

THREATENED SPECIES RECOVERY PLAN SERIES NO. 12

TAKAHE RECOVERY PLAN
(Porphyrio [Notornis] mantelli)

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1. INTRODUCTION

The takahe (*Porphyrio [Notornis] mantelli* Owen, 1848) is a large flightless, endemic rail, once thought to be extinct. There were only four confirmed sightings (all in the nineteenth century), before an expedition led by Geoffrey Orbell in 1948 located a population in Fiordland. *The Red Data Book of New Zealand* (Williams and Given 1981) and *The Conservation Status of New Zealand Wildlife* (Bell 1986) classify the takahe as "endangered". Active management is needed to ensure the long term survival of this species.

Soon after "rediscovery", a 500 sq km Special Area within Fiordland National Park was set aside for the conservation of takahe. A large amount of natural history information was collected in the following decade, and further research studies commenced in 1972 to determine the ecological requirements, breeding biology and population size of this species (Mills 1990).

By the 1970s it appeared the takahe population had declined dramatically and the species was in danger of extinction. The birds occurred in low numbers and were affected by introduced mammalian browsers and predators. The population reached a low in 1981 at an estimated 120 birds. Since that year the total population has fluctuated between 100 - 180 birds. The primary cause of takahe decline in this century has been habitat deterioration, caused by high numbers of introduced red deer.

Deer control operations in the Murchisons began in 1948, and intensified in the 1960s and 1970s. Operations lowered deer numbers significantly, and this was accompanied by an increase in takahe numbers. Since about 1981 the main population in the Murchison Mountains appears to have stabilised at 160-170. However, birds in some surrounding areas of habitat (e.g. the Doon catchment) have disappeared in recent years.

Early attempts at captive breeding of takahe began in the 1950s at what is now the National Wildlife Centre, Mt Bruce. By the 1980s research results were used to implement a wide ranging management plan which included: the intensive management of the wild population to maximise breeding success, habitat manipulation to improve habitat quality for the birds, the establishment of a new wild population in Fiordland, the building of a captive rearing facility to provide birds for the new population, and the release of birds onto browser- and predator-free islands.

The long term goals for takahe recovery are the conservation of a minimum of two large populations (circa 500 birds) in Fiordland and elsewhere on the mainland, and several small populations on islands (less than 30 birds each). At the moment, there is no other suitable mainland site. Therefore, the objectives of this Recovery Plan (1994-1999) are:

- 1) To ensure the Murchison Mountains population remains stable or increases;
- 2) To expand the wild population in Fiordland;
- 3) To maintain a minimum of three takahe populations on islands; and in captivity;

- 4) To collect information on takahe behaviour and disease which will aid in conservation of the species.

This plan is a guide to the Department of Conservation and other agencies involved in conserving takahe. It takes into account management plans for Fiordland National Park and the islands where takahe have been released. Implementation of the plan is overseen by the Takahe Recovery Group, which will be responsible for review of the plan.

2. DISTRIBUTION AND CAUSES OF DECLINE

2.1 Past Distribution

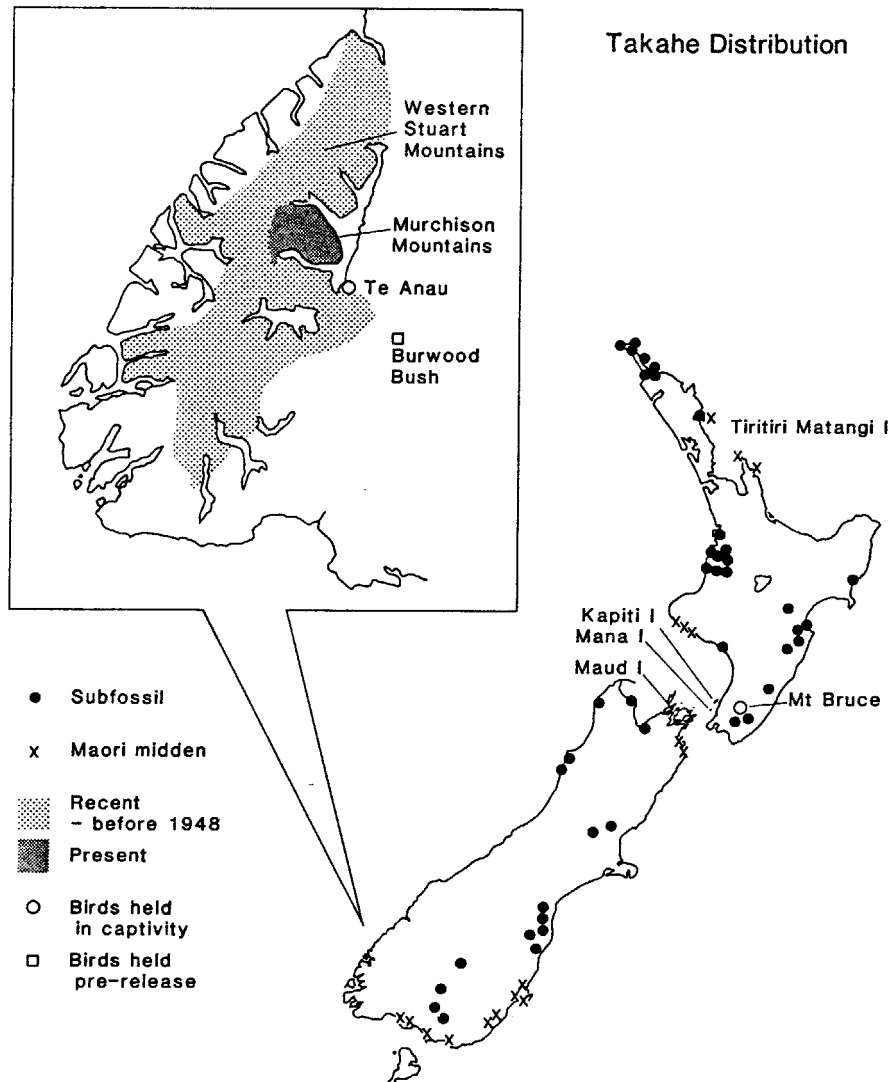
Map 1 shows the past and present distribution of takahe. The distribution of subfossil remains indicates that takahe once occurred over a wide area of New Zealand. Although the species now occurs naturally only in alpine grasslands, subfossil remains have been found in a variety of habitats, including areas dominated by forest cover (Atkinson and Millener 1991). Printed accounts of Maori legends indicate that by the time of European colonisation, takahe were known only in the southern South Island. Remains of takahe have been found in middens in the North Island and eastern South Island, showing that at some point Maori encountered takahe in these regions (Williams 1960).

