloy & Davis, 1994). The recovery group is concerned that this does not accord with an initial assessment using the IUCN Red List Categories (IUCN, 1994) which classifies the N.I. weka as **'Critically Endangered'** (Beauchamp, unpubl.) [Note: At present Kapiti Island weka are considered as North Island/South Island hybrids and thus not included in this assessment.] There appears to be a discrepancy between these two rankings and therefore North Island weka need to be ranked as Category A ('First priority.... for conservation action') in the next revision of Molloy and Davis.

WESTERN WEKA 'FIORDLAND'

Weka are distributed from Chalky Sound to Milford Sound, more common in the west with low numbers in eastern Fiordland and none east of Lake Te Anau or the Eglinton Valley. They are well established on most Fiordland Islands, but not abundant, and absent from Breaksea, Hawea, Gilberts and Chalky Islands. Numbers overall are reportedly lower than in the past and the distribution is apparently shrinking. None of the islands with weka are outside the range of stoats. (A. Roberts, pers. comm.)

Conservation status

The western weka (both forms combined) is listed as Category B ('Second priority... for conservation action') in the Department's ranking system (Molloy & Davis, 1994)). An initial assessment using the IUCN Red List Categories (IUCN, 1994) classifies the Western weka 'Fiordland' as **'Data Deficient'** (Beauchamp, unpubl.) to **'Endangered'** (Miskelly, pers. comm.) and the Category B ranking is probably insufficient. Western weka 'Fiordland' need to be re-ranked separately to the northern South Island /West Coast form in the next revision of Molloy & Davis.

WESTERN WEKA 'NORTHERN SOUTH ISLAND AND WEST COAST'

Northern South Island (Nelson/Marlborough)

Kahurangi National Park is the stronghold in the Nelson region with fluctuating (currently low) numbers in the fringe hill country/lowlands. Birds are continuing to decline in Golden Bay and this trend was also evident in Abel Tasman National Park in 1993-94 (I. Millar, pers. comm.) Weka were common at Farewell Spit but are now absent except for a few at the base near Puponga (Beauchamp, unpubl.) A recent (December 1993) liberation of weka taken from Te Kakaho Island (outer Chetwode) into the eastern Nelson foothills has not lead to the establishment of a population though a few birds still survive (Preece and Shaw, 1998). Increasing numbers are found on the Richmond range, extending south recently (1995) to Nelson Lakes National Park. Weka are found in good numbers in the Marlborough Sounds, including D'Urville Island, and have expanded in range there. However recent declines have occurred in the southern reaches of the Sounds (A. Beauchamp, unpubl.)

West Coast

Weka are now virtually absent in South Westland (Adams, pers. comm.) There has been some recovery in other parts with good numbers north of Greymouth but no population is as numerous as in pre-European times (Harper 1896). The isolated population in the Copland Valley appears to have been more numerous over the past 5 years (Miskelly, unpubl.) Two further small populations exist at Karangarua and on Open Bay Islands.

Conservation status

The western weka (both forms combined) is listed as Category B ('Second priority... for conservation action') in the Department's ranking system (Molloy & Davis, 1994). An initial assessment using the IUCN Red List Categories (IUCN, 1994) classifies the Western weka 'Northern South Island and West Coast' weka as **'Vulnerable'** given the dramatic fluctuations seen even in large populations (Miskelly and Beauchamp pers. comm.) Western weka 'Northern South Island and West Coast' need to be re-ranked separately to the 'Fiordland' form in the next revision of Molloy & Davis.

STEWART ISLAND WEKA

Weka are still found in numbers on many of the islands surrounding Stewart Island with recent observations confirming their presence on the Ruggedy; Ulva, Native, Bravo group (Patterson Inlet); Pearl, Anchorage, Noble (Port Pegesus); Big South Cape, Pukeweka, Solomon, Big Moggy, Little Moggy (SW Titi Islands); Haerekopare, Motunui, Jacky Lee, Bench, Bunkers Islet (off Halfmoon Bay) and Green and Bird Islands adjacent to Ruapuke (Appendix 2). The status of weka on Titi Islands and Breaksea Islands, Owens Island etc. is unknown. The Halfmoon Bay population comprises not more than 15 pairs (A. Roberts, pers. comm.) The weka population has recovered on Ulva Island after a rat poisoning operation in 1993 (Lindsay Chadderton, pers. comm.)

Weka are listed on the 3rd Schedule of the Wildlife Act 1953 for the islets off Stewart Island and in Foveaux Strait – i.e., 'Wildlife that may be hunted or killed subject to Minister's notification'. Stewart Island weka need to be re-ranked in the next revision of Molloy & Davis.

Conservation status

The Stewart Island weka is listed as Category B ('Second priority... for conservation action') in the Department's ranking system (Molloy & Davis, 1994)). An initial assessment using the IUCN Red List Categories (IUCN, 1994) classifies the Stewart Island weka as **'Vulnerable'** (Miskelly, unpubl.) The Category B ranking may be insufficient.

BUFF WEKA

There is a large population on Main Chatham which appears to sustain a take of approximately 5000 in a year (2000-3000 eaten, 1000-2000 through dog/sport kills, 500 on roads and 800 trapped by the Department in the Tuku Valley during localised predator control to benefit taiko and parea (A. Munn pers. comm. 1995). Pairs generally fledge 2-3 chicks/year and young disperse over long distances (Beauchamp, unpubl.) A smaller population exists on Pitt Island, and a few birds remain in a fenced enclosure on the South Island Banks Peninsula following a transfer from Chatham Island.

Conservation status

The buff weka is listed as Category B ('Second priority… for conservation action') in the Department's ranking system (Molloy & Davis, 1994). An initial assessment using the IUCN Red List Categories (IUCN, 1994) classifies the buff weka strictly as **'Endangered'** (Beauchamp and Miskelly pers. comm.) This is considered a somewhat inappropriate classification reflecting a northern hemisphere judgement of what is a 'small island'. In New Zealand terms, Chatham and Pitt are large islands and the weka population on both are not currently considered at risk. Currently Buff weka are considered at less risk than North Island and Western weka 'Fiordland' forms. However the long term aim of Pitt Island management is the removal of weka, at which point the status of the sub-species (restricted to one island) would move more towards endangered. In this case Buff weka need to be re-ranked as Category A ('First priority… for conservation action) in the next revision of Molloy & Davis.

4. Causes of decline

The stability, density and causes of decline of weka populations are multi-factorial and linked with the climate, food supply and environment of each region (Appendices 5 & 6). Declines were associated with some population instability, migrations and changes in habitats. Between 1880 and 1940 there is some documentation of weka movements, establishment, population increases and sudden declines, at Lower Hutt (Myres 1923), Wanganui (Annabell 1922, Myres 1923), Tutira Hawke's Bay (Guthrie-Smith 1927), Nelson (1909 McConochie pers. comm. in Butler, 1991) and Horowhenua (Buller 1898).

Weka declined in the western valleys of the Southern Alps in the 1890's associated with the influx of mustelids after rabbits, and maybe ship rats (Harper 1896, Pascoe 1957, King 1984). Stoats may have been a principal factor in the disappearance of weka near Lake Hauroko in 1912 (Philpott 1914). However in other areas declines were too sudden for mustelids to have been the only cause (i.e. Wanganui in 1919, (Myres 1923).

Appendix 5 summarises the factors that have been associated with weka decline, and the "evidence" and time period involved. The historical factors that have been implicated in declines are not necessarily the factors that would cause such events now (Arnold 1994).

5. Current threats to weka

PREDATION

A recent study (1992-94) in pastoral farmland with scrub and riparian forest patches at Rakauroa/Matawai in the Gisborne District has shown predation by ferrets (*Mustela furo*) to be a major cause of death of adult weka with ferrets and cats to be the most important threat to chick survival (G. Bramley, 1996.) An experimental removal of cats and ferrets from several weka territories was associated with an increase in productivity. Most of the weka released at Karangahake appear to have been lost in two separate predation events, one caused by a single dog and a second by a ferret(s) (Beauchamp, unpubl.) Predation by wild cats (and domestic cats and dogs around Halfmoon Bay) can be expected to be a factor on Stewart Island where no mustalids are known to be present. In addition, stoats (*Mustela erminea*) killed some birds (at Parekura Bay – Beauchamp, in press.) and were implicated in declines in Kenepuru Sound, Marlborough Sounds (Beauchamp et al, 1998). The weka population on Kawau appears to be stable in the presence of relatively low numbers of this species but there is the potential for an explosion in the stoat density given the current high rat (and weka) population. Harrier hawks (*Circus approximans*) are also weka predators (Appendix 5).

Significant predation of nests has also been recorded but the identity of the predator involved has not usually been determined. At Rakauroa/Matawai large numbers of hedgehogs were trapped in the study area, and these or rats were the most likely to have been responsible for losses of eggs there (G. Bramley, *submitted to* J. Avian Biology).

COMPETITION WITH INTRODUCED SPECIES

Potential 'new' direct competitors for weka include browsing mammals (deer, possum, wallaby – taking shoots, fruits), rodents (taking fruits, invertebrates), introduced birds (taking fruits) and wasps (taking invertebrates). However, in the case of these mammals, their indirect effects may be more significant, through impacts on forest composition and regeneration. On Kawau Island, for example, wallabies tend to reduce soil accumulation, leaf litter, ground cover and understorey diversity, leading to reduced food supply for weka and increasing susceptibility of the birds to drought.

LAND USE CHANGES

Historically, the impact of the loss and degradation of natural habitats to weka, may have been reduced by the introduction of high fruit producing weed species and introduced invertebrates. However the removal of thickets and weed communities (gorse, blackberry) from riparian strips and forest remnants, the under-grazing of those remnants (Bramley 1994), the burning of logs, and the spraying of weed species on farmland and roadside verges, has turned much of the New Zealand landscape into habitat unsuitable for weka (Beauchamp, 1997a).

The populations at Toatoa-Whitikau and in the Marlborough Sounds are in areas of regenerating shrubland with high native fruit production (Beauchamp, unpubl.) The long term stability of these types of habitat needs to be assessed.

DISEASE AND PARASITES

Both diseases and parasites were associated with some documented declines of weka and occurrences of fungal infections, avian pox (in captivity) and tick infestations have been recorded in recent studies (Appendix 5). Recently, disease has been associated with the loss of weka in good condition on Kawau Island (Beauchamp 1997b).

CLIMATE CHANGE

Droughts are implicated as a factor associated with the recent loss or decline in some populations (Appendix 5). Periods of low rainfall, or other weather extremes, will always have been an occasional factor affecting weka, but their impacts are potentially much greater now because of changes in habitat caused by humans (see below) and introduced mammals. (Beauchamp, in press). It is probably too early to say if droughts are increasing as a result of human-induced changes to climate (e.g., 'Greenhouse Effect').

The effect of climate change will depend on the degree of impact on any limiting resource and may be density dependent. The most important factors appear to be food and water availability, and changes in the ecological balance that may allow density independent factors, like predator switching by mustalids to bird prey, to dominate.

MOTOR VEHICLES

Vehicles ranked with ferrets as major causes of death of weka in the Rakauroa/ Matawai study area, which is bisected by State Highway 2 between Gisborne and Opotoki (Bramley, 1996). Road kills also occur in the South Island (Takaka Hill, D. Butler, unpubl. and 93 dead weka recorded in 7060km in north Westland in 1997, B. Stuart-Monteath, pers comm.)

PEST ANIMAL CONTROL OPERATIONS

The ground foraging habit of weka makes them vulnerable as a non-target species for pest animal control operations.

Monitoring of an aerial drop of 1080 poison that aimed to reduce possum numbers in the Marlborough Sounds indicated that these types of operations have a minimal direct impact on weka, with only one of 24 birds with radio transmitters attached dying of probable poisoning. Any indirect impact through reduction in numbers of invertebrates on which weka feed would be both unlikely, to judge from recent

research, and temporary in nature. A further indirect impact through increased predator numbers (see below) is unproved. However positive impacts on weka populations through improved forest condition as a result of reduced possum numbers would outweigh any short-term negative impacts.

A buffer zone was established for this 1080 operation in which possums were controlled with leg-hold traps and there were considerably more weka deaths in this zone. Research has shown that weka can jump to 700mm vertical height and climb a ramp set less than 38° to the ground (Thompson et al. 1996). These factors may dictate how traps for possums are set in areas with weka in order to avoid their capture.

Aerial operations to eradicate rodents from islands using the poison broadifacoum (tradename for bait/poison pellet – Talon) have had very significant direct impacts on weka, such that these operations have been used to assist in the eradication of weka populations at the same time. For example on Te Kakaho (Outer Chetwode) Island 95% of the weka population were killed as a result of the poison drop. The susceptibility of weka to such operations has lead to birds being removed to captivity for subsequent return after the poisoning to ensure the re-establishment of populations (Mokoia, Kapiti Islands). In the long-term weka populations will benefit through reduced competition and nest predation from rodents being removed from islands.

One of the factors associated with the decline in weka at Rawhiti – Parekura Bay from 1989 to 1995 was high possum control activity (a 1080 operation and at least two using cyanide). Whether or not this control had a direct impact on weka it seems possible that it had an indirect effect by increasing the numbers of mustelids. Cyanide destruction of the possum population on the farm holding most of the weka in the dry spring and summer of 1994 produced c. 700 skinned possum carcasses which are thought to have provided additional food for mustelids. Sightings at the carcass sites (3 in December 1994) and neighbouring properties during January - March 1995 suggested higher densities of mustelids than previously seen (1991-95). One mustelid was seen chasing weka on the 8 March 1995 (Bill van Berkum, pers. comm.), and apparently took this bird on the 27 March 1995. There were no dogs in the area and Fenn traps set had failed to catch the mustelid (Bill and Kay van Berkum, pers. comm.)The weka population was reduced from 12 to 5 weka in this time.

Other poisons (e.g. pindone, slug pellets) and traps (e.g.Timms – Beauchamp 1992, Bramley 1994) are considered to pose some threat to weka.

GENETIC DRIFT AND OTHER RANDOM EVENTS AFFECTING SMALL POPULATIONS

A number of weka populations are now relatively small and isolated. In this situation genetic diversity can be lost through random changes in gene frequencies arising from the transmission of genes from one generation to the next, 'genetic drift'. Such changes are greater when there is a smaller number of parents from which the genes of the next generation can be derived, i.e. in small populations. Reduced genetic diversity may reduce the ability of a population to respond to changes in its environment.

Another random event that may be a significant threat to small populations is unbalanced sex ratios. If generally the sex of offspring is determined randomly,

then the smaller the population the more chance of significant skewing of sex ratios leading to future reduced productivity: e.g., to take the extreme all young produced one year being of the same sex.

In addition, there are other factors like egg bound females, and probably some diet and nutrition or physiological factors associated with female reproduction (Beauchamp, unpubl.) which affect small populations.

6. Ecology

Weka occupy a wide range of habitats including forests, scrublands and wetlands. In some areas they now utilise highly modified habitats, even semi-urban situations, where they depend on a diversity of vegetation types, particularly seral ones with high numbers of fruit-bearing shrubs.

Their diet consists mostly of soil and litter dwelling invertebrates and fruit (Appendices 4 & 7) but they also take lizards, the eggs and young of ground-nesting birds and carrion. Analysis of droppings collected at Toatoa suggested that invertebrates were taken in large numbers even when fruit availability became high, with Coleoptera (beetles) and earthworms the most significant items (A. Beauchamp, unpubl.) Food scraps may be an important diet item for birds at some sites, e.g. parts of Kawau Island, urban Gisborne.

Weka generally maintain year-round territories though these can be replaced by site-based home ranges in some situations, e.g. Kawau Island (Appendix 6). Breeding is closely related to food supply and the associated ability of birds to put on weight beforehand. It can occur year round in some situations of high food availability. The productivity of pairs varies markedly from site to site and year to year with an average from 0.03 to 3.45 young raised in a year (Appendix 3). Young birds leave their parental territories at between 40 and 105 days of age and can breed at as young as 5 months of age under low population pressure (Graeme, 1994).

Weka populations are generally subject to relative large fluctuations, particularly on the mainland, which are thought to relate largely to major changes in food supply typically associated with adverse weather conditions. Islands seem to support the most stable populations and densities there can reach more than 1 bird per hectare (Appendix 3.)