In recorded history takahe have only been found in or near Fiordland. Although suitable habitat occurs in scattered pockets east of the main divide, from the Princess Mountains in the south to the Stuart Mountains in the north, records suggest that takahe were never numerous there either (Reid 1978).

Earlier estimates of over 500 birds existing in the Murchison Mountains in the late 1960s (Reid and Stack 1974) appear to be exaggerated, as they were based on the location of sign rather than actual sightings and did not account for seasonal movements of birds. From what is now known about habitat requirements and, judging by the distribution of suitable habitat and its condition due to deer browsing at that time, it is likely that the population was only about half that number.

2.2 Present Distribution and Status

The wild takahe population is currently confined to the Murchison Mountains, although birds are occasionally seen in outlying areas and the Stuart Mountains release area (see Map 1). The population declined through the 1960s and 1970s and reached a low in the late 1970s and early 1980s (Figures 1A and 1B). This low represented a 40% decline in numbers over the previous ten years (Mills et al. 1989). In 1984 the total number of birds increased to 153, and in 1985 it had further increased to 180. Since 1982, the population in the monitored area (east of the Woodrow, Esk and lower McKenzie burns) has fluctuated between 110-160 birds (Figure 1B). Recent management techniques, such as egg manipulation, probably did not influence the increase in numbers as much as other methods such as deer control, with its subsequent improvement in habitat (Mills



Map 1. Past and present distribution of takahe. After Lavers and Mills 1984.

et al. 1989). As recent techniques such as egg swapping, removal of infertile or addled eggs, and reintroduction of birds to other parts of Fiordland take effect, the population should increase.

The nucleus of a new wild population has been established in the headwaters of the Glaisnock River in the Stuart Mountains and is expected to expand and link with the Murchison population. These birds originate from the first liberations of a captive rearing and re-introduction programme. The first eight artificially reared birds were liberated in October 1987, with three of these now known to be dead. Six to 14 birds have been released annually since 1987, with a total of 58 birds released by December 1992.

In addition to the wild populations, takahe are found on four islands and held at three institutions (Table 1). The founding birds came from the original breeding programme at Mt Bruce, and the first birds artificially reared at Te Anau.

Table 1. Takahe on Islands and in Captivity (at June 1992).

Island/Site	Size (ha)	Year Established	Number of Birds (1992)	Number of Pair-years (1992) ¹	Number of Juveniles Produced
Maud	309	1983	8	27	11
Mana	217	1988	8	6	3
Kapiti	2023	1989	10	8	4
Tiritiri Matangi	210	1991	4	0	1 ²
National Wildlife Centre, Mt Bruce		since 1957	2	display only	
Te Anau Wildlife Centre		since 1979	2	display only	
Burwood		1985	6	9	10

¹ A pair-year is a score for each year a pair was present.

² In 1991 an egg was transferred to Tiritiri, hatched and reared by a male-male pair.

2.3 Reasons for Decline

Prehistoric: In prehistoric times, the takahe population appears to have declined from a New Zealand-wide distribution to a Fiordland population and scattered pockets of birds throughout the country. Although the broad distribution of takahe is evident through the location of fossil and subfossil remains, the abundance of birds in various habitats, especially forest, has been debated (Mills et al. 1984, Beauchamp and Worthy 1988, Mills et al. 1988). More recently it has been suggested that takahe were 'widespread in lowland forest, although not necessarily very abundant' (Atkinson and Millener 1991).

Recent: The Fiordland range has contracted from a maximum extent of some 16000 sq km in the late nineteenth century (Reid 1978) to the present 500 sq km area of the Murchison Mountains and the adjacent Doon River catchment in the north. Maori hunters (and fire lighters) may have been responsible for the first phase of this recent decline (Beauchamp and Worthy 1988). However, since the late 1960s a combination of factors has resulted in an accelerated drop in numbers of takahe. These factors include severe modification of the vegetation by deer, predation by stoats and possibly accidental poisoning by cyanide. Natural factors limiting breeding success, such as egg and chick loss caused by inclement weather (especially at hatching time) and weka predation, have become more significant when compounded by the effects of introduced animals.

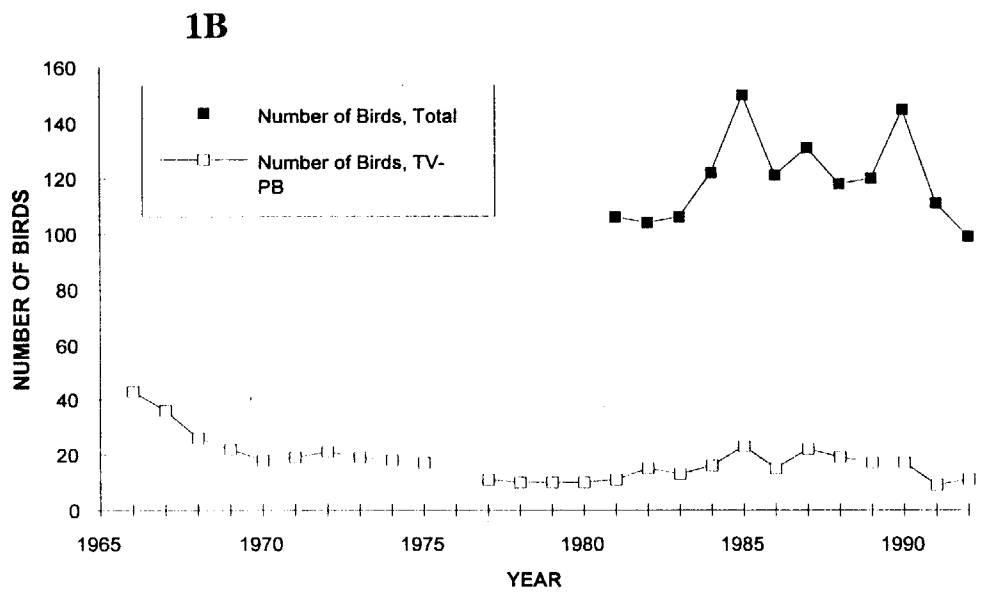
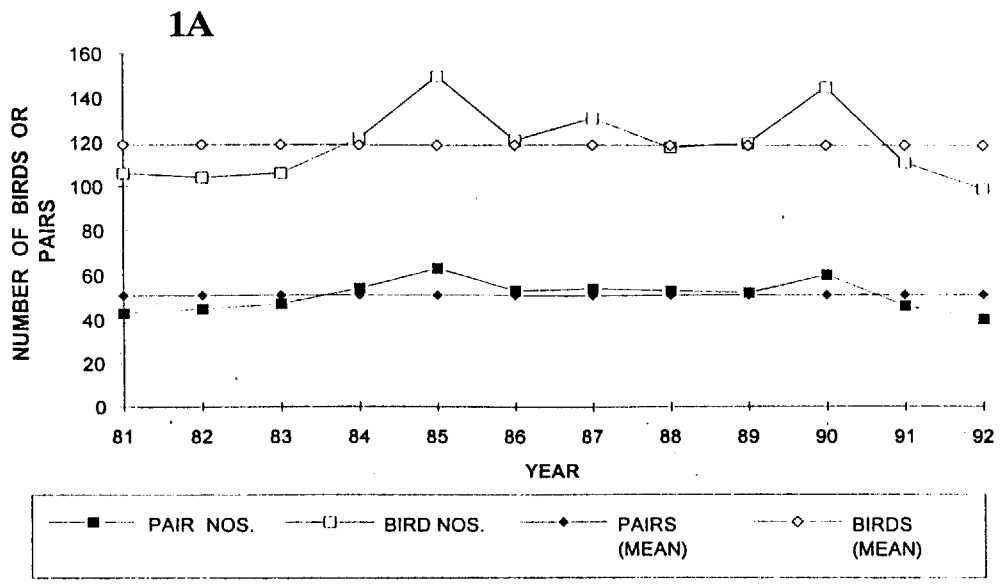


Figure 1. Population trends for takahe populations.
 1A. Trends in the Murchison Mountains sampling area (1981-1992). Total numbers of birds and number of pairs found east of the Woodrow-Esk burns. Mean numbers are shown as horizontal lines. Total number of birds: Mean = 119, SE = 16. Number of pairs: mean = 51, SE = 7.
 1B. Trends in the Takahe Valley/ Point Bum study area (1966-1992). Numbers prior to 1981 are from Mills et al. 1989. The figure for 1992 does not include four birds released in Takahe Valley in December 1992.

3. SPECIES ECOLOGY

Considerable work has been carried out on takahe ecology. Lavers and Mills (1984) provides a good general description and see Mills (1990) for an extended list of recent research publications.

The primary aspects of takahe ecology which affect their conservation are their specialised feeding habits and some of their behaviour. In Fiordland, takahe live on alpine grasslands and feed on tussocks during much of the year. Snow tussocks (*Chionochloa pallens*, *C. flavescens* and *C. crassiuscula*) are their preferred food. In the winter the birds move into forested valleys, where their major food source is the rhizome of a fern, *Hypolepis millefolium*. Takahe on islands feed on a mixture of native and introduced grasses. Grasslands and swamps appear to be the highly preferred habitat on Kapiti, a largely forested island.

Adult birds live in pairs and maintain large territories, which they defend aggressively against other takahe. This means that even in very good habitat they will not form dense colonies. They are long-lived birds and have a low reproductive rate, with clutches consisting of 1-3 eggs. Only a few pairs manage to rear chicks consistently from year to year. This is generally sufficient to maintain the population, although it recovers slowly from catastrophic events.

The combination of natural and introduced factors which have acted to limit takahe numbers are described below.

Competition: The disappearance of the birds followed the build up of deer numbers in particular areas. For example the first deer were liberated into Southern Fiordland in 1901 and the last takahe were observed there in 1930. Deer moved into the Kepler Mountains and were at peak numbers in the 1950s (Parkes et al. 1978). The last takahe record there was in 1962.

Deer and takahe have similar food preferences and takahe are affected when the most important food species are eliminated or reduced by deer (Mills and Mark 1977, Lee et al. 1988, Mills et al. 1989). Surveys by the New Zealand Forest Service (Evans 1972) show that the degree of modification of the grassland was related to two factors: the ratio of forest to grassland and the ratio of palatable to non-palatable species of tussocks. Takahe disappeared very quickly from areas where the ratio of grassland to forested areas was low (Mills and Mark 1977). Such areas include parts of the Kepler Mountains, areas west of the main divide and the "Wapiti Block". Takahe managed to survive better in the Murchison Mountains Special Area because not only was the grassland to forest ratio more equable, but also this area contained a higher proportion of alpine grasslands consisting of species palatable to takahe. This lessened the impact of deer on the takahe population over this area.

Predation: Stoat and weka predation have been observed but much information is circumstantial. These animals have probably contributed in some degree to the decline of the takahe. However any loss of birds to predators, while the population is low, is

a serious threat to the takahe and effective control of predators may be necessary.

Stoats pose the greatest threat with a number of cases of predation having been recorded (Layers and Mills 1978). Chicks are taken in most cases but in some instances stoats have been known to kill adults. Stoat numbers fluctuate with peak densities following mast beech seeding years when mice are abundant (King 1983). While stoat numbers tend to peak only in mast years, it is possible that in the Murchison Mountains they may have been kept at an artificially high level in the 1960s-1970s because of the presence of deer and possum carcasses left during deer control operations (R. Lavers, pers. comm.). Stoats are known to feed on carrion, which may have supplemented the usual diet of rodents, birds and other foods.

Stoat predation is not inevitable. Takahe have survived and reproduced successfully on Maud Island, where stoats have been present in low numbers for many years. There is no evidence that any takahe chicks on Maud have been killed by stoats.

There is evidence of eggs and young chicks being preyed upon by weka. Records suggest that individual weka may learn to prey upon takahe eggs and do so repeatedly. However, weka appear to be declining in Fiordland and pose little threat. Once again, results from islands suggest that concern over predation should not be exaggerated. Despite the dense population of weka on Kapiti Island, there are no records of takahe eggs or chicks being preyed upon (R. Empson, pers. comm.).

Egg failure: Hatching failure in the Fiordland population appears to be between 25 - 32% (Williams 1957, Mills 1978, Te Anau records 1989-1992). Egg failure reached 62% on the islands in 1991/92 (Eason 1992). The proportion of eggs which are infertile, and those which contain dead embryos varies considerably from year to year and from site to site. It cannot be said whether this is genetically, behaviourally or environmentally determined. Preliminary genetic analysis of a small number of birds suggests there may be a possible high degree of relatedness in the population, but inbreeding in New Zealand birds is likely a natural event (Craig 1991).