7. Ability to recover

Weka have demonstrated that in good conditions with high food availability and limited density dependent controls they can be very productive. Year-round breeding has been recorded at several sites with up to 14 young produced in a year (average 3.45 young/year), and birds can breed at 5 months old (Appendix 3). Populations persist on both North and South Islands where they have faced a wide range of threats since human arrival, though clearly they cannot withstand the combination of current pressures in these locations. Populations also persist in highly modified habitats, suggesting that weka can adapt to a wide range of conditions.

8. Options for management or recovery

NORTH ISLAND WEKA

OPTION 1 – Do Nothing

This is not a viable option given the current status of the North Island weka on the mainland which are still in a precarious position. The potential for a sudden decline on Kawau Island (Appendix 6), the potential long term need for rat eradication on Rakitu Island, the uncertainty of the two small-island populations (Mokoia & Pakatoa)and the unknown viability of the Whanganui Island population means that the offshore populations are also at risk.

Predicted outcome
Loss of all North Island weka populations.

OPTION 2 – Monitoring only

Monitoring of "spacing calls" (Beauchamp 1987) has been established in most of the North Island populations for 4 years, and works well as an initial assessment tool (Appendix 4). Weka densities can be estimated and a trained observer can gain some information about population structure (Beauchamp 1997a). However monitoring will only work as a management tool if after a population decline, there is time to assess the reasons for this, and undertake management before the situation becomes critical.

Predicted outcome
Loss of all North Island populations, unless used as a trigger for more pro-active research and management.

OPTION 3 – Research only

Considerable research over the past 4 years has shown the potential problems that most populations face, and are likely to face in the future. Further research and management should be targeted at the landscape management issues, and predator problems that are known to have prevented the re-establishment of weka (Appendix 5).

Predicted outcome
More knowledge about local problems but maybe lacking in overall applicability both spatially and temporally in the North Island.

OPTION 4 – Management of existing populations

Some of the existing urban and semi-urban populations are in decline or almost extinct (Opua, Parekura Bay and Gisborne City). The existing adults are breeding but there is little recruitment. They are living in areas where the impacts of humans, their domestic animals and poisons are difficult to counteract and management can only be contemplated with significant public support and involvement. The benefits for advocacy of success of such management would be considerable.

Other populations (e.g. rural Gisborne District) are less prone to human interference and may benefit from management. Management tools could include seral habitat protection and habitat enhancement using induced seral species management (fire, cutting, slips), predator reduction (especially mustelids) and possum reduction (using methods that do not affect weka or increase the survival of predators).
The long term prospects for weka on Kawau Island would be enhanced if there was a large area that was free from wallabies. This would enable native forest regeneration, which would lead to improved fruit supplies, and a deeper leaf litter layer less prone to drying and capable of holding higher invertebrate densities (Beauchamp 1993).

Predicted outcome

Current urban and pastoral country weka populations may continue to decline and some will be lost. The potential for enhanced survival of rural bush populations at Toatoa is unknown, but principal predator removal appears feasible as an interim management tool if the population is unstable.
The potential longevity of island populations like Kawau Island will be enhanced by management.

OPTION 5 – Establishment of new North Island populations

Efforts to establish a new mainland population at Karangahake Gorge through release of captive-reared birds have failed after initially looking promising, due to problems with predation. A further initiative by a private organisation 'Weka Rescue' involved the release of birds into the Tararua Ranges accompanied by some predator control. Decisions on the further use of this technique for ongoing management purposes should await assessment of these projects, together with a recently initiated study at Toatoa (see p. 29).
The Department has recently committed to several new projects to manage large areas of mainland forests (termed 'mainland islands') for restoration of biodiversity. These may provide appropriate sites for establishment of new weka populations, though there are problems of the vulnerability of weka to the pest control techniques that need to be overcome. The re-establishment of weka populations in areas of recent weka decline (e.g. Gisborne/ East Coast) may be viable, where the causes of weka loss is either known and can be managed, or are addressed through management trials such as in the Turihau enclosure project north of Gisborne City.

Predicted outcome

Unknown but it appears that it may be technically feasible to establish new populations (by the transfer of captive-bred or wild birds) if sufficient control can be exerted over predators.

OPTION 6 – Establishment of offshore island populations

Most of the islands where North Island weka are established have mammalian predators. Weka are capable of surviving on large islands with high densities of ship rat (Rakitu Island), and even low densities of cats, dogs and stoats (Kawau Island). A release on to a further small island, the predator free Pakatoa Island in the Hauraki Gulf, has happened recently and initial results are encouraging (A. Graeme, unpubl.)

The establishment of another weka population on the privately owned Whanganui Island, off Coromandel township, was undertaken in 1997 because of the precarious status of North Island populations and the current poor ecological status of weka on Kawau Island (Appendix 6). Similar islands are available in the Hauraki Gulf and the Northland coast but the introduction of weka will have to be balanced with the impact weka may have on other threatened or uncommon species present at island locations.

Predicted outcome
Very likely successful and would hedge against other population losses.

Preferred options

The preferred options are composed of elements of the preceeding options particularly Option 2, Option 4, Option 5 and Option 6.

1. Monitoring of the newly established Whanganui Island population and establishment of other large offshore island populations where possible.
2. Enhancement of the Kawau Island habitat through the removal of wallaby from a large area of Kawau or ideally the whole island.
3. Management of the Mokoia Island population
4. Management of the Toatoa – Whitikau mainland population.
5. Continued trials to establish further mainland populations (including in 'mainland islands') accompanied by management to reduce threats (particularly predation).

WESTERN WEKA ('FIORDLAND' & 'NORTHERN SOUTH ISLAND')

OPTION 1 – Do Nothing

The Western weka distribution is subject to change, for example expansion during the past 10 years on the West Coast of the South Island, and contraction in the Nelson/Abel Tasman National Parks areas. The outlying populations in the Copland Valley and Fiordland are at lower density and the latter is contracting in range (Andy Cox, pers. comm.)

Predicted outcome
Unknown.

OPTION 2 – Monitoring only

Stable weka populations have existed through the northern and western South Island for some time. However Coleman *et al.* 1983 found that one population was male dominated, and parts of the distribution were not permanently occupied, which may be cause for concern. Monitoring would provide information on the status of the populations, and enable assessment of research or other priorities.
PREDICTED OUTCOME: Status and trends information, and better management decisions.

OPTION 3 – Research only

The western weka populations are the most morphologically diverse. They form a cline north-south and east-west (Marchant and Higgins 1993). This plan recognises two separate groups, 'Fiordland' (populations with black morphology), and the northern populations. There is also the possibility that due to population transfers, there is little remaining morphological distinction between the Fiordland grouping and the Stewart Island weka. A morphological assessment of all forms (grey, chestnut and black) is needed on all remaining populations of this group combined with DNA analyses.

We lack knowledge about the 'Fiordland' weka populations, but have some ecological information about the northern Westland (Coleman *et al.* 1983) and the Marlborough Sounds populations (Beauchamp 1987a, unpubl.) Further research would provide more information on the status of the populations and current threats. In addition carefully designed studies could be used to establish the inter-relationship between weka and other biota.

Predicted outcome

Information for sound management decisions. Clear definition of taxa and clarification of status of Fiordland population.

OPTION 4 – Management of existing populations

There is little information available on which to base sound management decisions on the South Island populations. However, if the North Island population declines over the past decade are anything to go by, there is the potential for major losses associated with the greater climatic variability that appears to be associated with global warming and the like. Given this lack of information, and the generally more stable populations on offshore islands, at least two offshore island populations of each of the two forms are required to guard against catastrophic loss.

Because of the replicability of trials management of selected offshore island populations could provide valuable information on situations where weka are a potential threat to other important fauna.

Predicted outcome

Information for sound management decisions, conservation of populations and enhanced tangata whenua involvement.

Preferred options

'The preferred options are composed of elements of the preceeding options particularly Option 2, and Option 3.

1. Assess the status of weka throughout the South Island using a call-based survey methodology similar to the existing Kiwi call scheme along with more specific monitoring.
2. Establish monitoring at key South Island population sites in the Marlborough Sounds, Golden Bay, Paparoas and Fiordland (Appendix 4).
3. Assess the status of weka in Fiordland, especially the western islands.
4. Research to determine the taxonomic distinctiveness of 'Fiordland' weka.

STEWART ISLAND WEKA

OPTION 1 – Do Nothing

Some weka populations are naturally occurring (where islands are close to Stewart Island) and others established as a result of human introductions (e.g. Moggies, Foveaux Strait Titi islands). Weka have been regarded as a problem to the ecological viability of a number of the islands surrounding Stewart Island by predating some sea and land bird species (e.g.,. petrels, prions, saddleback, banded rail and snipe). If we do nothing there is a high probability that valuable species may go extict on some islands. On the other hand weka may disappear from some of the smaller islands through habitat modification and chance.

Predicted outcome

Reduction in distribution of weka and potentially significant changes to the biota on some islands where weka were introduced by humans and remain.

OPTION 2 – Research only

Research could be directed at three areas. Firstly, a taxonomic assessment of the Stewart Island weka populations could determine if there are any differences between existing populations near Stewart Island and Western Weka 'Fiordland' by looking at all morphologies (grey, chestnut and black).

Secondly, assessment of the numerical strength and the population demography of weka on the islands near Stewart Island, could allow more informed decisions to be made on the fate of populations that are causing concern. Bell (1992) suggested that Stewart Island Weka could be preserved on Pearl Island, Anchorage Island and Nobel Island but there are no reasons stated. Andy Cox has also suggested that Pearl be used for weka conservation. Andy Roberts holds the view that weka should be preserved on the islands of Port Pegasus because they are a naturally occurring population. However there is little information on whether these islands are suitable in the long term or whether the totality of the morphological variation is represented on these islands. A number of the islands where there are weka are owned by Ngai Tahu. Management of weka on these islands will require on-going discussion and co-operation.

As well as a full review of the status of weka on islands in Foveaux Strait and around Stewart Island there is a need to determine their effect on other biota.

Predicted outcome

Information on which to form a balanced assessment of the status of the Stewart Island weka and its management.

OPTION 3 – Management of existing populations

Management options need to ensure that viable populations are maintained, and that other conservation and cultural factors are considered. Management options fall into three categories:

1. leave the population alone.
2. control the numbers of weka to a pre-defined area or density.
3. eradicate weka from the island.

The first two options permit weka to survive/evolve with other biota. In the past the first option appears to have occurred by default, the second option is being

tried elsewhere (e.g. Buff weka in the southern Main Chatham Island, exclusion from the Tuku Nature Reserve area for taiko (*Pterodroma magentae*) management reasons) but has not yet been acknowledged as a viable means of population management, and the third option has been the principal tool of management in areas where weka were a proven or perceived threat and usually where weka had been introduced to islands by humans. The second option could be used in partnership with tangata whenua.

Predicted outcome
The informed and structured management of populations.

OPTION 4 – Re-establishment of Stewart Island population

The reasons for the decline of weka on Stewart Island are unknown and probably complex. The only major attempt to release weka back to Stewart Island occurred between 1978 and 1981, when about 960 weka were released associated with the removal of weka from Codfish Island (Galbreath 1993 pg. 199). Thirty percent of the birds went to Halfmoon Bay and supplemented the remnant population there and the rest were released at Waituna Bay – the closest point on Stewart to Codfish Island (Andy Roberts pers comm.) These liberations have failed to produce a long term viable population. The reasons for failure could be different from those that caused the earlier collapse on Stewart Island.
Stewart Island has cats, rats, hedgehogs, possums, red and white–tailed deer, but lacks mustelids. A single stoat was reported there in 1995 but no stoat was found despite some 11000 trap nights effort (A. Cox pers comm.) Wild cats are large, well distributed, and have taken birds larger than weka. The technology is not currently available to allow the removal of the complete suite of weka predators/competitors from Stewart Island. Considerable resources would be needed to restore weka to Stewart Island.

Predicted outcome
Failure.

OPTION 5 – Establishment of island populations

There is no need for further populations to be established on islands.

Predicted outcome
Not applicable.

Preferred options

'The preferred options are composed of elements of the preceeding options particularly Option 2, and Option 3.

1. Research to establish the taxonomic differences between Stewart Island and 'Fiordland' weka. Application of morphology "taxonomic" criteria to the population composition and status of the remaining weka populations, and tabulation of this information for each island.
2. Assessment and tabulation of the threat that weka are posing to other biota on all islands in relation to the overall threat to that taxa (Appendix 8). In such an assessment whether weka appear to be naturally occurring on an island and the cultural implications of removal will be taken into account.

3. Management of the remaining populations to provide at least three viable and well distributed populations in the long term, on islands surrounding Stewart Island.

BUFF WEKA

OPTION 1 – Do Nothing

There is limited short term risk to the weka population on Chatham Island which has maintained a high density and wide distribution, in habitats that are not prone to drought. The only major threat would be over-hunting or extensive trapping/ poisoning operations. Current legislation does not preclude residential use (harvesting) of the population. Long term Chatham Island is likely to become more populated and developed, and major ecological changes (forestry) could be detrimental to weka. The population on Pitt Island is smaller and there is a long term desire by the Department to have Pitt Island weka-free for conservation reasons.

Predicted outcome
Status quo, or decline.

OPTION 2 – Monitoring only

There is little data on the annual kill of weka by Chatham Islanders or the impact of this on the weka population. Monitoring of the density and distribution of the Chatham Island population should be established to support specific management options, like the continued removal of between 200 to 700 weka from the Tuku Nature Reserve (Imber *et al.* 1994). Such a sizable removal is estimated to take account of the annual production of between 430 and 870 individual weka over 172-348ha (density 0.4 weka per ha) of the surrounding countryside (Beauchamp, unpubl.)
Monitoring would provide a quantitative assessment of the population and its distribution.

Predicted outcome
Better understanding of the size, distribution and impact of activities on the population.

OPTION 3 – Research only

Limited research has been carried out on the existing populations of Buff Weka. Morphometric research on Chatham Island, and distribution information on the former South Island suggest that there is considerable overlap in characters with Western Weka (Beauchamp, unpubl.) Other research suggests that the population dynamics and breeding systems are similar to North Island Weka (Beauchamp, unpubl.)
Research could be needed in order to establish a relationship between monitoring and actual causes of population change.

Predicted outcome
Information for management options.

OPTION 4 – Management of existing populations

The population in the Tuku Valley is being reduced using trapping to benefit the critically endangered taiko. Management of weka on Chatham Island and Pitt Island is possible given the degraded status of other biota on the two islands and the healthy status of the weka population.

Predicted outcome
Population reduction.

OPTION 5 – Establishment of new South Island populations

The eastern South Island is prone to drought, and any population in this area is likely to suffer similar problems to that in Gisborne/Poverty Bay in the 1980's. Consequently any population that is established there is likely to be temporary, unless it is widely distributed including areas less prone to drought.
There have been at least two proposals for the re-introduction of Buff Weka to the Eastern South Island in recent years. One of these proposals, to Hinewai Reserve Banks Peninsula, was declined because of the potential impact on invertebrates (Euan Kennedy, pers. comm.)
An experiment to fence off an area on the mainland as an 'island' is underway on Banks Peninsula. The Department is also initiating a new 'mainland island' project to attempt to restore beech forest communities in the Hurunui Valley which might be a potential site for weka in the long term.
The Department's Otago Conservancy, in partnership with local Papatipu Runanga of Ngai Tahu and the University of Otago, are also working towards establishing a population of Buff weka from Chatham Island to Stevenson's Island in Lake Wanaka. This is considered as a first step in the establishment of a mainland population.
The establishment of any new weka population on the mainland will need to be accompanied by suitable predator monitoring and control.

Predicted outcome
Unknown but it may be technically feasible to establish new populations (by the transfer of captive-bred or wild birds) if sufficient control can be exerted over predators.

OPTION 6 – Establishment of (offshore) island populations

Islands generally provide the most stable areas for weka, due to the lack of human influences and predators. However most of the islands within the previous range of buff weka on Lakes Wanaka (Harwicks and Crescent) and Wakatipu (Pigeon and Pig), and offshore are small. In addition several of the offshore ones (Quail, Quarantine) are close to the coast and vulnerable to predator invasion. Stevenson and Silver Islands are seen as the most promising. In the longer term Bell (1992) suggested the removal of weka from Ruapuke Island in Foveaux Strait (approx. 1200 ha) which is arguably within the previous range of Buff Weka and replacement with Buff weka. All potential islands would require a through investigation of their suitability for weka (Appendix 8), including and assessment of other conservation values.