Weather: Weather patterns in the Fiordland mountains vary from year to year. High chick and adult mortality may occur during severe winters and poor breeding may result from exceptionally stormy weather during the spring breeding season. Short, cold summers mean that tussocks do not seed the following year, and these seeds are an important food source. Although a natural factor, if years of severe weather coincide with peak years for stoat numbers the effect on takahe mortality is magnified.

Cyanide poisoning: Prior to mandatory use of bait stations to keep cyanide poison off the ground, it is quite possible that possum hunters were using poisoned baits on the ground in all the main valleys in the Murchison Mountains. This would have posed a threat to wandering juvenile birds or those that were forced down to the valley floors in severe winters. There is no direct evidence that takahe were killed by poisoning, but it is a possible explanation for some local declines in takahe numbers which cannot be explained adequately by any other factors.

4. SPECIES RECOVERY

Conservation of takahe has proceeded in some form ever since the birds were rediscovered in 1948. Research in the early years (1949 - 1960) was directed at gathering basic information about this little known bird (Falla 1951, Williams 1960, Williams and Miers 1958). Deer control began in 1948 and intensified during the 1960s and 1970s (Parkes et al. 1978). Early attempts at captive breeding began in 1957 at what is now the National Wildlife Centre, Mount Bruce, Masterton, with only sporadic success. Two takahe died at Mt Bruce in 1973 while under stress. The birds were found to have succumbed to haemochromatosis (intravascular haemolysis), a condition associated with the bacterium *Campylobacter*. While this bacterium is common in birds at many New Zealand locations, studies in the 1970s showed it was not found in Fiordland weka (which were used as an analogue for takahe since sampling is destructive), and it therefore was unlikely to be in the wild takahe population. Since then, management of Fiordland takahe has been regulated to avoid introducing this bacterium or any other disease to the area.

An integrated research programme was begun in 1972 (Mills 1990). It covered a wide range of topics including population studies of takahe, reproductive biology, feeding, and nutrition. Related work was carried out on stoats, deer, and the grassland habitat. Results from the studies emphasised the importance of poor nutrition in chick loss and the detrimental effects of deer on habitat quality. It was concluded that stoats were not a major factor in the loss of adult birds, although their effect is more important when takahe are at low population levels. An important result of the population work was the discovery that takahe pairs generally succeed in raising only one chick per year, even though they may hatch up to three.

The most important management which resulted was the stringent control of deer in the takahe area. Fertilising of takahe territories was tried in an effort to improve habitat quality, but the differences in breeding success between the fertilised and non-fertilised areas were not great enough to justify continuing this programme.

In 1981 a coordinated approach to takahe conservation was begun, based on the results from the earlier research (Mills et al. 1982). The Murchison Mountains population was managed each year to ensure that most pairs were incubating fertile eggs, and putting their effort into raising single, healthy chicks. A programme was begun to establish another wild population to the north of the Murchisons in the western Stuart Mountains (Glaisnock/Edith rivers area). This involved removing 'extra' eggs (surplus to the one healthy chick per pair regime), artificially incubating and rearing the chicks, and then releasing the young birds (as yearlings) in the new habitat. The techniques were developed at the Te Anau Wildlife Park (now Wildlife Centre) until a new facility was built at Burwood in 1985, where hygiene and behavioural management could be more strictly regulated. So far 58 birds have been released, and at least one pair has produced chicks. This release programme is currently on hold until the results of the releases are determined, and all birds destined for the Stuart Mountains are being released in the Murchison Mountains.

Introduction of takahe to relatively secure (free of most browsing and predatory mammals) offshore islands began in the 1980s (see Table 1). Small numbers of birds continue to be held at Te Anau Wildlife Park and Mt Bruce.

In summary, takahe conservation over the past 20 years has probably prevented the extinction of this species in the 1970s and 1980s. Long term research has produced invaluable information for the conservation of the species. Currently, takahe conservation depends on a combination of programmes which aim to provide increased numbers of birds in secure habitats.

5. OPTIONS FOR RECOVERY

Without some form of management, takahe would have slowly declined in numbers and become extinct. Options for the recovery of this species include mainland management, island rescue, and captive management. The recovery programme for takahe includes all these options as means of minimising risk. The long term goals for takahe recovery are the conservation of at least two large populations (circa 500 birds) and a minimum of three small populations on islands (less than 30 birds each). At present, there is no suitable second mainland site or large island which could support a large population of takahe. Current planning for takahe recovery includes three primary management strategies. Programmes in order of priority are:

- 1) Protection of the Murchison Mountains population;
- 2) Enhancement and expansion of the Fiordland population through captive rearing and release;
- 3) Maintenance of island and captive populations.

The protection of the wild Murchison Mountains population will continue to be of highest priority. While the size of a minimum viable population is open to debate, a large population is preferable to a small one. Given the state of animal control techniques and the size of available habitats, there is presently no other site or combination of sites that can support the number of birds that the Murchison Mountains currently (and potentially) can hold. A management target of 500 birds has been selected to denote a large population as it is likely to provide a buffer against natural fluctuations in the population, and it is believed to be the carrying capacity of the Fiordland ranges where takahe were found historically.

The success of liberations in the western Stuart Mountains needs to be critically assessed. If this attempt to establish a new Fiordland population is shown to be unsuccessful, options are to:

- try a release elsewhere in Fiordland (if the failure was due to local conditions), **OR**
- continue the present regime of adding the artificially reared birds to the Murchison Mountains population, **OR**
- to use artificially reared and wild birds to enhance the island populations, **OR**
- to concentrate on managing the Murchison and island populations and phase out the artificial rearing programme altogether, **OR**
- to look at an alternative mainland site or large island which could carry large (100s) numbers of takahe and be managed to mitigate the effects of browsing/predatory animals.

6. RECOVERY STRATEGY: OBJECTIVES

General / Long Term

- 1) - Establish a self-sustaining population of over 500 takahe in its present and former range in Fiordland National Park, and another mainland site.
- 2) - Establish free ranging populations on at least three predator-free islands having suitable habitat as insurance against loss in the wild.
- 3) - Promote public awareness of takahe and the conservation of the species, by maintaining a small number of birds in captivity for public display; through visits to islands as appropriate; and through the media.

Specific / Short Term

- 1) Maintain and enhance the wild population.
 - Maintain takahe habitat by controlling deer numbers within Fiordland National Park, and reduce deer numbers to maintain habitat quality in the Murchison Mountains Special Area.
 - Through active management (egg manipulation, release of artificially reared birds and localised predator control) maximise production and survivorship of the Murchison Mountains population.
 - Maintain Special Area status for the Murchison Mountains and maintain this area as the core area for intensive management and protection of the Fiordland population.
 - Establish a new population centred on the western Stuart Mountains through the liberation of takahe reared at the Burwood Rearing Unit, which will in time link itself to the Murchison Mountains population.
 - Monitor behaviour of juvenile takahe in Murchison Mountains, to learn about survival of juveniles.
 - Monitor takahe populations, habitat and management activities (ensuring accurate and thorough data collection) for review purposes and to identify research needs.
 - Minimise the risk of the spread of possible disease by maintaining high hygiene standards at Burwood and using preventative inoculations where necessary. Follow movement restrictions between wild, Burwood, island and captive populations.
- 2) Establish free ranging, managed populations on Maud, Mana, Kapiti and Tiritiri Matangi Islands which will consist of 25 - 35 pairs in total.
 - Evaluate production annually and move birds between islands to maximise breeding.

- Monitor interactions between takahe and other threatened species, and manage as necessary.
 - Maintain genetic diversity of island and display populations through interchange of birds and eggs between these populations.
 - Review disease status of takahe in wild, island and captive localities.
- 3) Promote public awareness of takahe and their conservation.
- Hold a small number of breeding pairs for display at National Wildlife Centre (Mount Bruce) and Te Anau Wildlife Park for display.
 - Encourage public visits to islands designated as open sanctuaries.
- 4) Monitor takahe recovery programmes and update Recovery Plan.
- Maintain Takahe Recovery Group to assess recovery programmes and to be available for consultation both within and outside the Department of Conservation.
 - Review and revise Recovery Plan objectives five years after it is formally approved.

7.0 WORK PLAN

7.1 Maintain and Enhance the Wild Population

- 7.1.1 Deer Control - Fiordland
 - a. Murchison Mountains Deer Control
 - b. Glaisnock Area Deer Control
- 7.1.2 Egg Manipulation (see 7.1.5b)
- 7.1.3 Predator Control - Fiordland
 - a. Weka Control
 - b. Stoat Control
- 7.1.4 Murchison Mountains Special Area
- 7.1.5 Egg Manipulation and Reintroduction Programme
 - a. Minimum Disturbance
 - b. Egg Manipulation & Collection
 - c. Artificial Incubation & Rearing
 - d. Reintroduction
- 7.1.6 Monitoring of Wild Population and Habitat
 - a. Special Population Census
 - b. Breeding Success Survey
 - c. Juvenile Recruitment
 - d. Monitoring of Stuart Mountains Reintroduction Programme
 - e. Weather
 - f. Tussock & Beech Seeding
 - g. Habitat/Deer Monitoring
 - h. Predator Monitoring

7.2 Establish Island Populations

7.3 Promote Public Awareness

7.4 Monitor Takahe Recovery Programme

7.5 Research Needs

7.1 Maintain and Enhance the Wild Population

7.1.1 DEER CONTROL - FIORDLAND

7.1.1.a Murchison Mountains Deer Control

Explanation:

Undertake official control operations and where applicable, use selected operators to reduce the numbers of deer in the Murchison Mountains to maintain current habitat quality (see Monitoring, 7.1.6g). Use a variety of techniques to achieve maximum reduction of deer numbers.

Principal Activities:

- Aerial control operations centred on spring - summer period and using approximately 20 hours of helicopter time. This activity is at present subsidised through the recovery of carcasses for sale.

- Ground hunting operations centred on spring and "roar" periods. Indicator dogs are used when available to personnel undertaking this work. Dogs must be under good control before being permitted to enter the area and must be muzzled or tied up securely at all times. Their handlers should be aware of areas that may contain takahe and take special care in these, especially during the nesting period. Night shooting, Q should be employed in suitable clearings such as those in the Point Bum and Lower Snag Burn. Snares will not be used.

- Capture pens have been used effectively in recent years and permanent pens will be maintained in sites where captures have been frequent. These pens will not be run continuously but will be operated in conjunction with ground and possibly aerial operations.

- Natural bait poisoning is an option that may be carried out in one catchment on a trial basis. Experience gained elsewhere indicates that this technique could be effective in further lowering deer numbers in selected areas. This work would centre on low - mid altitude forest and would be undertaken outside winter months to give greatest protection to the takahe (Slater 1982).

- Lake front hunting blocks (approx. 170 m above shoreline) are issued to selected operators to carry out approved operations. These operators are generally those also issued blocks for lake front possuming. No areas will be open for public hunting on application.

Further details are given in the Operational Project Plan for Murchison Mountains Wild Animal Control (Southland Conservancy).

7.1.1.b Glaisnock Area Deer Control

Explanation:

Deer numbers will be controlled to levels that maintain takahe habitat and the dominant forest and grassland cover (see Monitoring 7.1.6.g). Being within the "Wapiti Block", control of red type deer hybrids will generally be carried out by commercial operators. Control of wapiti-type animals, will be carried out primarily by recreational hunters (FNP Management Plan).

Principal Activities:

- The "Wapiti Block" will be issued to one commercial aerial recovery operator. They will be restricted to the taking of red deer type deer only, with no operations being permitted during the months of March and April. Subsidy of aerial hunting may be required if financial returns do not allow this activity to be commercially viable, and habitat monitoring indicates increased browsing pressure.

- Ground hunting of all animal types is open to the public throughout the year. For the period mid-March to end of April, hunting blocks are issued by a ballot held in January. Hunting effort is concentrated on the "bugle" period of mid-March to end of April.

Key Personnel:

Conservation Officer (Wild Animal Control) - Te Anau Field Centre.

7.1.2 EGG MANIPULATION

(See Section 7.1.Sb)

7.1.3 PREDATOR CONTROL - FIORDLAND

7.1.3.a. Weka Control

Explanation:

Weka have been known to prey on the nest of takahe and have been known to attack young chicks (Layers and Mills 1978). The removal of weka that have learnt this predatory behaviour may greatly increase the production of chicks from these territories.

Principal Activities:

- If predation by weka is shown to be affecting nesting success, offending birds will be transferred to areas where they will not interact with takahe.

7.1.3.b. Stoat Control

Explanation:

The potential effect of stoat predation on the takahe was described in Chapter 3. Radio telemetry studies suggest that stoat predation is not a significant threat to adult takahe. The threat to chicks or juveniles is not fully known but likely to be more significant.