Predicted outcome
"Unknown, but it may lead to the establishment of further populations of Buff weka

Preferred options

'The preferred options are composed of elements of the preceeding options particularly Option 2, Option 5 and Option 6.

1. Implement monitoring of the Chatham Island population.
2. The introduction of Buff Weka to a South Island site where drought effects are minimal or can be minimised and predation can be limited.
3. The investigation of Stevenson and Silver Islands, within the previous eastern distribution of the Buff Weka, as suitable sites for introduction.

9. Biodiversity benefits

The benefits to biodiversity in general of the recovery of weka populations is dependent on the habitats in which weka are established. Weka in open farmland eat grassgrub (*Costelytra* spp.), black cricket (*Teleogryllus commodus*) and other invertebrate pests. They also are capable of distributing seeds of native and introduced plants which add to the diversity of farmland habitats. This is desirable for other introduced game birds like the pheasant and quail, as well as native seed eating birds and reptiles. Weka are of more benefit in bushlands, being capable of spreading a substantial amount of the heavier seeds like hinau, toru, tawa, and taraire as well as numerous small seed producing trees such as *Coprosma* spp., *Pseudopanax* spp., mahoe (*Melicytus ramiflorus*), and kawakawa (*Macropiper excelsa*). Weka are therefore one of the few large seed distributing birds that are left today to do this.

10. Recovery strategy

LONG TERM GOAL

To restore all weka taxa to their traditional* range as a significant component of mainland and island ecosystems, ensuring that all taxa have the conservation status equivalent to Category 'C' of Molloy and Davis, 1994. or lower.

SHORT TERM GOAL FOR THE DURATION OF THE PLAN

To improve the conservation status of threatened weka taxa, to clarify the status of data deficient taxa, and maintain the non-threatened status of other weka taxa.

SHORT TERM OBJECTIVES

1. Review and re-define the taxonomy of weka, to determine the different units for long-term conservation management.
2. Define and keep under review the conservation status of all weka taxa based on their distribution and population trends.
3. Define the populations for each taxa, on the mainland and islands, that will be monitored and establish monitoring procedures.
4. Carry out management to prevent further loss of populations.
5. Identify the relative importance of different threats to weka populations (immediate and long-term), and design and implement management procedures to reduce these threats where possible.
6. Establish further populations as required, so that each taxa has at least one large (core) population on the mainland and three back-up island populations.
7. Recognise and give effect to the kaitiakitanga of tangata whenua in relation to the conservation management of weka.
8. Recognise and promote community understanding of and involvement in weka conservation.
9. Recognise that weka on islands may be a conservation problem, e.g., a threat to other protected species, and provide a process for involvement of the weka recovery group in decision-making regarding their future.
10. Review the conservation benefit of holding weka in captivity, develop criteria to ensure that captive populations contribute to the achievement of the plan's goals, and manage populations according to those criteria.

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* Encompases former natural range as well as significant sites where introductions have occurred for cultural reasons (e.g.,. Chatham Islands).

11. Promote the re-introduction of weka to sites in their previous range where threats to their survival can be controlled (e.g., 'mainland islands'), as a significant component of New Zealand ecosystems.
12. Promote the development of pest control and eradication techniques with reduced impacts on weka.

11. Work plan

OBJECTIVE 1

Review and re-define the taxonomy of weka, to determine the different units for long-term conservation management.

Explanation

This objective will answer the question of whether the current taxonomy of weka, based on morphology, reflects some genetic variation, apparent in mitochodrial DNA, in the species. This plan recognises five taxa, not the four in the published literature. The validity of this, which involves splitting Western weka into two forms, needs to be assessed. Once the taxa are determined, then it will be possible to assign populations. It will allow a re-assessment of the management options for each taxa and will allow identification of island populations (e.g. Foveaux Strait) where hybridism is significant. Some island populations including Slander (Wilson 1982), Open Bays Islands, Chatham and Kapiti may hold the only representatives of weka from former populations or taxa on the main islands.
This objective will also allow each different type to be assigned a status whether as different species, sub-species or perhaps race.

Actions required

Morphological Analyses and publication of findings. Development of weka morphology assessment sheets, and/or detailed descriptions of areas on weka for feather collection (This could be standardised by cutting plumage from the defined feather tracts (Appendix 1) for central analysis. Scored morphological assessment of at least 10 hand held weka on each offshore islands to assign each to a morphological range.
DNA analysis of a comprehensive collection of blood samples. Further samples need to be collected from some of the islands off Stewart Island. Analysis of a large number of samples from one site (in this case Kapiti Island) will allow estimation of the variability within a population to place variability between populations in context.
Results of morphological studies, DNA analysis and electrophoretic analysis of blood proteins conducted earlier (Miskelly, pers. comm.) synthesised to produce an agreed taxonomy of weka.

Intended Outcomes and Outputs

Publication in peer-reviewed scientific journals confirming existing taxonomy or describing new taxonomy within the term of this plan.
Provision of an assessment of the representative populations to guide management so as to maintain high levels of genotypic and phenotypic diversity.

Responsibility

Southland Conservancy; Research personnel.
Dr David Lambert, Massey University, has funding for mitochondrial DNA analyses of existing blood samples in 1996/97. Outputs included a report by 30 June 1998 but the research has run over time. The study is ongoing.

OBJECTIVE 2

Define and keep under review the conservation status of all weka taxa based on their distribution and population trends.

Explanation

Both the IUCN criteria for assigning conservation status to taxa (IUCN 1994) and the Molloy and Davis (1994) priority setting system used by the Department depend primarily on analysis of trends in distribution and numbers. Initial assessments for the different weka taxa were presented in section 3 as:

TAXONOMIC GROUPING	SUGGESTED IUCN CATEGORY	MOLLOY AND DAVIS CATEGORY
North Island weka	**'Critically Endangered'**	**Category B** (Second priority for conservation action)
Western weka 'Fiordland'	**'Data Deficient'** to **'Endangered'**	**Category B** (Second priority for conservation action)
Western weka 'Northern South	**'Vulnerable'**	**Category B** (Second priority for conservation action)
Stewart Island weka	**'Conservation Dependent'** and **'Vulnerable'**	**Category B** (Second priority for conservation action)
Buff weka	**'Endangered'** (noting that the IUCN criteria over emphasise the risk in this case).	**Category B** (Second priority for conservation action)

Better information followed by re-ranking of taxa under both systems would allow more confidence to be placed in the classification of their threat status. It is then necessary to continue to measure changes in distribution and numbers of the different taxa, to determine the programme's progress towards achieving its goals – (such monitoring is dealt with in Objective 3).

Actions required

Distribution surveys

Priorities to refine present distributions are as follows:

North Island weka: Confirm presence on Mt.Taranaki – where occasional reports persist following three transfers of birds in the 1970's.

Western weka 'Northern South Island & West Coast': assemble information on current range and status of this weka, including results of transfer of birds to Cable Bay, Nelson.

Western weka 'Fiordland': define the full range.

Stewart Island weka: Identify which islands in the Stewart Island region hold weka and which type is present on each.

Completion of these surveys will provide a baseline against which to measure future change and, where previous data exist, allow a more detailed comparison of current population trends.

Note: The Ornithological Society of New Zealand is proposing to re-do its national distribution survey within the next few years. This will provide an opportunity to gather further information about current weka distribution and allow assessment of changes since the 1976-79 survey (Bull et al., 1985).
Re-rank weka taxa to better reflect their threat status and guide future conservation action.

Intended Outcomes and Outputs

- A known population status for all weka groups.
- Weka groups all ranked appropriately.

Responsibility

Wanganui, Nelson/Marlborough, West Coast, Southland Conservancies, Weka recovery group, BRU.

OBJECTIVE 3

Define the populations for each taxa on the mainland and islands that will be monitored, and establish monitoring procedures.

Explanation

The once contiguous populations of weka are now split into small discrete populations. To ensure the survival of the weka morphology throughout New Zealand, and to assist the recovery group to respond to proposals to manage islands for other threatened and endangered biota, populations of each weka taxon need to be defined and monitored.
Monitoring by itself has little benefit unless it leads to management. The Gisborne/ Poverty Bay weka population collapsed between 1983 and 1990. Despite early recognition of the problem nothing was done to assess the situation because it was expected that weka would quickly bounce back. This has not occurred, and research by Gary Bramley (1994) has indicated that there have to be considerable changes in land management before the current trends are reversed.
Different degrees of monitoring and management response are appropriate for different populations. For those populations critical to the survival of a taxon (see objective 6 core populations/back-up islands) it is necessary to monitor sufficiently to pick up any declines early so that a response can be made. For other populations, such as the large mainland ones of the western weka 'Northern South Island & West Coast', monitoring is aimed at detecting longer-term trends.

Actions Required

1. Define the monitoring sites
Currently some sites can be identified (below) but others need to be defined.
North Island weka: Toatoa, Rakauroa (counted since 1991) (East Coast); Kawau, Rakitu and Pakatoa Islands (Auckland); Mokoia Island (Bay of Plenty); Whanganui Island (Waikato).
Kapiti Island weka: Kapiti Island; Tararua Range.

Western weka 'Northern S. Island and W. Coast': Mainland monitoring sites to be defined; D'Urville, Arapawa and Forsyth Islands.
Western weka 'Fiordland': Mainland & island monitoring sites to be defined following survey. Secretary/Bauga/Shelter Islands have been suggested as two island groups for monitoring.
Stewart Island weka: Halfmoon Bay population to be monitored for any potential to become the 'mainland' population; Ulva/Bravo Islands, Pearl/Anchorage/Noble Islands, selected Titi Islands (which to be determined in consultation with owners).
Buff weka: Chatham Island, Pitt Island (until potential eradication), all new mainland or other island populations as established.

2. Establish monitoring protocols

A draft monitoring protocol is set out in Appendix 4. It includes a range of techniques from 'broad brush' ones like postal surveys, appropriate for large mainland populations, to detailed ones based on the 'spacing calls' made by weka which can be used to provide information on the density, age distribution, sex ratio and even the breeding status of populations as well as presence/absence. A monitoring plan should be produced for each taxon which states the techniques to be used, what change in results is considered necessary to demonstrate a population decline of concern, and what actions are to be taken at this point, whether it is more detailed monitoring, research, or management.

Intended Outcomes and Outputs

- Well documented populations with monitoring plans leading to management action as required.

Responsibility

Department of Conservation conservancies, contract work, communities and conservation groups, hunting and tramping clubs.

OBJECTIVE 4

Carry out management to prevent the further loss of populations.

Explanation

This objective focuses on the management of current populations. It covers options for managing these populations, and provisions to ensure that if one is to be lost through a planned eradication of birds, this does not take place until a replacement has been identified or established. A further management requirement, to ensure that there are sufficient core populations, is covered by Objective 6.
A limited number of management actions can currently be proposed and these are listed as 'actions required' for the different populations. The priority taxon for management is clearly the N.I. weka and within that the priority population is the Toatoa one. The current work at Toatoa is aimed primarily at conserving that population but it also has an experimental element, to establish possible techniques that can be applied more widely to conserve weka (see Objective 5). If it succeeds in this secondary aim then more options for management should become available during the term of this plan.

Actions Required

N.I. weka

Toatoa

A management project has been initiated by East Coast Conservancy (September 1996) –with the aim of determining minimum management actions which will ensure the ongoing viability of that population. A paired trial will be established with a treatment block receiving predator (mustelid, cat, dog) control compared to a non-treatment block. Population density, chick production and survival will be monitored. This should be maintained until a definitive result is gained and this population is recognisably self-sustaining.

Kawau

The removal of wallabies from Kawau is advocated to improve the habitat of the island for a range of native species including weka. The resulting improvement in food supply for weka would increase the probability of the long-term survival of this population. The first step may be to lower wallaby numbers in the parts of the island managed by DOC (e.g. around Mansion House leaving animals only in the secure enclosure already established). At the same time an advocacy programme needs to be established with the aim of securing community support for complete removal.

Rakitu

Should a rat eradication programme is carried out here (as has been proposed by the Auckland Conservancy) steps have to be undertaken to ensure that the island retains its back-up status (refer Objective 6) or that Rakitu weka are re-located to a safe site or that an alternative back-up population is identified.

Whanganui Island

Monitoring of this population during the establishment period is crucial with contingency planning established in order to respond to impacts such as high predation levels, drought etc. if required.

Mokoia Island

Annual monitoring of chick production and survival trends. Consider transfers to supplement island populations.

Western weka 'Northern S. Island & W. Coast'

Only monitoring is proposed at this point. Techniques to manage the mainland population are not yet available. The three island populations identified for monitoring and providing a 'back-up' to the mainland (Objective 6) are not currently under threat from any planned pest control operations. If they were to become so then steps should be taken to mitigate effects on weka or other islands in the Marlborough Sounds, e.g. Pickersgill, should be designated as back-up populations and monitored as such.

Western weka 'Fiordland'

Similarly no management is proposed at this point, though this might change once the conservation status (IUCN category) of this taxa has been determined.

Stewart Island weka

It is particularly important to conserve sufficient island populations because there is no secure 'mainland' site. Thus, no pest control programmes should be planned on the 'back-up' islands (identified in Objective 6) unless further secure populations are identified and protected.

Buff weka

Main Chatham

There are clearly management initiatives that could be taken to conserve this population in the event of a serious decline as there is a significant direct human impact on this population. Options include contingency planning in anticipation of serious decline, actively protecting birds at representative/key sites and enhancing the protected status of weka at those sites.

Pitt Island

The eradication of weka from Pitt Island is the Department's long-term objective. The establishment of further populations outside of the Chatham Islands (Objective 6) is thus the key management priority for buff weka.

Intended Outcomes and Outputs

- Annual reports on the progress of the Toatoa project.
- The development of advocacy material concerning the reduction or removal of the wallaby population on Kawau Island and resultant benefits to weka.
- The establishment of an additional North Island weka population before any rat eradication programme on Rakitu Island.
- Reports on the annual monitoring of the Mokoia Island population.
- Pest control operations which are undertaken on identified 'back-up' islands are designed not to reduce weka numbers below 50 pairs, or where this cannot be assured further secure populations are defined and protected.
- Contingency planning to protect/manage weka on Chatham Island in the event of serious decline.
- The establishment of a further buff weka population before an eradication programme is undertaken on Pitt Island.

Responsibility

East Coast Hawke's Bay Conservancy, Auckland Conservancy, Bay of Plenty Conservancy, Southland Conservancy and Wellington Conservancy.

OBJECTIVE 5

Identify the relative importance of different threats to weka populations (immediate and long-term), and design and implement management procedures to reduce these threats where possible.

Explanation

Section 4 listed the currently identified threats to weka. Any population is likely to be exposed to some of these threats, and its management will depend on identifying the most important ones and instigating procedures to address them. Some of the threats are immediate and could be dealt with by specific programmes (ferret control), but the recent disappearance of the populations in the Poverty Bay/ Gisborne and in the Bay of Islands, has stressed the importance of long term changes in the environment as important in determining how to manage weka populations, especially on the North and South Islands.

The first element of this objective may have to be dealt with on a population by population basis. The Toatoa project and the Tararua release can be considered management trials, and at both sites predation is the key threat being addressed. Land use issues are also being considered at the former. Enhanced information for all taxa, through increased monitoring of populations, should also assist in distinguishing the importance of different threats. For example: weka would be exposed to different suites of predators on island and mainland sites.
Recognising predation as one significant threat, there is a clear need for further research on means to control mustelids and means to monitor their populations.

Actions Required (by currently known threats)

1 To identify relative importance of different threats:

- Management trials targeting individual threats. Ideally a single threat should be tackled in comparable managed and un-managed sites.
- Research (ideally long term) focused on given ecosystems, documenting changes in weka populations and factors considered to influence them.
- A combination of these two approaches may be best in the long-term, however the former needs to be given priority in situations where significant populations of taxa are at risk – e.g., N.I. weka on mainland.

2 To design and implement management procedures to reduce threats (considered by threats identified in Section 4.):

Predation

- Implement predator control of core populations where required.
- Improve methods of controlling predators of weka, particularly ferrets and stoats.
- Improve methods of monitoring mustelids.
- Determine levels and extent of predator control needed to allow weka populations to recover.