Large scale control techniques for stoats are not available at present. However, it appears that predation may be minimised by trapping at certain times and in particular areas. Trapping in key winter habitats and at nest sites is likely to be most effective. Field observations suggest that certain territories are more prone to nest predation than others.

Principal Activities:

- In recent years (1982-1989) Fenn traps were set in tunnels along the tracks in the Snag, Etrick and Chester Burn valleys and were checked and rebaited approximately once a month over the winter period (May - August), or about four times over this period. Approximately 75 traps in the Snag Burn, 80 traps in the Etrick Burn and 100 traps in the Chester Bum were set. Winter trapping was halted in 1990 as it was observed that the trap checking regime contravened the Animal Protection Act (1960). Furthermore, trapping success was negligible.
- The prevention of stoat predation is most achievable if the few nesting territories where stoat predation has been recorded are targeted. For this reason Fenn trapping over the breeding season at identified high-risk territories will be maintained. Crown dispensation from the daily checking requirements of the Act will be sought.
- The development of more efficient and effective stoat control methods would benefit the protection of takahe and other species. Current research aimed at such developments will be supported by combining relevant field trials with existing field programmes where possible.
- Research into survival of young chicks will be carried out to determine if stoat predation is a significant factor (see 7.1.6.b).

Evaluation:

If stoat predation is shown to be a major factor in chick survival, and if techniques for stoat control are improved, management of these animals in the wild should increase.

Key Personnel:

Conservation Officer (Protected Species) - Te Anau Field Centre.

7.1.4 MURCHISON MOUNTAINS SPECIAL AREA

Explanation:

Shortly after the rediscovery of this species, a 500 sq km Special Area within Fiordland National Park was set aside to protect takahe from human disturbance. This Special Area remains. No public access (except for 500 m up rivers from lakeshore for fishing) will be permitted. All entry will be by permit only and for specific purposes relating to management and research. As this area is where the last takahe population survived and contains the most significant areas of takahe habitat, it will continue to receive a higher degree of protection and be the centre of management activities for the takahe.

Principal Activities:

- Aurora Caves, although being within this special area, will be treated separately for the issue of entry permits.
- Issue of entry permits will be at the discretion of the Field Centre Manager, Te Anau Field Centre. Minimum disturbance and security of the takahe will be a major consideration in assessing permit applications. Generally only those activities that support the conservation objectives of this plan or which cannot be done elsewhere, will be permitted.
- Visits to the areas specifically for filming or photography, can place significant pressures on the birds. However, they have considerable input into public education, and advocacy of the takahe and its conservation.

When assessing the issue of entry permits for this purpose, the following points should be considered and may restrict the issue of some permits:

- suitable takahe for filming or photography must be available (i.e. confiding birds that are not perturbed by human presence).
- filming of birds in poor weather conditions during nesting or chick rearing to be prohibited.
- supervision by a suitably experienced person who has had field experience with takahe will be required.
- only filming or photography that cannot be done elsewhere is to be permitted. Captive/display birds offer good opportunities for close up and feeding shots etc. Suitable takahe may be available in the Glaisnock area. This policy also holds for Burwood.

- the amount of recent activity in suitable bird territories may restrict filming or photography, if considered detrimental to the birds' behaviour, security or breeding success.
- the permitting of filming or photography in the Special Area that is not in relation to takahe must also be considered in light of any possible disturbance to the takahe.
- Restricted possum hunting will be permitted within the Special Area to discourage indiscriminate poaching and help police any such activities. No harmful relationships between possum and takahe or its habitat have been found. Therefore these operations are mainly to prevent illegal poisoning (which has occurred in previous years) and the possible killing of takahe. The restricted possuming is controlled to prevent additional risks to takahe:
 - only selected operators will be issued blocks on an ongoing basis but without an automatic right of renewal. These tend to be existing deer control operators or those with experience of the area from previous official work.
 - only poisoning with the use of bait stations at least 1 m above ground level will be permitted.
 - no possuming above approx. 170 m above lake shoreline will be permitted.
 - notice of particular poison operations will be required by the Te Anau Field Centre, Department of Conservation and from time to time Conservation Officers will inspect operations.

Evaluation:

Any activities which result in the disturbance of the birds will be halted. Any entry into the Special Area without a permit is unlawful and may result in legal action.

Key Personnel:

Conservation Officer (Protected Species) - Te Anau Field Centre.
 Conservation Officer (Wild Animal Control) - Te Anau Field Centre.
 Field Centre Manager - Te Anau Field Centre.

7.1.5 EGG MANIPULATION AND REINTRODUCTION PROGRAMME

These two topics cover both manipulation of the wild population and establishment of a new population, but are discussed together as they involve a single field operation. The goal of this programme is to maximise production of the Murchison population. 'Extra' eggs or chicks have been removed, reared, and released in the western Stuart Mountains when they reached adulthood. However, releases into the Stuart Mountains are on hold until the success of the releases has been determined. The critical path (Figure 2) is a flowchart that shows the interaction between the egg manipulation and reintroduction programmes. It outlines the activities detailed below.

7.1.5.a Minimum Disturbance

Explanation:

Some management activities are potentially disturbing to takahe. In some cases, birds were found to be unapproachable following banding operations. The benefits of any management or research need to be balanced against their potential disturbance to birds. This policy of minimum disturbance will also apply to all research and monitoring activities.

Principal Activities:

- During population census and monitoring activities all pairs may be visited. However, only those pairs which have been established for at least two seasons should have their nests inspected closely for egg manipulation or egg collection purposes. This will allow pairs to establish before they are subject to a greater degree of disturbance. It must be recognised that some young pairs will inadvertently have their nest visited due to circumstances such as pairs shifting territories.
- Dogs can at times be particularly useful for the location of nests or location and capture of birds. When used for this work, dogs must be trained specifically for this task and be under full control. A special entry permit that specifies relevant testing (certification by the Department of Conservation) and conditions that require muzzliniz or tying up at all times is required before entry into Fiordland National Park.
- Birds are not to be caught unless necessary (e.g. for approved management or research purposes).

Evaluation:

Any management practice which causes obvious stress to birds (nest desertion or hatching failure) will cease.

7.1.5.b. Egg Manipulation and Collection

Explanation:

Takahe have an apparently high rate of eggs failing to hatch. Normally two eggs are laid per clutch but one egg clutches are common. If two eggs of a clutch hatch, the likelihood of one of the chicks being lost is high (Mills 1975, Mills 1978). By removing addled eggs from nests and shifting viable eggs to leave one good egg in each nest, the ratio of chicks raised per breeding pair should be increased. Takahe will renest if first nesting attempts fail, especially if early in the breeding season or during good tussock seeding years.

Principal Activities:

- During November and early December each year established breeding pairs are to be located and eggs candled, measured and weighed. From this, likely viability and hatch dates can be calculated (Appendix 5).
- All addled eggs are to be removed from nests to allow birds to devote all their energy to good eggs or newly hatched chicks. Removing addled eggs can also remove a possible source of infection for healthy eggs.
- Eggs from nests containing two or three good eggs can be used to replace eggs in clutches where no viable eggs exist. The aim is to have one viable egg per nest. Any viable eggs not needed to fulfil this can be deemed as "surplus" and be available for artificial incubation and rearing.
- Certain pairs may be selected each year from which whole clutches may be taken to supply eggs for artificial incubation and rearing. The pairs selected will be those breeding pairs with a poor history of chick production (i.e. failed to produce chick/s in up to two or more recent breeding seasons). During years of good tussock seeding, when renest attempts are far more likely to be successful, pairs with good production history will be selected. The selection of genetic material from birds with a history of good productivity may well be important in the successful establishment of a self-sustaining population in the western Stuart Mountains. Eggs from pairs expected to renest will be taken as early in the breeding season as possible. A maximum number of pairs that are renested in any one season will be set at 10% of the total number of pairs (e.g. if 50 breeding pairs in the population, a maximum of five pairs may be renested).
- Eggs obtained through the taking of whole clutches or "surplus" eggs from manipulations may be taken to Burwood Rearing Unit (Appendix 2) to be artificially incubated and reared.

Evaluation:

If the egg manipulation programme is shown to have a negative effect on the wild population, it will be reviewed.

7.1.5c Artificial Incubation and Rearing

Explanation:

Takahe produced through the incubation of eggs at Burwood will be raised to provide birds suitable for reintroduction. Potential problems of imprinting, incorrect feeding behaviour and disease risks will be addressed.

Principal Activities:

- Good hygiene standards will be maintained at Burwood, especially in the incubator/brooder room. This will include the sterilising of equipment prior to use, the changing of footwear when entering the incubator/brooder room and frequent cleaning of brooders.
- Eggs may be brought to Burwood from the wild (Fiordland). No eggs or birds are to be shifted from island or captivity/display populations to Burwood (see history of disease section).
- Takahe reared at Burwood will be raised primarily for reintroduction to Fiordland. Only if necessary for the input of new genetic material will birds be available for transfer to island or captive/display populations. Some birds will be needed to establish resident breeding pairs at Burwood (initially about four pairs). These will be treated as wild birds with no contact with island or captive/display birds and their eggs will be made available for artificial incubation if required.
- Takahe reared at Burwood will be raised during the early chick stages, with as little visual or audible contact with people as possible. This is achieved by using specially designed, enclosed brooders and pens with one-way glass observation windows and feeding hatches.
- Appropriate tape recordings of takahe calls will be played to chicks and eggs through the early stages to independence. Also models of takahe will be used to provide brooding cover and puppets designed to simulate a takahe head will be used when feeding young chicks.
- If suitable breeding pairs establish at Burwood, they may be given additional eggs or chicks from the artificial incubation/rearing process to rear. Also eggs from these pairs will be available for artificial incubation and rearing.
- Takahe reared at Burwood will be encouraged to develop desired feeding behaviour by introducing them to pens containing tussock as soon as possible. *Hypolepis* fern will be propagated in the bush areas of their pens to offer an easily accessible and good quantity of this preferred winter food. Where necessary the birds will be placed in smaller pens containing *Hypolepis*, for a short period over winter to encourage feeding on it. Feeding on *Hypolepis* appears to be a learned behaviour. Fertiliser will be applied to the main enclosures from time to time to

maintain the food quality of the tussocks and to enhance the growth of the other grasses.

Evaluation:

If hatching success at Burwood falls below 75% the programme will be reviewed. Chicks will be reared at Burwood for the duration of the release programme unless it can be shown that a more efficient method for producing birds for release is available. This method would have to maintain current movement restrictions and not adversely affect the wild population.

7.1.5.d Reintroduction

Explanation:

The purpose of the reintroduction programme is to accelerate the recovery of takahe in the wild, a process begun by in situ management. Reduced deer numbers and recovering alpine grasslands made this reintroduction feasible. The best areas of takahe habitat were identified through surveys of much of Fiordland (Lavers 1986). The western Stuart Mountains were selected as the reintroduction site because:

1. When the programme began, the Murchison Mountains population appeared to be increasing rapidly and not in need of an additional 'boost' in numbers.
2. There was concern that introduced birds could possibly carry disease into Fiordland, and that an area should be chosen away from the main population to act as a natural quarantine.
3. The western Stuart Mountains had the greatest area of suitable habitat.
4. The Stuart Mountains are within the historic (1960s) range of takahe, and an increasing population in the Murchisons would be expected to eventually extend back into this area.

The Murchison Mountains were later included in the release programme because this population did not appear to be increasing as quickly as was first presumed, because quarantine procedures at Burwood are apparently sufficient to prevent disease problems, and because monitoring of released birds (to observe their behaviour and survival) was far easier in the Murchisons. In 1993 the Takahe Recovery Group decided that releases to the Stuart Mountains would be put on hold and that the birds targeted for the Stuart Mountains would be released in the Murchisons.

Principal Activities:

- In December each year birds that are available from Burwood will be liberated in the Murchison Mountains. The birds will be placed in groups in pre-release pens and then have the pen removed from around them after approximately two days.

Groups will not contain more than eight birds, with no more than one group released in a mountain basin per year.

Evaluation:

See Monitoring 7.1.6.

7.1.6 MONITORING OF WILD POPULATION AND HABITAT

Monitoring activities are needed to assess the results of management procedures and follow population trends. These activities are part of the integrated pattern of long term research for management. They shall at all times be undertaken with the minimum disturbance necessary to the takahe.

7.1.6.a Special Population Census

Explanation:

Over the summer breeding months an estimate of total takahe numbers is to be made each year. This is to monitor population trends and assess effects of management activities and limiting factors such as predation and periods of harsh weather.