Disease & parasites

There are three main areas for action:

1 Establish influence of disease/parasites on the dynamics of weka populations.

2 Prevent/minimise the transmission of disease/parasites from site to site when transferring birds.

3 Develop means to manage disease where it poses a significant threat to weka populations.

While it would be impractical to systematically sample all weka populations for the incidence of disease/parasites opportunities should be taken to determine causes of poor condition or death when they occur. These include sending off for necropsy all birds found dead when the cause of death is not obvious (curently done through Massey University). Prevention of the transmission of disease can be assisted through screening and quarantine procedures for use when transferring birds. However, some weka-specific disease management may be appropriate, and this needs to be derived from an assessment of all the documented cases of disease in weka. This is typically

included in a Husbandry Manual if, as is the case with weka, captive management is involved. This assessment might also lead to management options for 3/, as means exist to control most known disease-causing organisms. Recent losses of birds on Kawau Island included the presence of granuloma in the liver (Beauchamp, 1997b.) and it would be valuable to obtain baseline data on the frequency of this by necropsying any birds found dead, even if killed by vehicles/traps/etc.

Climate Change

A threat that should be monitored, as it is not practical to manage at the level of a recovery plan.

Land use changes

Advocate for changes in land use considered beneficial to weka and against changes considered harmful. Target advocacy at regional and district council plans, the Resource Management Act 1991 resource consent assessment process and towards the education of land owners and land managers.

Motor vehicles

Trial erection of signs warning of hazard to weka in key areas. Actioned in East Coast Conservancy

Pest animal control operations

Covered specifically in Objective 10.

Intended Outcomes and Outputs

- Cost effective predator control techniques developed that minimise the risk of trapping/killing weka.
- Better understanding by the public, landowners and local authorities of the relationship between their actions and native wildlife.
- Establishment of a protocol for the necroscopy of weka especially for those found dead after pest-animal control operations.

Responsibility

Tony Beauchamp; Department of Conservation protected species officers, researchers, managers and planners.

OBJECTIVE 6

Establish further populations as required, so that each taxon has at least one large (core) population on the mainland and three back-up island populations.

Explanation

The choice of four as the number of populations in this objective is to some extent arbitrary, but it is based partly on the IUCN criteria and partly on what is practical for the term of this plan. A secondary requirement is that back-up islands should be capable of supporting at least 50 pairs in habitats that enable weka to maintain

weights above 700g (males) and 600g (females). This has an arbitrary element to it, but it is based on population studies on Kawau and Kapiti Islands where it was seen that weka did not breed below these weights. In the case of Western 'Fiordland' and Stewart island weka, closely associating island groups can fullfill the requirements of a single back-up island.

The different taxa are assessed against this objective below. Priority is assigned in the following order: North Island, Stewart Island, Western weka 'Fiordland' (depending on survey results), buff weka, Western weka 'northern S. Island and W. Coast'.

The short-term priority is to maintain and strengthen mainland populations, with island populations as back-ups, which may themselves require management. Bell (1992) worked on the principal of three island populations per sub-species. Recent declines of North Island weka have indicated that the core populations should be large, widely spaced geographically, and in different climatic zones.

North Island weka

Mainland population

The one large remaining population is in the Toatoa- Matawai area and management is being undertaken to try and strengthen it.

Island populations

Kawau provides one relatively secure back-up (Appendix 6), Rakitu: the most stable island population with potential for increase as habitat improves. Although eradication of rats from there (or rats and weka) is being considered as a future option the weka recovery group will continue to push for the retention of Rakatu Island as an important weka consevation area. Mokoia: may meet population size/ weight requirements. Pakatoa: at c25ha. too small an island to meet back-up requirements. Whanganui: too early to say how many will establish given the proximity to the mainland but the population is likely to exceed 50 pairs.

Unfortunately Kawau, Pakatoa, Rakitu and to a large extent Whanganui Islands are all in the same bioclimatic zone which is (as been shown on Kawau Island) subject to occasional drought conditions.

Conclusion

Given the current uncertainty about the mainland population and some of the islands, consideration still needs to be given to establishing a further population in a protected area capable of supporting a large number of birds. Rakitu should currently be considered a backup island but Mokoia Island needs to be monitored to see if it achieves backup island status.

Western weka 'Northern South Island and West Coast'

Mainland population

Occupies a large range and is considered secure.

Island populations

There are more than 3 large island populations identified as secure and the following can be considered the best 'back-up's: D'Urville, Forsyth, Arapawa.

Conclusion

No new populations required at present.

Western weka 'Fiordland'

Mainland population

Probably secure, though declines have been noted and confirmation is required.

Island populations

More than three large islands/island groups hold secure weka populations, though all are within swimming range from the mainland for some predators. The following provide two good 'back-up's: Secretary/Bauga/Shelter Islands group. A further island group in Lakes Te Anau or Manapouri or Breaksea and Dusky Sounds needs to be identified following the proposed survey.

Conclusion

No new populations required at present.

Stewart Island weka

Mainland population

Stewart Island (174,600ha) population low with 15 pairs remaining in the Halfmoon Bay, Horseshoe Bay area. The population appears to be declining.

Island populations

The following two island groups have secure populations and are identified as 'back-up's at this point: Ulva/Bravo Islands, Pearl/Anchorage/Noble Islands, Ruggidies, Port Pegasus group, Big South Cape group. Further islands or island groups (e.g. Breaksea Group and Ruapuke) need to be checked.

Conclusion

Efforts to re-establish a secure population on Stewart Island should be considered in the future if and when predator/competitor control techniques are available that would allow this. In the effective absence of a 'mainland' population, it is considered appropriate to retain more than three island populations. This is achieved currently, subject to discussion with iwi on which Titi Islands might retain weka long-term. The retention of weka on some back-stop islands needs to be kept under review as proposals come forward for their removal or as proposals to eradicate other pest species come up where the eradication operation might have significant non target impacts on weka.

Buff weka

Mainland population

No secure population exists on the South Island mainland, however, Main Chatham can be considered as 'mainland' for the purposes of this plan, as it supports a substantial population over a very large area (90650ha).

Island populations

Pitt (6203ha) is also a very large island holding weka, however steps are already being taken to remove birds from reserves there and eradication from the whole island is a long-term objective of the Department of Conservation.

Conclusions

Significant populations of buff weka are only found on Main Chatham and Pitt and the latter population may be under long-term threat. A core population on the eastern South Island would provide more certainty as to the long term sustainability of the taxa. Island options exist off the east coast of the South Island and within some South Island lakes, and the restoration of weka to mainland sites should also be considered in the long term.

Actions Required (in priority order)

1 Have input into Conservancy island management discussions, to ensure that where pest control operations (other than for weka) are planned for a back-up weka population (e.g. Rakitu, Pitt) steps are taken to ensure the maintenance

of at least 50 pair of weka on the island (but allows for temporary captive management off-site) or a replacement population at another site has been established.

2 In consultation with Te Runanga o Ngai Tahu, establish two further populations of buff weka either on the eastern South Island or its associated islands.

3 In consultation with Te Runanga o Ngai Tahu, in the long-term, re-establish a secure population on Stewart Island.

4 Instigate monitoring of new populations as core populations (Objective 3).

5 Identify a further large island or mainland site for the translocation of N.I. weka.

Intended Outcomes and Outputs

- Sites selected in each area and fully assessed as to suitability.
- Transfer proposals prepared (using Appendix 8 as guide).
- Transfers approved and carried out.
- Monitoring established and need for further transfers to supplement populations identified.

Responsibility

Action 1
Weka recovery group to have input into Conservancy island planning where weka issues may arise.

Action 2
In consultation with Te Runanga o Ngai Tahu, Otago Conservancy to finalise planning for introduction to Stevensons Island.

Action 3
In consultation with Te Runanga o Ngai Tahu, Southland Conservancy to keep the current situation under review.

Action 4

Any Conservancy establishing a new population.

Action 5
North Island Conservancies.
Regional Offices to evaluate/approve relevant proposals. Transfers and monitoring to be carried out by Conservancies or Conservation Groups/Universities.

OBJECTIVE 7

Recognise and give effect to the kaitiakitanga of tangata whenua in relation to the conservation management of weka.

Explanation

Active management of weka populations has long been a conservation activity undertaken by Maori. Iwi transferred weka into areas where ecological conditions enabled the populations to multiply. This was done purposefully so that at some

future date the iwi could return to harvest the bird. This management tool has been recorded as being used on Chatham Island and the Titi Islands as a supplementary food source for Maori engaged in the traditional and seasonal activity of mutton-birding.

While the principle aim of conservation in these instances was for traditional use, fundamental to the exercise of kaitiakitanga is the objective of maintaining mauri, the life force that underpins the existence of all living things. The role of kaitiaki is supported by:

- the exercise of rangatiratanga;
- knowledge; and
- resources, being people, funding and equipment.

Actions Required

1 Kaupapa Atawhai Advisers, through their networks with kaumatua discuss and provide information as to how Maori wish to work alongside the recovery group/Department of Conservation towards the protection and recovery of weka.

2 At selected sites, identify the cultural and intellectual 'place' (significance) of weka to the tangata whenua in a way that enhances awareness of their values to both DOC staff and iwi/hapu.

3 Inform tangata whenua (and particularly Ngai Tahu in the context of taonga species management as set out in sections 277, 278 and 283 of the Ngai Tahu Claims settlement Act 1998) of specific project activity which enables positive and practical inter-action.

4 Agreement between DOC and iwi representatives is required where the removal of weka populations from Maori beneficially-owned Islands is contemplated. This relates particularly to Ngai Tahu in the context of taonga species management as set out in sections 277, 278 and 283 of the Ngai Tahu Claims settlement Act 1998.

5 The management of weka on islands significant to Maori and particularly when close to major population centres (such as Kapiti Island) should be enhanced through iwi Maori involvement in management actions (including pre and post-animal control operations).

6 Consult with iwi to define the type of weka related activity that the tangata whenua wish to participate in, and encourage iwi/hapu Maori to tender for weka related contract work where possible.

7 Assess the potential for re-introducing weka onto Maori lands or near places of special significance to Maori, and assist in the development of management plans where required.

Intended Outcomes and Outputs

- DOC staff and iwi/hapu aware of the value of weka to each other and weka projects are undertaken in partnership.
- Iwi/hapu input sought in DOC weka management initiatives.
- Iwi/hapu initiatives in weka conservation management assisted where possible by DOC through support in planning and implementation.

Responsibility

Department of Conservation conservancies, iwi authorities, runanga and marae committees, volunteer groups. Te Runanga o Ngai Tahu and its Papatipu Runanga (pursuant to the Re Runanga o Ngai Tahu Act 1996 and the Ngai Tahu Claims Settlement Act 1998).

OBJECTIVE 8

Recognise and promote community understanding of, and involvement in weka conservation.

Explanation

The North Island captive weka programme has shown that weka are amenable to captive management, and the programme has played a role in advocating weka conservation to the public. This is particularly important to weka as the bird's predatory and sometimes destructive behaviour has meant that attitudes towards the species are mixed. Subject to any requirements of departmental policy and guidelines on captive management some captive display of weka, conveying appropriate advocacy messages relating to weka conservation, would be in line with the goals and objectives of this plan. It is desirable that where weka are displayed that the local subspecies/form is used. However weka will not be brought into captivity from the wild for the sole purpose of allowing captive display for advocacy purposes.

There are significant interactions between people and weka in many parts of the birds' range. Some of these interactions are positive from the weka conservation standpoint: e.g. birds being bred in captivity and released, birds being transferred to new sites, birds being given supplementary food, and predators controlled to benefit birds. Others are negative from a weka conservation standpoint, ranging from situations where birds are being killed directly as a control operation, for food, or for sport, to others in which people's actions pose a threat to birds, e.g. clearance of forest or scrub, release of dogs, indiscriminate use of traps and poisons. There is thus a clear need for the public to be well-informed about weka conservation, as their actions can make a difference.

Advocacy has two aims in this case: firstly to encourage people to be involved in positive actions to benefit weka, and secondly, to encourage them to alter those practices that negatively impact on the birds e.g. unsafe trapping methods.

Actions required

1 Advocating appropriate landuses to support and enhance weka populations.

2 Advocate for active public involvement in the protection of weka particularly in such places as urban Gisborne, Kawau Island and Halfmoon Bay, Stewart Island where weka are a significant part of the local environment.

3 Liaise with the National Captive Management Co-ordinator to ensure that the there is conformity between current practice of those that hold captive weka for display purposes and this plan.

4 Advocate for the removal of Wallabies from Kawau Island.

5 Ensure the new dog control legislation is applied to key sites for weka.

6 Advocate new trapping protocols based on Landcare's research on weka-safe trap sets e.g. raised >70mm off the ground.

Intended Outcomes and Outputs

- Public and territorial agencies aware of their role in the protection of weka.
- Significant weka sites, particularly those on private land, appearing on schedules in district plans.
- Captive management practices support and consistant with the aims of this plan (refer Objective 10).
- Press releases, articles, fact sheets and newsletters produced informing the public and other agencies, such as territorial authorities, as to the status of weka and weka management programmes.
- DOC staff, and other land managers in weka areas, aware of weka safe trapping techniques (also see Objective 12).

Responsibility

Conservancy protection and advocacy staff, national captive weka management co-ordinator.

OBJECTIVE 9

Recognise that weka on islands may be a conservation problem, e.g. a threat to other protected species, and provide a process for involvement of the weka recovery group in decision-making regarding their future.

Explanation

In the past weka have been cited as having a detrimental impact on the population demography of petrels (Wilson 1959 pg. 58, Harper 1979), and other species including snipe (Miskelly 1987), penguins (St Clair & St Clair 1992) and parakeets (Taylor 1979). Predation by weka on South Island saddleback is reported in the S.I. saddleback recovery plan 1994. Weka have also been removed off other islands where no impact was cited (i.e. Allports, Veitch & Bell 1990), or where their potential impacts prevented island restoration or the introduction of other species (Peter Lawless, pers. comm.)

It is suggested that the weka recovery group should be consulted before a population of weka is intentionally removed from any island. Such consultation will not normally be necessary in situations where only one or two weka periodically reach an island that is being managed for other threatened species and they need to be removed urgently (e.g. some sites in the Marlborough Sounds).

The recovery group would provide an assessment of:

- the importance of that island population to the weka taxon concerned, or the need for prior identification of this taxon if the taxonomic status is uncertain
- the likelihood that weka are causing sufficient problem, and that their removal would be of significant benefit to other threatened species

- the availability of other options other than removal to manage the threat posed by weka to other threatened species

Note: The group will only be in a position to provide this third assessment once the results of current weka exclosure research on Kapiti Island is available (C. Miskelly, pers. comm.)

Actions required

1 Define the process to involve the weka recovery group in the planning, approval and adoption of weka control on islands

2 Ongoing research on managing weka and other threatened species together at the same site.

Intended Outcomes and Outputs

- 'Problem' weka populations are managed on islands in the interests of both the weka taxon and other threatened species, to the satisfaction of Conservancy managers and the weka recovery group.
- Timely resolution of issues on case by case basis.

Responsibility

Department of Conservation conservancies & regional offices, weka recovery group.

OBJECTIVE 10

Review the conservation benefit of holding weka in captivity, develop criteria to ensure that captive populations contribute to the achievement of the plan's goals, and manage populations according to those criteria.

Explanation

A successful voluntary breeding programme established in 1991 for the North Island weka has shown that captive breeding is a viable and valuable tool for weka conservation management. The objective of the NI weka captive breeding programme is " To establish from captive bred stock a self sustaining population of North island weka". Since the establishment of the programme a number of changes have taken place in our understanding of the status of the North Island (emphasising the desirability of the programme) and other subspecies of weka. The NI weka breeding programme has achieved its goals with the successful introduction of captive reared weka onto Whanganui Island, thereby establishing an possible backstop island for the NI taxon. The NI weka breeding group expects to finish the breeding programme when the Whanganui population reaches 50 pairs. There is a high level of public interest in breeding weka in captivity. While the status quo of weka captive management is satisfactory in the immediate short term, future captive management needs will be assessed. The views of iwi could be important in this process.

To rationalise weka captive management nationally, existing and future captive management programmes need to support and be consistent with the aims of this recovery plan. Relevant Objectives are 6, 10 and 11. A review of captive management will be undertaken to assist this process.

Actions required

1 Review national needs for captive management of weka relevant to advocacy, conservation management (breeding for re-introductions, holding during pest eradication programmes etc.) and wildlife health.

2 Develop a protocol for vetting, adding and deleting breeders and programmes in line with any departmental policy or guidelines on captive management.

Intended Outcomes and Outputs

- National needs for captive management known.
- Proticol available for ongoing captive management.

Responsibility

Weka recovery group co-ordinator, national captive management co-ordinator, weka captive management co-ordinator.

OBJECTIVE 11

Promote the re-introduction of weka to sites in their former range, where threats to their survival can be controlled (e.g., 'mainland islands'), as a significant component of New Zealand ecosystems.

Explanation

This objective covers situations in which the main aim of introducing weka is to restore as near as possible an 'original' ecosystem of which they were part, rather than Objective 6 which covered the need to establish new populations to ensure the long-term survival of different taxa. Objective 9 should clearly be actioned for its own value, noting in particular the importance of weka as a disperser of some native tree seeds, but it can also serve to further reduce the risk of loss of taxa and provide further opportunities for the public to see weka in the wild.

Implementation of this objective is expected to be difficult. Firstly one cannot yet design a management regime to establish and maintain weka in areas of former occupancy. Information from the work beginning at Toatoa and other initiatives, such as the Tararuas release and Karori Wildlife Sanctuary Project, may provide such a regime for some sites during the duration of this plan. Further research on threats to weka is required. Secondly, most ecosystem restoration projects such as the 'mainland islands' now being initiated involve programmes to control pests, particularly browsing and predatory mammals, and these can generally not be managed without causing significant losses to weka. The research identified in Objective 12 may provide the means to deal with this problem for the duration of the plan. Thirdly, there are questions about the point at which weka should be introduced, recognising that they may be a significant predator of invertebrates or lizards in the chosen habitats. One option is not to introduce weka until populations of these other target species are well established. The research currently being carried out on Kapiti (item 3/ in section 12) should allow assessment of the validity of this approach.

Actions required

1 Encourage those planning ecosystem restoration projects in areas formerly occupied by weka to include the species in their long-term planning.

2 Liaise with those involved with 1/ above to assess time frames and source populations of weka.

3 Provide those involved with 1/ above with information to assist the introduction of weka to their site.

Intended Outcomes and Outputs

- Ecosystem restoration project management plans include the (re-)introduction of weka as a long term aim.
- Restoration project managers are informed about weka availability, issues and requirements for the (re-)introduction of weka into their sites.

Responsibility

Conservancy protection staff, North Island weka breeding group, weka recovery group members.

OBJECTIVE 12

Promote the development of pest control and eradication techniques with reduced impacts on weka.

Explanation

Section 4 identified that weka are at threat from some pest control operations, either directly (as a result of ingesting poison while feeding, or getting caught in traps), or indirectly, through eating dead animals carrying poison. Techniques have been refined to reduce non-target impacts for some operations, e.g. aerial drops of 1080 poison to control possums. The means exist to reduce the impact on weka during trapping and hand-poisoning operations and it is current Departmental policy that all leg-hold traps are to be set 700mm off the ground but this may not be high enough to avoid weka. Significant impacts on weka are accepted as a unavoidable side-effect of aerial rodent eradication operations using Brodifacoum, and populations have been conserved where appropriate by the removal of some birds to temporary captivity or transfer to other sites (Kapiti, Mokoia rodent eradication operations). Ground-based operations using Brodifacoum appear to have reduced impact on weka (c.f. aerial operation on te Kakaho only 5% of a population of weka survived, with ground operation on Ulva where 25% of weka survived and numbers were high again after two years (A. Roberts, pers. comm.) The benefits of such operations to island ecosystems, and in the long-term to weka populations are so considerable that such losses are justified. However, ideally, a means should be found to conduct these operations with minimal loss of weka.

There may be an indirect detrimental impact of some pest control operations on weka through resulting changes in predator guilds (increasing the numbers of a predator with greater impact on weka) or switching of prey by remaining predators (increasing predation of weka as other prey no longer so readily available).

Actions required

1 Continue research on baits for carrying poisons that are not attractive to birds. Lynette Hartly of Waikato University has undertaken some bait trials using the weka held in captivity during the Mokoia Island rodent eradication (K. Owen, pers. comm.) Science & Research are funding a long-term Landcare Research study to investigate 'bird repellents for rodent baits (investigator: E. Spurr, finish date: June 1999).

2 "Provide advice to pest managers on techniques to avoid, remedy or mitigate adverse impacts of pest control operations on weka. Such advice may be provided as required or prepared and circulated proactively."

3 Continue research on ability of weka to reach poisoned baits and traps and means to 'weka-proof' ground based pest control operations while still ensuring operations are still viable (ie kill pest species). Science & Research Division funded a Landcare Research study to design 'possum trap sets which exclude kiwi' and which should also benefit weka (C. Thomson, B. Warburton and L Moran, 1996). This publication recommended trap sets be raised at least 700mm off the ground (although weka are able to jump to 1000mm off the ground in some cases).

4 Conduct research to test or develop rodenticides with reduced impacts on birds.

5 Conduct research on changing of predator guilds and prey switching following pest control operations, particularly possible impacts of possum control through poisoning on numbers of rats and mustelids.

Intended Outcomes and Outputs

- Reports produced and circulated on outcome of bait trials by Landcare Research.
- Baits developed that are not attractive to birds. Research undertaken to test or develop rodenticides with reduced impacts on birds.
- Pamphlet produced advocating the use of control techniques that are "weka friendly". DOC operations in weka areas undertaken using techniques designed to minimise impacts on weka. Agencies undertaking control operations outside of the Department are aware of those techniques that are "weka friendly" and apply them in areas where weka occur.
- Outcome of Landcare Research study on weka proofing ground operations known to managers in weka areas. Managers aware of the preference for using 1080 over ground trapping in weka areas.
- Research undertaken on changing of predator guilds and prey switching following pest control operations.

Responsibility

Science and Research, Conservancy protection staff, weka recovery group members. Public awareness staff.

12. Research priorities

The following are the key research needs for weka in priority order.

1 Taxonomy of weka – see Objective 1.

The most immediate priority and covered by research in progress at Massey University.

2 Threats to weka and management options to counter them – see Objective 5.

The second priority which will require significant work in the course of this plan. Some information will be obtained by close monitoring of existing management projects, at Toatoa and in the Tararua Range. Research with this objective should also be encouraged.

3 Impacts on other species – see Objective 8.

C. Miskelly has funding for a study on the 'impacts of weka on reptiles and macro-invertebrates' (completion date: June 2001) to be conducted using weka-proof exclosures on Kapiti Island.

4 Improved pest control techniques – see Objective 10.

Some research is ongoing and other studies have been published , e.g. designing weka-safe possum trapping techniques (Thomson et al., 1996). The implications of these methods on target species catch rates needs to be assessed in the field. In addition new research is needed for further items listed under Objective 12, including indirect effects through changes in predator guilds.

5 Reasons for population fluctuations, influence of climate, etc. – see Objective 5

Research on this topic is considered a lower priority at this stage for it is less likely to lead to management techniques that can be applied directly to weka populations. It would have more strategic, longer-term value.

6 Predator training for release – related to Objective 6.

This research is given a lower priority as it is considered experimental at this stage with no guarantee of practical results. Weka tend to run to the first available cover and then stop. Predator recognition training, especially with live dogs and mustelids (key predators of weka), has been suggested as possibly of benefit in getting weka to run beyond the first cover. Trials are being undertaken by Landcare Research.

13. Implementation schedule (critical path)

The life of this weka recovery plan will be for 5 years. The critical path prioritisation process is to be completed at the first weka recovery group meeting post publication of the weka recovery plan. The schedule will set out the order that different actions will occur – e.g. clarification of taxonomy will identify the different taxa for conservation (4, 5 or conceivably more) which in turn would determine core populations for future, etc. Timing and sizing the different actions will also be needed.

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Appendix 1: Morphometric distinction of subspecies

There is considerable confusion in the reported morphology of South Island and Stewart Island weka (Marchant and Higgins 1993). In general three distinct gradings can be recognised Buff/Grey eastern dry region, Black/Chestnut/Grey Fiordland and Grey/Chestnut North Westland and Marlborough Sounds. The Stewart Island populations show similar characteristics to Fiordland. Marchant and Higgins stated that the grey morphology intergrades with the chestnut morphology in Fiordland and Stewart "but both morphologies can be recognised at these localities".

D. J. James (in Marchant and Higgins 1993) ascribed individual weka of *G. a. australis* and *G. a. scotti* to one of three morphologies using museum material. However there may be problems with this material that are not acknowledged, e.g., some of the weka in the Museum of New Zealand are in non-definitive basic (subadult) plumage and the labeling of some weka in the Canterbury Museum is questionable (G. Tunnicliffe, pers. comm.) The status of Stewart Island weka is further confused by the transfer of Western or Buff weka from Southland to Slander (Wilson 1979) and other islands. The weka from Slander Island are labeled *G. a. scotti* in the Museum of New Zealand.

It is suggested that the morphologies of the southern populations have to be assessed in the field on a population by population basis. The museum specimens from Stewart Island itself should be used to assess the characteristics of the Stewart Island weka.

The following descriptions draw on experience with the Northern South Island populations and North Island and Chatham Island populations (Beauchamp, unpubl.), analysis of material from Museum specimens, and the descriptions in Oliver (1955), and Marchant and Higgins (1993). The table concentrates on the regions of the weka that provide distinction between morphologies (for tract positions see Beauchamp 1987).

FEATURE IN DEFINITIVE BASIS PLUMAGE

	NORTH ISLAND WEKA *G. a. greyi*	BUFF WEKA *G. a. hectori*	WESTERN WEKA *G. a. australis*	STEWART ISLAND WEKA *G. a. scotti*
Morphologies	Grey	Grey Buff	Grey (G), Chestnut (C), Black (B)	Grey (G?) Chestnut (C), Black (B)
Population locations	North Island and islands. No chestnut or black phases	Chatham Island, margin Te Anau?, Slander Island? Most grey buff with a few chestnut upper plumages.	Marlborough: grey and chestnut phases. Fiordland: grey, chestnut and black phases.	Islands near Stewart Island, grey, chestnut and black phases.

	NORTH ISLAND WEKA *G. a. greyi*	BUFF WEKA *G. a. hectori*	WESTERN WEKA *G. a. australis*	STEWART ISLAND WEKA *G. a. scotti*
Crown	Rufous-brown feather margin black centre.	Narrow yellow brown or rufous brown feather margin	Broad rufous brown edges (G) Red Brown feather margin (C), dark reddish brown (B)	Broad rufous brown edges (G) Red Brown feather margin (C), dark reddish brown (B)
Supercilium	Base of upper mandible to side of nape. Light grey with pale buff anterior, broadening posteriorally.	Upper lores to side of nape. Light grey with faint light brown.	Base of upper mandible to side of nape. Light grey with tinge pale buff lower margin in front of eye (G), Narrower than G, pale rufous brown front to obscure behind (C), None (B).	Base of upper mandible to side of nape. Light grey with tinge pale buff lower margin in front of eye (G), Narrower than G, pale rufous brown front to obscure behind (C), None (B).
Facial stripe	Narrow in front than behind eye, extends over eye, generally extending to neck.	Brown flecked black, less distinct posteriorally merging to neck.	Broader under eye than *greyi* but not over it. May not extend beyond ear merging into neck (G); as (G)	Broader under eye than *greyi* but not over it. May not extend beyond ear merging into neck (G); as (G)
Pt. interscapularis Pt. humeralis Pt antebranchialis (front between wings and minor wing coverts)	Rufous brown to rich brown (less rufous than crown)	**Narrow pale yellow & some olive or buff edges**	Rufous brown to light brown edges (G), Narrow rich brown to rufous brown edges (C), very narrow russet brown edges	Rufous brown to light brown edges (G), Narrow rich brown to rufous brown edges (C), very narrow russet brown edges
Pt. pectorialis (Breast band)	Dark reddish brown to brown. Some with olive to yellowish brown flecks and darker brown centres to feathers.	Brownish olive grading to straw yellow edges. Some with olive to buff flecks.	Yellow brown and brown to dark reddish brown. Some with darker brown indistinct centres. (G) & (C) Olive buff and yellow brown flecks on feathers of 60-70% (G) & less (C).	**Generally rich brown and rufous brown (G) & (C). Some with darker brown indistinct centres (G) & (C), *lack marginal flecks*. (G) & (C).**

	NORTH ISLAND WEKA *G. a. greyi*	BUFF WEKA *G. a. hectori*	WESTERN WEKA *G. a. australis*	STEWART ISLAND WEKA *G. a. scotti*
Pt. pelvica (back)	**Absent to broad olive brown to reddish brown band, many not clearly defined, can be mottled rich brown on edges and no spotting**	Present, brown with olive tinge spotted with black, yellow brown on edges, some with scattered olive and buff spots.	Present indistinct to pronounced. Brown grading rufous brown edges giving streaked appearance or brown with brown buff spots on webs giving mottled appearance (G), Rufous brown mottled black centres (C).	Always present and broad and pronounced in adults (G) & (C),
Pt sternalis (lower breast)	**Grey to brown grey**	**Light grey with olive buff**	**Brown grey (G), red brown similar to upper parts (C), dark olive brown faintly greyer than rest of body (B)**	**Brown grey (G), red brown similar to upper parts (C), dark olive brown faintly greyer than rest of body (B)**
Pt. femoralis	Feathers **never fully barred**, occasionally with olive flecks.	Boldly **barred black brown and pale brown.**	Variable browns **barred with black brown to dark brown** (G); Dark brown or rufous brown with **black bars** (C); Black with russet to rufous brown fringes to feathers, no bars (B)	Variable browns **barred with black brown to dark brown** (G); Dark brown or rufous brown with **black bars** (C); Black with russet to rufous brown fringes to feathers, no bars (B)
Retrice	**Brown margin, never barred**	**Black broadly edged and barred rufous brown at base and edged brown distally**	**Rufous brown with black centres barred black (G); Rufous brown black barred (C); Black with very narrow rufous or russet brown margin proximally (B)**	**Rufous brown with black centres barred black (G); Rufous brown black barred (C); Black with very narrow rufous or russet brown margin proximally (B)**
Under tail coverts	Black rachis and notching, notched rufous brown and rufous brown, with **distinct to no opposite or alternate barring** in black brown.	Rufous brown boldly barred black. (equal)	Rich brown to rufous brown barred with black (G); Rufous brown boldly barred black (equal) (C), Black narrowly and indistinct bar rufous brown (B).	Rich brown to rufous brown barred with black (G); Rufous brown boldly barred black (equal) (C), Black narrowly and indistinct bar rufous brown (B).

	NORTH ISLAND WEKA *G. a. greyi*	BUFF WEKA *G. a. hectori*	WESTERN WEKA *G. a. australis*	STEWART ISLAND WEKA *G. a. scotti*
Underwing greater and median coverts	Rufous brown to brown with or without grey black bars.	Grey black with rufous brown barring at tips of feathers.	Rufous brown with subdued black barring (G); Grey black tipped and distally barred rufous brown (C); Black tipped with russet brown (B).	Rufous brown with subdued black barring (G); Grey black tipped and distally barred rufous brown (C); Black tipped with russet brown (B).
Notching in minor wing overcoverts	Generally absent or very few feathers	Always present all or most feathers	Marlborough and West Coast: absent to pronounced. Fiordland: generally absent of few feathers	Generally absent or very few feathers

Appendix 2:
Islands and sub-specific status

ISLAND POPULATION	MORPHOLOGICAL FORM(S)	ISLAND SIZE (ha)	NUMBERS	DENSITY
NORTH ISLAND				
Kawau Island	greyi	2350	2000	0.85
Rakitu Island	greyi	350	135	0.38
Mokoia Island	greyi	120	100	1.2
Kapiti Island	greyi/australis	1760	3500	1.98
SOUTH ISLAND				
MARLBOROUGH SOUNDS				
D'Urville Island	australis			
Maud Island	australis			
Blumine Island	australis			
Arapawa Island	australis			
WEST COAST AND FIORDLAND				
Open Bays Islands	australis?			
Secretary Island	australis	8140	present	
Bauza Island	australis	480	present	
Nee Island	australis	6	present	
Shelter Islands	australis	22	unknown	
Crayfish Island	australis	10	present	
Breaksea Island	australis	170	not present	
Gilbert Islands	australis	61	present	
Entry Island	australis	38	not present	
Harbour Island	australis	51	present	
John Islands	australis	60	present	
Oke Island	australis	38	present	
Long Island	australis	1878	not present?	

ISLAND POPULATION	MORPHOLOGICAL FORM(S)	ISLAND SIZE (ha)	NUMBERS	DENSITY
Indian Island	australis	168	present	
Passage Islands (Chalky)	australis	176	present?	
Elizabeth Island	australis	75	present	
Fergusson Island	australis	15	present	
Fixed Head Island	australis	26	present	
Stop Island	australis	11	unknown	
Nomans Island	australis	23	present	
Many Islands	australis	16	present	
Petrel Islands	australis	30	present	
Parrot Island	australis	41	unknown	
Pigeon Island	australis	75	not present	
Curlew Island	australis	14	present	
Heron Island	australis	6	present	
Anchor Island	australis	1525	present	
Cooper Island	australis	1780	unknown	
Resolution Island	australis	20860	present	
Harbour Island	australis	9	present	
Great Island	australis	723	present	
Little Island	australis	27	present	
Passage Island (Dusky)	australis	17	present	
Chalky Island	australis	475	not present	
Cording islands	australis	40	present	
Weka Island	australis	108	present	
Coal Island	australis	1163	present	
Seal (East)	australis	15	unknown	
Seal (West)	australis	11	unknown	
Small Craft Harbour	australis	48	present	

ISLAND POPULATION	MORPHOLOGICAL FORM(S)	ISLAND SIZE (ha)	NUMBERS	DENSITY
Steep To (Pres.)	australis	61	present	
Styles	australis	14	unknown	
Unnamed (Resolution Isl.)	australis	29	present	
Unnamed (Dusky)	australis	47	present	
Unnamed (Resolution Isl.)	australis	13	present	
Unnamed (Dusky)	australis	16	unknown	
Utah	australis	6	present	
FOVEAUX STRAIT				
Slander Island	australis? hectori? scotti?	100	present	
Pig Island	australis	10	present	
Little Slander		8	not present	
Bird Island	australis?/hectori?/ scotti?	26	present	
Ruapuke Island	australis?/scotti? hectori?	1525	present	
Green Island	australis?/hectori?/ scotti?	81	present	
STEWART ISLAND				
Motunui Island	australis?/scotti	48	present	
Jacky Lee Island	australis?/scotti	30	present	
Bunker Islets	scotti	8	present	
Bench Island	scotti	120	present	
Herekopare	scotti	28	present	
Native Island	scotti	60	present	
Iona Island	scotti	10	present	
Crayfish Island	scotti	8	present	
Groper Island	scotti	8	present	
Tommy Island	scotti	15	present	

ISLAND POPULATION	MORPHOLOGICAL FORM(S)	ISLAND SIZE (ha)	NUMBERS	DENSITY
Goat Island	scotti	10	present	
Ulva Island	scotti	270	present	
Bravo Island	scotti	20	present	
Tia Island	scotti	23	present	
Horomamae Island	scotti	36	present	
Pearl Island	scotti	512	present	
Anchorage Island	scotti	150	present	
Nobel Island	scotti	173	present	
Ernest Island(outer)	scotti	11	present	
Poutama Island	scotti?	36	present	
Big South Cape Island	scotti?	939	present	
Soloman Island	scotti?	26	present	
Putauhinu Island	scotti	141	not present	
Tamaitemioka Island	Nil	20	not present	
Pohowaitai Island	Nil	45	not present	
Kaimohu Island	Nil	8	not present	
Big Moggy Island	scotti	86	present	
Boat Group	Nil	48	not present	
Ernest Island (Inner)	scotti	140	present?	
Rugged Islands	scotti	40.5	present	
Weka	scotti	7	present	
Rukawahakura (Breaksea)	scotti	24	present	
Takiwiwini	scotti	4	present	
Poutuatua	scotti	3	present	
Pomatakiarehua	scotti	4	present	
Kaihuka	scotti	11	present	
Wharepuaitaha	scotti	20	present	

ISLAND POPULATION	MORPHOLOGICAL FORM(S)	ISLAND SIZE (ha)	NUMBERS	DENSITY
Owens (Lords River)	scotti	36	present	
Pukeweka (SW Stewart)	scotti?	8	present	
Little Moggy (SW Stewart)	scotti	11	present	
Rat (SW Stewart)	scotti	13	present	
CHATHAM ISLANDS				
Chatham Island	hectori			
Pitt Island	hectori			

Appendix 3: Factors influencing weka population structure and dynamics

The weka's behavior, population structure, density and potential impact on the environment are related to food supply. Weka put on fat to tide them through limited periods of food shortage. Rapid changes in food availability happen when fruit supplies finish, droughts reduce the number and distribution of soil and litter dwelling invertebrates, wet weather reduces the availability of litter dwelling invertebrates and frost kills open pasture invertebrates. These factors can dramatically change food availability from a feast to a famine in days. As a result of these factors weka may be placed under sufficient stress to cause mass deaths of all age groups (Beauchamp 1987).

On Kapiti the condition status (weight for individual weka size) of territorial weka is generally better than non-territorial weka, but this can reverse during breeding and parental care. Egg laying can reduce female weights by 10 percent, and incubation and parental care can lead to 20-44% reductions in female weight and 32-42% reductions in male weight. Consequently breeding can place territorial adults at risk during periods of lowering food availability, and nest desertions are high when adults are declining in weight.

The position and duration of the breeding period is related to the weight/food cycle. Carroll (1963b) found that the breeding period in Gisborne followed weight increases associated with fruit and worms. On Kapiti successful breeding periods followed weight increases associated with possum carcass and fruit (hinau and fivefinger) availability, and during stable weight periods (above 800 grams for males, and 600 grams for females) when litter invertebrates were plentiful (Beauchamp 1987). In the Bay of Islands breeding followed weight increases associated with plentiful fruit and worms in spring, and crickets in late summer (Beauchamp, et al, 1998), and in the Marlborough Sounds breeding followed substantial weight rises after heavy falls of fruit (*Coprosma*, fivefinger) (Beauchamp 1987).

The number of young raised per pair per season varied from 0.03 to 1.00 on Kapiti (over 6 years, n = 28 to 30 pairs, Beauchamp 1987),1.40 to 2.13 in the Marlborough Sounds (over 2 years, n = 5 to 8 pairs, Beauchamp 1987a), 0.13 to 0.44 at Rakauroa (over 23 months, n = 9 pairs, Bramley 1994), and 1.37 to 3.45 (over 4 years, n = 8 to 16 pairs, Kawau Island Mansion House (Beauchamp, unpubl.) Year round breeding is found in situations where there is high food availability and a lack of density dependent controls (Wilkinson 1927, Wilkinson & Wilkinson 1952, Beauchamp, unpubl.) Such populations exist or have existed in Gisborne (Bramley 1994), Kapiti Island (Wilkinson 1927), and Takaka Nelson (Soper 1965). Under these conditions a pair of weka have raised 11 young (Gisborne, Blackburn observations in Stidolph 1955), 14 young (Bay of Islands, Beauchamp, unpubl.) and 9 young (Marlborough Sounds, Beauchamp 1987a) in a calendar year. Under low population pressure weka can breed at 5 months old (Graeme 1994).

Juveniles tend to leave the parental territories or home ranges at between 40 and 105 days, when the parents are no longer interested in feeding them, or they have developed independent feeding methods. Immediately after leaving the parental

territory they loose weight as they move into unknown areas and run into conflict with other weka, and a high proportion may die. On Kapiti Island and Mansion House young tend to concentrate in areas of high food availability and only set up home ranges after 3-6 months.

The strict territorial arrangement on Kapiti Island is not found on Kawau Island and in parts of the Gisborne population, and site fixed home ranges replace territories (Beauchamp, unpubl., Bramley 1994). When territoriality is found, the home ranges of single weka overlap more than one territory. Home ranges are stable including during periods of food stress, and single weka can shift their home range and survive. Weka enter the territorial population through displacement of a territory holder, replacement of a territory holder, or the formation of a pair who establish a territory at the boundaries of existing pairs. Territories are maintained throughout all conditions, and weka have been recovered dead from starvation in their territories. Displaced male territorial weka did not survive more than a few months on Kapiti, while displaced females could die or establish a home range near the former territory.

The above observations on sub-adult movement, territorial fixation, and the mass loss of weka under poor food availability conditions; may explain the sudden disappearance of past populations often attributed to diseases (Guthrie-Smith 1927). The past references to migrations appear to have been movements of weka into an area, and death of established weka in the former range, rather than mass movements of adult weka.

Population stability was also found in Gisborne in the 1950s-70s and in Rawhiti and Opua in the mid 1980s when the population centres expanded with sub-adult and/or non-site attached weka surviving with the site attached population, and consequently there was a pool of birds to replace site fixed weka. However after declines and wide fragmentation in both of these populations this capacity has not been re-established. Recruitment continues, but current research indicates that sub-adults either do not live long enough to establish and breed, or move from the population centre and are not available to replace adults (Beauchamp, unpubl., Bramley 1994). The other detrimental factors that North Island populations contend with (predators, greater climatic instability, mammalian food competitors and rabbit and possum poisoning operations) are probably more important when the populations are at lower density (Appendix 5). These factors also appear to reduce the average longevity of site attached adult weka to approximately 4 years. A similar situation is likely on the east coast of the South Island should populations become established there.

The most stable populations are those on islands, where predator and competitor interference with the birds and their food supplies is lower. Stability is also enhanced by the restrictions on movement of sub-adults which leads to a mixing of site fixed and non-site fixed weka and higher densities. In the absence of major climatic impacts on food supplies the longevity of individual weka can exceed 15 years, while the average population longevity of paired weka can exceed 6.5 years (Beauchamp 1987, unpubl.) Population stability occurs through replacement of territorial holders when positions occur, so that a potential breeding nucleus is maintained.

The Chatham Island Buff Weka population has a substantial potential maximum and a large area of habitat. Other populations are at high density but are more unstable. The populations on Slander Island and Nukuwaiata Island (prior to removal) have been at high density (>1 weka per ha) and have shown periods of poor condition (Wilson 1973, Miskelly unpubl.)

Appendix 4: Weka population status and census methodologies

This appendix is split into two parts:

1. The first section is population assessment using calls, observations of breeding and the recovery and analysis of dead weka. *This assessment is most applicable to general monitoring.*
2. The second section is individual assessment based on the capture and handling of a sample of live weka. *This assessment is best used for areas where intensive weka management is contemplated.*

The best assessment will be gained if both these assessments are used together. Only partial assessment will be possible if you rely on any one method.
All assessment should include as a minimum spacing call and mating call counts as they are the quickest method of assessing the number and distribution of paired and partner seeking adults.
Further information, and the reasons for the collection of each piece of information are given in brackets.

1. POPULATION ASSESSMENT

1.1 Postal Survey

This survey method is designed to assess the distribution of weka over a large area and is particularly useful in the rural situation. A pamphlet (pre-paid return post) is sent out through the rural mail system to landowners asking set questions regarding the number of weka they are aware of on their property or in their local area. It is useful to ask whether apparent numbers are increasing/decreasing over time periods of 1-5yrs and/or 10 years. Also whether weka chicks or signs of predation are regularly seen. Results are collated and mapped and a rough assessment of the general number, spread and populations trends of weka can be gained. The survey can be undertaken in conjunction with a news release in local papers to stimulate replies and raise awareness of weka issues. Contact for David King or Andrew Bassett, East Coast Hawke's Bay Conservancy for further details.

1.2 Call analysis method

Call analysis is based on spacing and mate finding calls in an area of known weka presence.

Call descriptions

Spacing call: This is the loud rising and repeated "coeet" call generally associated with weka. The call is given by single "home range" or "territory" holding birds, or as a duet by pairs. A call sequence usually lasts from 5 to 90 seconds, but choruses of many weka can last many minutes with pairs and single weka calling repetitively.

Duets can be given by pairs separated by over 400 metres. The male call is lower and slower than the females. Either sex can start or finish a duet.

Mate finding call: This call is similar to that of a pukeko "crowing call" (Marchant & Higgins 1993). It is repeated many times over periods from 1 to 100 minutes but can be given for much of 48 hours. It is as loud as the spacing call, and is given in response to spacing calls. It has only been heard on the North Island mainland.

Population composition

Survey time: The best time for survey differs throughout the country. It is dependent on the breeding and pair contact behaviour of weka. The best time is generally in from late January to June when the population is not breeding.

[One role of spacing calls is to bring the members of a pair into contact in the evening, to find a partner during parental care, and to define spatial relationships with other weka. Weka rearing young and in courtship are generally together in the evening and do not need to find each other. They may not be inclined to call unless immediate neighbours call. Weka that are incubating seldom call from the nest, and if they do the calls are very short or given near the nest when their partner returns (Beauchamp 1987).]

Time of day: Half an hour before sunset to half an hour after the sunset.

Number of census counts: Count at each site three times within 14 days, at the same time each year.

[Not all birds will call on the same night and counts should be conducted for each spot on at least two closely spaced nights.]

Weather conditions: The best conditions are; clear to partly cloudy (<4/8 cloud) sky, stable weather conditions, little wind (< 3 Beaufort scale), and little moon, i.e. when the moon is not rising within an hour of dusk.

[Weka calls rates are lower when there is a change in the weather within an hour of dusk, and when the twilight is extended by the moon.]

Survey method

1. Find a location that gives good coverage (knoll) and is not influenced by traffic, wind or other loud noise.
2. Define in daylight the area of converge on a map with a scale at least 50 mm per km^{-1}, where you are likely to be able to distinguish the exact location of a weka calling. On flat country this is likely to be within a km, while on hills and ridges this may be up to 2 km.
3. Align the map and plot all calling weka to location. Number each call location, and in the notes define the status of the callers (single male, single female, pair, bird giving mate finding call) at that location. Note the direction of weka which call but cannot be accurately plotted on the map but do not count repetitions.

   [The compass direction method used in Kiwi surveys is too cumbersome for weka in moderate densities of 0.1 ha^{-1}. However if there are only a few birds it may be useful to define these using compass bearings].
4. Note separately the time and number of calling weka and the number of repeat calls of each pair or single bird.

   [Calls are generally given in bursts of a number of weka and it is frequently easier to listen and in a space plot and note times].

5. On a subsequent evening note the micro-habitats that weka were calling from on a copy of the map.

   [Weka tend to call from the same roost areas each night, and from important areas of habitat like log piles, blackberry or gorse patches].

6. On the final evening of each count series a tape should be played to encourage a response. The number of additional weka heard should be noted and mapped.

   [Tapes are useful in getting weka a very low density to respond. Weka use voice for pair and neighbour identification. Tapes should be used with care and only to get population status information. A tape of birds of the general region should be used if possible, but definitely not a recording of a weka within the survey area as birds know the local calls and their own calls].

7. Interpretation: Spacing calls are given by adults with fixed home ranges and territories or by weka looking for partners. Weka less than five months old do not give spacing calls, and on Kapiti Island unpaired non-territorial weka up to three years old seldom gave this call (Beauchamp 1987). On Kawau Island young weka did not call until they paired.

   [Calls can be used to give ratios of paired and unpaired weka, and individual spacing call giving and mate finding call giving weka, and to provide an index of population composition changes. The addition of environmental status and environmental change will assist in assessing one of a number of factors that may be affecting weka].

1.3 Assessment of breeding and distribution

The information collected should include:

1. The duration of parental care.
2. The number of young hatched and fledged per pair.
3. Map the habitats being used for breeding and chick rearing on a scale no less than 50 mm per km.

   [This information will make the choice of the time of year for monitoring easier. The parental care duration and the clutch information will provide an indication of the food supplies available, and the habitat information will pin-point critical habitats than may need to be maintained to ensure survival of the population.

   Productivity on its own is a poor measure of population stability in weka populations, however the productivity relationship and adult age classes found in the population, can be used to form some conclusions on the stability of the population (see later)].

1.4 Road kills

We assume here that road kills are fresh and intact enough to be assessable.
The information collected should include:

1. Time and location: Record the date and time (hour, day, night) of death, the position (NZMS 260 map reference), and the immediate habitat on both sides of the road opposite the kill.

   [Weka use certain habitat types and routes as corridors and it is possible that

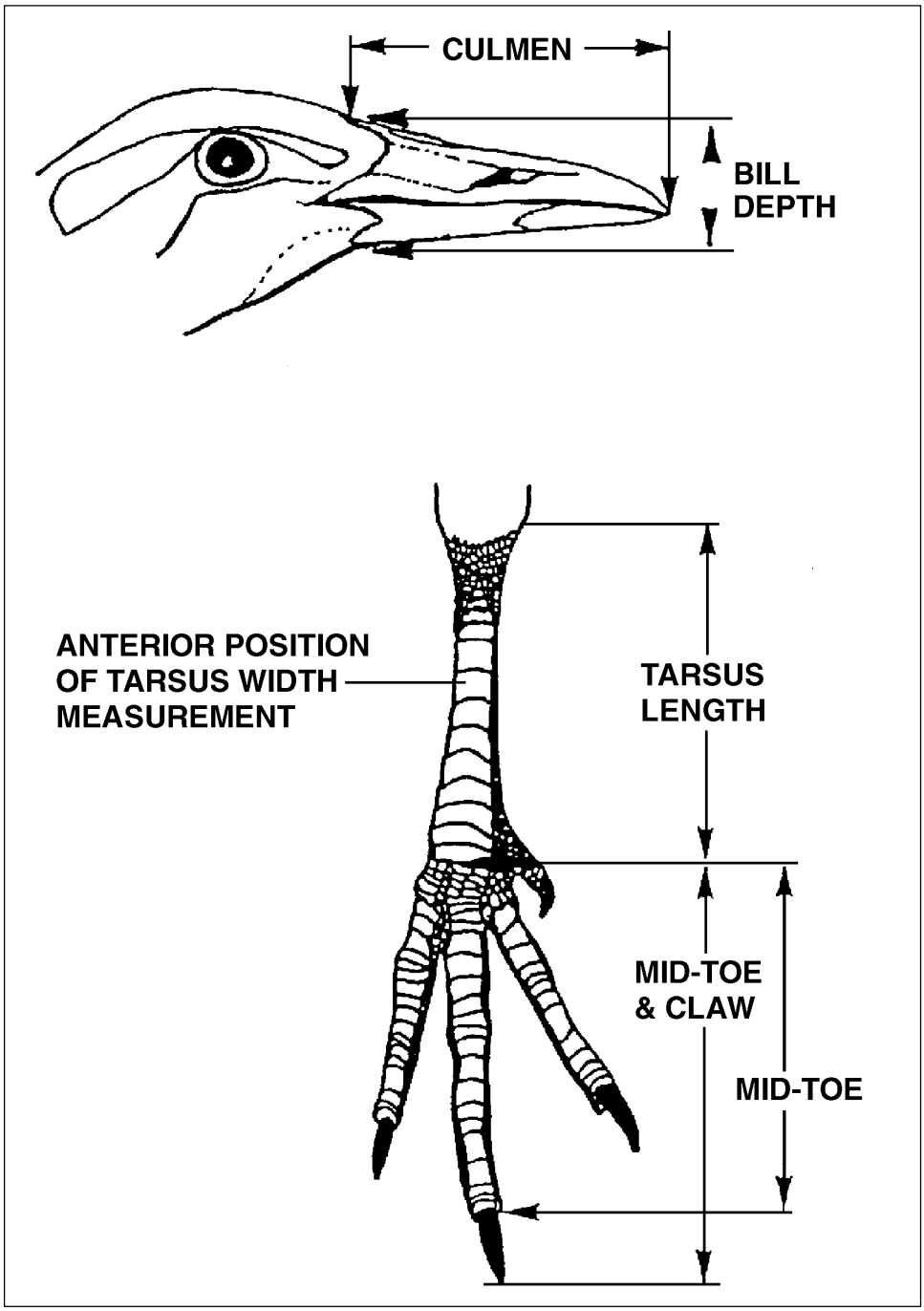
roadside vegetation management is influencing the location and number of road kills].

2. Sex and age: If possible take the measurements defined in Figure 1, and/or autopsy the weka to sex it. The measurements can be then used to develop discriminant functions for each population, and to decipher adult and sub-adults.

   If possible look at both wing and wing spurs and all claws and use Table 2, to assign the weka to an age class.

   [Use this information to assess the impact of road kills on the sub-adult and adult populations. This information will be more valuable if you know something about 'breeding and distribution' (above)].

FIGURE 1: THE LOCATIONS OF WEKA MEASUREMENTS



3. Autopsy: Freshly killed weka (warm when collected) can be used to gain weight information and assign measurements to sex. Autopsies also are likely to give important information on the overall disease and parasite status of a healthy population of weka (Appendix 5).

   Potentially important information includes:

   - Assessment of the liver for granulomas lesions.
   - Assessment of blood for viral antibodies.
   - Assessment of ectoparasite and endoparasite loading.

   Weka should be held cool but not frozen and dispatched to the laboratory using the procedure outlined in the draft Wildlife Health Management Guidelines (TSU 1996).

2 INDIVIDUAL WEKA ANALYSIS TO DEFINE POPULATION STRUCTURE

The following assessments should be based on the handling of at least 20, and preferably 50, randomly captured cage trapped individuals in a population, from a variety of habitats within the extent of the population. Trapping should ideally take place over a year to avoid biases associated with breeding, and fledging. Shorter duration trapping will have to take account of the breeding and call status of the population at the time.

This method is recommended for getting detailed information that is required for active management of a population.

The method involves sexing and ageing weka, taking the weights to define individual and population weight and condition profiles and looks at plumage to ascertain if there are stresses in weka development or during the moult period.

2.1 Age and sex

Age and sex structure can provide significant information on population health.

1. Take all the measurements indicated in Figure 1. Leg measurements should be taken with the weka suspended upside-down with a straight leg. The upper end of the tarsus measurement is taken from the most proximal notch from the body.

Culmen	Measure from the distal tip of the mandible to the proximal rhampotheca base of the mandible.
Bill depth	Measure the bill vertically in the line that would just strike the tip of the feathers that project onto the bill in front of the superciliary stripe. (This is a soft measurement and the bill should not be compressed).
Tarsus	Measure from the back of the leg at the distal notch (top of the tarsometatarsus as opposed to the top of the joint) to the front of the leg where the major anterior tarsometatarsal scales split at the distal end (base) of the mid toe. (The callipers should be inserted into the slot and the mid toe base should be treated as a soft end point)
Tarsus width	Measure horizontally, in the bill-tail line, from the middle of the third large anterior front facing distal tarsometatarsal scale to the back of the tarsus. (This is a soft measurement and the callipers should only just touch the leg).

[NOTE: Some of these measurements are not standard. They need to be taken from the positions indicated to use already developed discriminant functions].

2. Apply measurements to the appropriate discriminant function to sex weka.

[Discriminant functions may be population specific so sexing using a function developed from another population (i.e., in Table 1) in the same taxa must be used with caution and not over-ride common sense. If the sex can be defined by other behavioural attributes then these should be followed].

Table 1: DISCRIMINANT FUNCTIONS FOR SOME ADULT WEKA POPULATIONS

BILL DEPTH	CULMEN	TARSUS LENGTH	TARSUS WIDTH	CONSTANT	% ERROR OF MISCLASSIFICATION
CODFISH (*G. a. scotti*)					
0.289	0.132		1.178	-25.22	9
0.337		0.116	1.084	-25.48	9
	0.190	0.109	1.143	-28.17	8
		0.156	1.393	-24.36	9.9
KAPITI ISLAND (*G. a australis*) & (*G. a. greyi*)*					
0.783	0.0195		1.794	-35.61	0
0.732		0.0788	1.587	-37.51	0
	0.0322	0.182	1.936	-32.90	1.7
		0.190	1.966	-32.22	1.7
	0.123		2.305	-31.07	3.4*
MARLBOROUGH SOUNDS (*G. a. australis*)					
0.0934	0.390		0.930	-33.62	0
0.0904		0.360	0.894	-33.95	0
	0.0116	0.253	0.971	-27.34	0
		0.258	0.982	-27.19	0

Example for a Marlborough Sounds captured weka where there are the culmen and tarsus length and tarsus width:

*function: (0.0116*culmen) + (0.253*tarsus length) + (0.971*tarsus width) - 27.34 = -ve or +ve value*

The discriminant functions in Table 1 should give a negative value for females and positive value for males. However I recommend that you use all the functions in each group to make sure of sex. The percentage of misclassification give the mis-sexing potential of each function based on the data that was used to design and test the function.

3. Inspect the wing spur of the weka to define the age class (Table 2).

[Note: these categories are not applicable to weka kept in captivity or on hard surfaces because of unnatural wear of the spur].

TABLE 2: AGE CATEGORIES OF WEKA*

CATEGORY 1: Weka <1 year old.	Spur needle sharp recurved backwards and approximately 4 - 6 mm long
CATEGORY 2: Weka 1- 3 years old	Spur longer at 6 - 12 mm, pointed but with the recurved needle sharp section abraded.
CATEGORY 3: Weka 3 - 15 years old	Spur at >10 - 14 mm, blunt tip, grey or dark grey brown.
CATEGORY 4: Weka >7- 15 years old	Spur reduced <10 mm blunt, blunt usually grey.
CATEGORY 5: Weka >7 - 15. years old	Spur reduced to 2 - 5 mm, very blunt usually grey.
CATEGORY 6: Weka >6 - 15 years old	Spur long and up to 20 mm, cork screwed.

** Based on information collected on Kapiti and Kawau Islands.*

2. 2 Weight and condition

Weight (fat and protein reserves) explains a high proportion of the variability in size of weka in all populations (Beauchamp 1987, 1987a, see data in Marchant and Higgins 1993). Weight information is important in assessing how well a weka population is coping its environment. An assessment of food availability and stress in the previous January and February can also be gauged from the presence or absence of clear bars on the remiges (large wing feathers).

1. Weka should be weighed each capture to at most ±10 g. Note other adults and/or young at the capture site.

   [The weights of male weka vary between 520 - 1650 g, and females between 350 - 1050 g (Beauchamp, all populations data). Males are at immediate risk of death if their weight are below 580 g and females if below 450 g. However individual weka undertaking parental care can reach such weights. Populations are under stress if the median weight of adult females is < 600 g and the median weight of adult males is <780 grams (Beauchamp 1987)].

Growth bars and plumage

2. Growth bars should be looked for on the remiges (large wing feathers) and the location from the tip on the feather noted.

   [Growth bars show up as a clear stress lines or as brittle regions on feathers. Their presence indicate periods during development or moult when the bird suffered from food shortage or other stress. They are useful in assessing population stress].

2.3 Population assessment using individual analysis sample and information gathered on breeding

Long standing populations can be split into four groups. Those with:

1. Restricted breeding periods, relatively high numbers of weka in older age groups and moderate to low weights.

[Likely on islands with territorial populations controlled by density dependent factors. The structure favours older weka and loss of most young because they cannot find space (i.e., Kapiti Island pre 1996)].

2. Restricted breeding periods, low numbers of weka in older age groups and relatively low weights.

   [Indicate populations that have periodic instability due to environmental or internal population demographic factors. (i.e. Kawau Island)].

3. Year round breeding, with most weka younger than 6 years and moderate to high weights.

   [Found where there has been a major loss and a population recovery, or where there is high population turnover associated with high productivity (i.e. Chatham Island)].

4. Year round breeding but few, and generally paired, first year weka with moderate to high weights.

   [Generally found on the North Island mainland when the population is in trouble].

Appendix 5: The factors associated with (implicated in) weka declines or losses

STATED CAUSE OF DEATH	AREA OF DEATH OR DECLINE	EVIDENCE TO SUPPORT STATEMENTS
DISEASE	Northland	Rapid decline (McKenzie 1971)
	Kapiti Island	Shivering by chicks in 1978 (Peter Daniel, pers. comm.)
	Opua	Death of females with fungal disease (Beauchamp, unpubl.)
	Karangahake	Aviary young with avian pox (Beauchamp, unpubl.)
PREDATION		
Dog	Opua	Some losses (Beauchamp, unpubl.)
	Karangahake	Many losses (Graeme 1994)
	Rawhiti	Some losses (Isobel Robertson, pers. comm.)
	Wanganui	
	Waitakere	Distribution in 1880s-1905 (Annabell 1922
Cat	Stewart Island	
Stoat	Western South Island	Seen chasing weka (Macmillan 1990)
	Parekura Bay	Inference based on predator ratio (Bell 1992)
	Paihia	Major decline (Harper 1896)
	Orongorongo Valley	Some losses (Beauchamp 1995)
Ferret	North and South Islands	Inference (Demming in Stidolph 1947)
Hawk	Rakauroa	Inference (Phillips 1963)
	Kawau Island	Associated with spread (Myres 1923)
		Some losses (Bramley 1994)
		Some losses (Beauchamp, unpubl.)
BI-KILL THROUGH POISONING	Waipu 1936-40	Timing of decline (Gee 1956)
	Waipu 1987	Timing of decline (Beauchamp, unpubl.)
Rabbits	South Wairarapa	Timing of decline on farmland (McLean, cited Stidolph 1971)
	Canterbury & Otago	
	Rawhiti, Parekura Bay and	Timing of decline (Harper 1946)
Birds	Kawau Island	Coincided with decline (Beauchamp, 1988), deaths in Timms traps (Beauchamp, unpubl.)
Possums	Double Cove, Marlborough Sounds	Found dead on cyanide lines (Beauchamp 1987a)
Snail	Karangahake	One death (Beauchamp, unpubl.)
MIGRATION	Tutira Hawke's Bay	Disappearance (Guthrie Smith 1927)
	Wanganui	Appearance (Annabell 1922)
	Manawatu	Appearance (Buller 1898)
	Lower Hutt	Appearance (Myres 1923)
STARVATION	Kapiti Island	Population study adults and young (Beauchamp 1987)
	Kawau Island	Loss of young (Beauchamp, unpubl.)
	Marlborough Sounds	Loss of young (Beauchamp, unpubl.)
	Nelson	Loss of released population due to inability to release at sufficient weight (Beauchamp, unpubl.)

STATED CAUSE OF DEATH	AREA OF DEATH OR DECLINE	EVIDENCE TO SUPPORT STATEMENTS
DROUGHT	Paeroa, Kaipara Gisborne Opua and Rawhiti	Past climatic analysis and probability (Beauchamp, unpubl.) Coincided with losses in 1982-84 and 1986 (Ward *et al.* 1992). Coincided with mass declines (Beauchamp, unpubl.)
FLOODS AND WET WEATHER	Motu Karangahake	Coincided with decline (Beauchamp unpubl). Drowning in culvert (Beauchamp, unpubl.)
VEHICLE TRAFFIC	Rakauroa Parekura Bay & Opua	Found dead (Bramley 1994) Found dead (Beauchamp, unpubl.)
TICKS AND PARASITES	Waipu Kapiti Island	Weka tick infested (Carroll 1963a) Ticks removed off one weka in poor condition (Beauchamp, unpubl).
HABITAT DESTRUCTION	Gisborne Karangahake Kawau Island	Motu habitat changes to 1995 (Beauchamp, unpubl) Habitat destruction (Bramley 1994) Pair movements (Beauchamp, unpubl.) Poor native fruit availability and leaf litter development due to wallabies (Beauchamp, unpubl).
FIGHTING	Opua & Kapiti Island	Deaths after fights (Beauchamp 1987)

Appendix 6: Stability of the Kawau Island population

It has been suggested that because of their impact as a predator of other native fauna, weka are best retained on highly modified islands. Kawau Island is an example of such an island but though it retains a high weka population, the largest North Island weka populantion extant, it shows that there are a number of reasons why highly modified islands may not be the most suitable for weka. I summarise these points below, and provide data from a 5-year ongoing study (begun in 1991) in the Mansion House area of Kawau Island to support some of the points.

1. PREVIOUS POPULATION EXTINCTIONS

These has been one earlier population on Kawau Island this century. It was introduced in 1863 (Buller 1892) and apparently died out some time before the 1920's. During this time Kawau Island had more extensive grasslands, and potentially better habitat for weka.

2. FOOD AVAILABILITY

The mean number of invertebrates in weka faeces ranged from 3.5 to 44.4 recognisable food items (median 19.93, 6.2 items). Weka depend on a few major foods. Sub soil sources like worms are important, but are lost during summer droughts. The native bee (*Leioproctus fulvescens*), and fruits of weeds (*Chrysanthemoides monilifera*, *Lantana* spp., arum lilies, Jerusalem cherry, and tree privet) are important in summer and early autumn. Shoot material is more important in winter. The failure of one item could have significant repercussions for the population.

The density of weka (0.65 per ha) and the behaviour of adults when without chicks suggests that they try to gain food in the most dense habitat. The exact period of activity each day needs to be established with telemetry, but appears typical of that found in other populations (Bramley 1994). Generally adults do not use the grasslands at Mansion house except when they have young. The day visitors and the Department of Conservation tea rooms provide significant food supplies and weka travel up to 500 metres to these places to get food for young. These movements would be unlikely if there was sufficient local foods for young in the home range.

3. THE WEIGHT CYCLE OF WEKA

Weka are generally heaviest in late autumn and lightest in late summer. Females can fluctuate between 500 and 850 g and males 700 to 1200 g each year. The weights of adult weka on Kawau Island generally exceed those on Kapiti Island (Beauchamp 1987), but are significantly lower than those on the South Island (Beauchamp 1987a). However, poor food availability and weight losses during breeding and a failure of the autumn food supplies can place weka on Kapiti and Kawau Islands in a vulnerable position. On Kawau Island the lowest weights at the end of the breed season were 450g for females, and 710g for males (within the critical region – Appendix 3, Beauchamp 1987). Adult weka were recovered newly dead at this time.

On Kawau sub-adults are generally heavier than adults in summer, but can also be affected by poor summer food supplies. The weights of sub-adult weka during dry conditions in January 1999 were also in this critical region, and significant losses were expected within weeks on Kawau Island. This occurred in the Mansion House study area in March 1999.

4. MORPHOLOGICAL STRESS MARKS IN WEKA PLUMAGE

During the study eleven young weka have shown considerable stress barring on plumage. The barring has shown stress at between 10 and 14 days on 3 young and between 25 and 50 days in others. It has been most marked in young birds that were deserted by their parents in drought conditions, and who established near the tea rooms at Mansion House. If this food supply had not been available these young birds would have died.

5. CONDITION AND SUB ADULT MOVEMENTS

The number and condition (by weight) of young moving into the Mansion House area from elsewhere can be used as an index of survivorship of young raised in surrounding areas. In all seasons the young moving into the Mansion House area were lighter than the fledging weights of young raised in the area.

6. DISEASE FACTOR

In June 1993 2 young weka were found collapsed but otherwise alert, and were considered to have injured themselves.They subsequently died, cause unknown. In March and April 1996 young weka were found with similar symptoms throughout the Mansion House Reserve. During that 6 week period 75% of young and at least 25%, and potentially 40%, of adults died of an unknown disease factor. This factor killed heavy and well fed young and adult weka. The cause of these deaths is unknown but could be a virus. Similar deaths have not been recorded during 18 years of population studies throughout North Island, South Island and the Chathams, but disease is suspected in some weka population declines.

Appendix 7: Captive breeding and release methodologies

The following information is taken from the breeding and release programme for North Island weka at Karangahake. That programme was responsible for good initial site attachment of released weka (when it was assessed in mid April 1995). This methodology assumes that site evaluation has been carried out (Appendix 8).
Weka have are more difficult to establish and breed in aviaries than was previously envisaged, and the method suggested by Bell (1992), and Ward *et al.* (1992) has been modified to ensure that time and birds are not wasted. A Husbandry Manual was drafted by the Royal Forest and Bird Protection Society (Hanbury 1996).

1. CAPTIVE BREEDING

Captive breeding should only be attempted where regular care and observations of the weka are possible.
Captive breeding, and the removal of young from breeding aviaries, should follow the procedures laid out in the Husbandry Manual.

2. MAINLAND SITES

2.1. Site preparation

Sites may need to be prepared by:

- Control of the possum and rabbit densities, before the programme begins, to reduce the potential increase of predators and to reduce negative impacts on weka from later predator reduction campaigns.
- Signs placed to exclude or control dogs, and the speed of traffic.
- Provision of areas of high cover (including the fencing of swampy areas and piles of logs), including re-vegetation of corridors between major areas of habitat.
- Erection of aviaries, partly planted with cover and provided with tunnels and piles of logs and branches for cover, nest sites and compost areas. The aviaries should be in sunny locations (for details see the Husbandry Manual, Hanbury 1996)
- Planting dense cover near (not immediately beside) the aviary (Ferns like *Paesia scaberula*, or other dense low cover).
- Water reticulated to each aviary.
- Each sites should have at least 3 aviaries capable of holding a breeding pair, and two additional aviaries for holding young weka before release.

2.2. Liberation

Weka should be accumulated in holding aviaries and released after 30 days and at 10 or more weeks old. Releases should preferably be regular and in groups and be controlled to provide a continuous flow of weka

2.3. Monitoring

At least 10 percent of the weka should be fitted with transmitters with break thread harnesses to assess any factors causing initial mortality, and the likely impact of these factors in the long term. Harnesses should be placed on weka a few days before release to make sure that the harness is not causing problems.
Sites should be selected for call monitoring (Appendix 8) and should be monitored a minimum of quarterly, where there is infrequent telemetry or trapping follow-up, and six monthly where there is intensive monitoring.
All weka should be sexed, weighed and banded before release. Weka should only be colour banded at sites where sight recovery is possible, or where monitoring is intensive.

3. ISLANDS

It has been suggested that direct release of weka onto an island is sufficient to establish a population. However it is evident from the similarity in plumage of weka on some islands (Allports Island (founder number unknown), Rakitu Island (release of 13 weka)) that these populations were probably founded from a very small proportion of the individuals released.
Once the island is cleared for release of weka the following release strategy is suggested.

1. Catch or breed 30 young weka, or weka in age categories 1-3 (Appendix 2). Assess and record morphology (Appendix 1). Any sex bias should favour females. Younger weka in category one, will be easier to hold in aviaries than a mix of category 1-3 birds.
2. Preferably transfer the weka to the island and hold in release aviaries. Weka should be held in groups of no more than 6 birds, and the groups should be of the same sex. Release colour banded individuals when weights are above critical limits (Appendix 6).
3. If a hard release (release without holding) is contemplated then weka older than 5 months should be used.
4. Monitor the population to assess any founder effect (morphology, and breeding) and assess whether further weka should be released.

The release strategy should be modified if weka are taken from an area near the release site to reduce any homing instinct. Under these circumstances aviaries should be established and weka held for at least 4 weeks.

4. TIME FRAME

Each programme will probably need to operate for a minimum of five years. The programmes should be assessed annually using relevant performance measures.

Appendix 8: Habitat considerations for weka

MAINLAND RELEASES

Weka were not found on many offshore islands in 1880, and were scattered on the main islands. However on the main islands the density and distribution of previously used foods and habitats have been reduced or modified by man, browsing mammals and introduced birds. Other potentially important foods and habitats have been established. Current and future habitat changes have to be assessed for all potential liberation sites.
These include the following areas:

1. Current land management
2. Future land management
3. Introduced animal density control
4. Public attitudes and access
5. Climate and soil stability
6. Food sources
7. Threatened species

Current land management

- Current land use in urban and rural areas.
- Current permitted and conditionally approved land use provisions in the district plan (forestry, market gardening, dog kennels, pig farming, poultry farming, ferret farming).
- Current location and status of public lands.
- Management plans for public lands, especially Department of Conservation lands.
- Land management practices by land owners and regional and district councils for weed and riparian strip control, and the conservation of indigenous vegetation and habitats.
- Current status of pest vertebrates, invertebrates and weeds and their control.
- Current age and understorey of any plantations and their likely management in the near future.
- Current access provisions and riparian rights.

Future land management

- Permitted and conditionally approved activities that may alter the area (Soil and Water Plan, Coastal Regional Plans, District plans).
- Iwi and Rununga Waitangi Tribunal claims to public lands.

- Potential for subdivision, block size and location of the most likely subdivisions.
- Potential for major changes to dense cover though clearance or planting (forestry, crops).
- Potential for changes in land use towards crop farming or horticulture, area and likely location.
- Potential loss or development of corridors and existing dense vegetation.
- Potential future land access problems.
- Potential changes to roads, road seal and road speeds.

Introduced animal density and control

- The current number of dogs and their control (e.g.,. if possible map the distribution of fast small dogs capable of killing weka).
- Current introduced mammal densities (possums, rabbits, ferrets, stoats, rat species, goats, deer species, and wallaby species).
- Incidence of pig hunting and general feral dog problems.
- Incidence of pheasant and duck shooting.
- Possum and rabbit control operations undertaken by territorial authorities and private land owners, their frequency and potential conflicts.
- Potential density and composition changes to the introduced mammal fauna.

Public attitudes and access

- Local Iwi and Rununga consulted about spiritual aspects of the land and the release.
- Relevant scientists consulted and attitudes assessed.
- Conservation and other groups consulted and attitudes.
- Regional council pest management staff consulted (plant and animal control) and potential problems and conflicts.
- Public attitude to weka and the need for information, public meetings, etc.
- Access arrangements and opposition to access to land.
- Degree of community involvement offered and requested.

Climate and soil stability

- The climate should be moist, with a low potential for more than 60 days between rainfalls of less than 20 mm in 24 hours.
- Incidence of drought and flooding including analysis of up to 50 years of rainfall information at nearby rainfall stations.
- Incidence of slippage, and colonising plants.
- Permanent water distribution.

Food sources

Food supply for weka in the various habitats. An area with good and frequent supplies of the following types of foods, with one or a number of these foods available in all weather conditions especially droughts and after heavy rain.

FRUIT	
>10mm Native Fruit	Hinau, pigeonwood and fuchsia.
<10mm Native Fruit	*Coprosma* spp., *Macropiper excelsum*, *Pseudopanax* spp., *Neopanax* spp, *Pennantia corymbosa*, *Melicytus* spp., *Podocarpus* spp., *Dacrydium* spp. *Cyathodes* spp.,
Introduced Weed Fruits	Nightshades, blackberry, tree privet, Gooseberries, *Cottoneaster* sp., cereal crops (corn), lilies, *Chrysanthemoides monilifera*, *Lantana* spp. Inkweed.
INVERTEBRATES	
>10mm Native Invertebrates	Amphipods, wetas, crickets, Carabidae, click beetles, Scarabaeidae, spiders, longhorn beetles, worms, spiders, harvestmen, pseudoscorpions, snails, native bees.
<10mm Native Invertebrates	Amphipods, nests of typhulid and other larvae
>10mm Introduced Invertebrates	Crickets, worms, isopods, snails,

Threatened species

Weka interact with other species and processes in the environment and can have a marked effect on some, particularly threatened species. Impacts can be separated into **direct** (food item, change succession, erosion) and **indirect** (micro habitat disturbance) and **beneficial** (i.e. reduction of competition, seed distribution, reduction in standing food crop and rat numbers) or **not beneficial.**

1. The sites of impact should be identified and the potential weka densities at these sites identified,
2. A risk analysis should be carried out for each threatened species, stating the potential nature and time of impact and the known or assumed risks envisaged. Such an assessment should identify the people and organisations (i.e. DOC, university, OSNZ, SRARNZ, Maori) consulted, areas where information is lacking, and any need and time scale to gain the critical information. In addition a mechanism of monitoring the status of potentially threatened species should be identified.
3. Other aspects of the habitat that may bring weka into conflict with biota that are usually safe from impact should be identified. Such areas include rocky shore biota when weka reach high density, vertebrates using the same water holes etc.
4. The assessment should identify methods of dealing with potential threats to enable weka and other threatened biota to share the site (i.e. electric fence exclusion).

The above information should be used to provide the following:

1. An assessment of the habitat as suitable or unsuitable for weka.
2. If the area is suitable:
    1. An assessment of the likely pattern of establishment.

2. Any critical areas that require further in depth assessment.
3. The critical habitats and areas that may need protection from weka.
4. Any short and long term land management or predator problems.

ISLAND RELEASES

A series of factors need consideration which are similar to mainland releases but the emphasis differs.

Island size and stability

Weka should not be placed on islands not capable of holding less than 50 pairs. Releases should aim at producing stable populations. The most stable populations will form on islands which are damp throughout the year and maintain high leaf litter invertebrate and food densities.

The density of weka that the island can hold and the social structure that forms is dependent on the size of the island, the distribution of food and water resources. Weka require water throughout the year, and water should be well distributed, and preferably not stagnant to get optimal distribution and density. Water will be taken from leaves in mist zones and after rain so creekless parts of islands in moist areas may still be good habitat.

One of the best indicators of stability is the density and size of invertebrates in leaf litter. Leaf litter should be assessed by scrapping areas of damp, but not wet litter and looking for invertebrates and amphipods greater than 5 mm long, and numbers of small amphipods. If invertebrates are not plentiful then drought and rat densities may need more investigation. In addition, objects heavier than 1 kg should be moved to locate large and nocturnal invertebrates. These areas will be refugia from weka.

In stable populations the optimum density of adults attainable should be estimated at 1.0 weka per ha. In less stable populations on drier islands the density of adults attainable should be estimated at 0.5 weka per ha.

Land management

Weka do not require pristine islands but will be better catered for if there is some older bush with preferred fruit trees (see above). Stocked islands are also very desirable as long as there is well distributed (in each ha) low cover (Buildings, shrubland, bush, log piles, rank grassland, swamp margins) and they are moist and can offer good worm resources. This may need to be checked. The best islands will be those without stock disturbance in these cover areas and where stock disturbance in other regions of forest and shrubland areas is minimal. Land management needs to enhance cover and water and a mosaic of habitats. Habitats like gorse and blackberry may be important in islands left to regenerate.

In addition to the lands the better islands will maintain beach with high amounts of seaweed and waterline invertebrates. These are important if the island is subject to periodic drought.

Introduced animal density control

Weka will survive on rat infested islands, but the impact of rats on the food supply may need to be evaluated (see above Island size and stability). Weka should not be placed on islands where rat, possum, cat or other mammal control is contemplated, unless weka are to be subsequently removed or held in safe locations during the control operations.

Public access

Weka will benefit from being in areas with public access, however dogs must be controlled and preferably excluded. Residents should be well informed about the habits of weka before weka are released onto islands. Information should be handed out on how to live with weka, so that weka do not become an unwelcome nuisance.

Climate

Weka populations in each taxa should preferably be situated in different climatic zones, so that periodic saturation and drought is less likely to place all populations under stress at similar times. Rainfall records should be assessed.

Other species

Experts on taxa that are likely to be weka foods (sub-soil and surface invertebrates, reptiles, birds, marine littoral invertebrates, snails and chiton) should be consulted about each island, and if there is doubt about the species presence, distribution and density, this should be assessed in a systematic way by the expert or under his/her guidance. Weka should not be placed on islands which have important breeding populations of ground nesting petrels, banded rail, spotless crake, reef heron or variable oystercatchers. Weka should not be placed on islands with threatened invertebrates or reptiles unless there is to be exclusion fencing or some other method to protect important habitats.

Appendix 9: Published Recovery Plans

RECOVERY PLAN	#	COST	YEAR APPROVED
Weka	29	($15)	Approved 1999
Pittosporum patulum	28	($15)	Approved 1999
Cyclodina skinks	27	($15)	Approved 1999
Coastal cress	26	($15)	Approved 1999
Threatened weta	25	($15)	Approved 1998
Striped skink	24	($15)	Approved 1998
Fairy tern	23	($15)	Approved 1997
Blue duck	22	($15)	Approved 1997
Kakapo	21	($15)	Approved 1996
Stitchbird	20	($15)	Approved 1996
Brown teal	19	($15)	Approved 1996
Native frogs	18	($15)	Approved 1996
New Zealand (Hooker's) Sea Lion	17	($15)	Approved 1995
Dactylanthus taylorii	16	($15)	Approved 1995
Bat (Peka peka)	15	($15)	Approved 1995
Otago and grand skinks	14	($15)	Approved 1995
Giant land snail	13	($15)	Approved 1995
Takahe	12	($15)	Approved 1994
South Island saddleback	11	($15)	Approved 1994
New Zealand Dotterel	10	($15)	Approved 1993
Tuatara	9	($15)	Approved 1993
Kowhai ngutukaka	8	($15)	Approved 1993
Subantarctic teal	7	($15)	Approved 1993
Mohua (yellowhead)	6	($15)	Approved 1993
Chevron skink	5	($15)	Approved 1993
Black stilt	4	($15)	Approved 1993

Whitaker's and robust skinks	3	($15)	Approved 1992
Kiwi	2	($15)	Approved 1991
North Island kokako	1	($15)	Approved 1991
Yellow-eyed penguin*	–	*–	Approved 1991
Kakapo		Out of print	Approved 1989

* *Available: from Otago Conservancy, Department of Conservation, Dunedin*

Copies may be ordered from:

DOC Science Publications
Science & Research Division
P.O. Box 10420
WELLINGTON, N.Z.