Principal Activities:

- During the November / early December nesting period, all nesting pairs to be located and surrounding habitat in the Takahe Special Area to be searched to locate as many lone or juvenile birds as possible.
- If factors such as weather conditions or restrictions on resources (such as availability of suitable personnel) prevent an accurate census, certain areas, for which long-term census information is available, will be concentrated on to obtain accurate data to monitor trends etc. These blocks will be Miller Peaks, Dana Peaks, Mystery Burn-Point Burn-Takahe Valley. There should be not more than two years between any full census counts.
- Additional data obtained during late summer breeding success surveys will also be used to determine population size. The boundary of the Murchison Mountains for population counts will be the Woodrow Burn, Esk Burn and lower McKenzie Burn rivers in the west and the shore of Lake Te Anau elsewhere.

Evaluation:

Because population numbers in the Murchison Mountains have fallen since 1990 and the results of the Stuart Mountains releases weren't clear, the egg manipulation and/or egg removal programmes were reassessed in 1993, and the priority for reintroduction was changed from the Stuart Mountains to the Murchison Mountains.

7.1.6.b Breeding Success Survey

Explanation:

High egg failure and chick mortality has been evident during the decline of the takahe and current management activities are aimed at improving the production of chicks. Therefore it is necessary to accurately determine each year from which territories a chick or chicks are produced.

Research on the ecology, habitat requirements and factors influencing the decline of the takahe has been undertaken since the bird was rediscovered in 1948 (see Appendix 1 and References). From such studies several management procedures have been proposed and implemented. Current research is closely related to monitoring activities and centres on the analysis of data collected through monitoring. This is to ensure that the planning and implementation of management activities is based on soundly made decisions.

Principal Activities:

- During the month of February each year the territories of breeding pairs that were located during the previous November/December population census are to be revisited.
- Nests are to be inspected to attempt to determine the fate of any eggs. Evidence such as abandoned eggs, eggshell fragments or chick droppings, should be looked for and recorded.
- The pair is to be located or recent sign of the presence of a chick searched for. Tape recordings of takahe calls may assist in determining the presence of a chick/s. Fresh brood nests and droppings of a very small size are evidence of the presence of a chick.
- Existing data on population dynamics need to be analyzed and published.
- Research is to be carried out on survival of young chicks to determine factors affecting this survival (also part of evaluating effect of predation).

Evaluation:

Analysis of recruitment and population trends will identify population bottlenecks and the relative contribution of individual birds to the population. This information will be used to modify the management programme if necessary to improve management techniques.

7.1.6.c Juvenile Recruitment

Explanation:

The recovery of takahe has not continued on the upward trend observed in the mid 1980s, and is well below known historical population levels (Figure 1). Monitoring to date has not been able to give sufficient information on the fate of juvenile takahe to determine whether mortality during this stage has contributed to this trend. Habitat availability, predation, change in age structure of the population or other factors may have caused this plateau. While the egg removal programme has been designed to minimise impact on the wild population, there may be some effect.

Principal Activities:

- During autumn (1991 - 1993) up to ten chicks of sufficient size to carry transmitters are being colour banded and having long-life transmitters (2-3 years) placed on them.
- The birds will be located to determine their status during the middle-later part of their first winter and the following summer. The number of checks and closeness of tracking must follow the minimum disturbance policy.
- Existing data on population dynamics should be analyzed for chick survival and recruitment into the adult population.

Evaluation:

Results will be used to determine if there are any management programmes which could increase juvenile survival.

7.1.6.d Monitoring of the Stuart Mountains Reintroduction Programme

Explanation:

The results of the release programme in the Stuart Mountains (takahe survival and breeding success) will show the success or otherwise of this programme.

Principal Activities:

- Collection of blood samples may be taken from released birds for genetic "finger printing" for long term monitoring of dispersal, inbreeding and population mix.
- All birds released will be banded with individually identifiable colour band combinations. Released birds may also have radio transmitters attached to allow for more detailed monitoring, in conjunction with the juvenile monitoring programme.

- During late January each year a field party will visit the area to locate and identify as many takahe as possible in the area around the liberation sites in the western Stuart Mountains. January field checks will monitor breeding attempts within the block.
- Habitat/vegetation monitoring plots have been established in the headwaters of the Glaisnock and Edith Rivers. These were established in 1989 and are to be remeasured at five-yearly intervals. They are primarily to monitor the effects of deer numbers on takahe habitat (see 7.1.6.g).
- The Recovery Group will write and circulate a plan for measuring the success of the western Stuart releases. The plan will define the area to be searched, the methods to be used and degree of effort, and define criteria for assessing success, including minimum population levels and the ratio of locally bred birds to released birds.

Key Personnel:

Conservation Officer (Protected Species) - Te Anau Field Centre.
 Conservation Officer - Burwood.
 Scientists as appropriate.

7.1.6.e Weather

Explanation:

As one of the factors affecting the mortality of takahe, weather patterns have been monitored at Takahe Valley over the last 17 years and monitoring will continue. Also weather is a major factor determining mast seeding of tussock and beech seeding. Accurate monitoring will help in the prediction of mast seeding years and years of probable high stoat numbers.

Principal Activities:

- Monthly visits to Takahe Valley meteorological station to change thermograph chart and record temperature, maximum temperature, minimum temperature, rainfall and snow depth.
- Charts (or copies) and data to be forwarded to NZ Meteorological Service and held by the Department of Conservation.

7.1.6.f Tussock and Beech Seeding

Explanation:

Annual monitoring of beech seed collection trays in the Special Area and at other sites will enable the prediction of years when high numbers of stoats occur. Annual

monitoring of tussock seeding lines will also contribute to these predictions which can be used to plan predator control and egg manipulation activities. Years of good tussock seeding also influence the success of takahe breeding and therefore annual monitoring to follow trends and assess impacts of management procedures is necessary.

Principal Activities:

- Beech seed collection trays established in Takahe Valley, Eglinton Valley and Princhester Creek (Takitimu Mountains) to be cleared on the first of each month to monitor seedfall during the months of March, April and May each year. Total number of seeds and number of viable seeds to be counted for each tray per month (mountain beech monitored at Takahe Valley, silver beech monitored at Princhester Creek and red beech monitored at Eglinton Valley).
- Annually, in autumn, tussock seeding lines established in Takahe Valley are to be counted. Headbasin line monitors *Chionochloa crassiuscula*, *C. pallens*, *C. flavescens* and *C. teretifolia*. The valley floor line monitors *C. rubra*.

7.1.6.g Habitat/deer Monitoring

Explanation:

The detrimental effect of deer on takahe habitat has been the main cause for recent decline of this bird (Mills et al. 1982, Mills et al. 1989). The effectiveness of deer control needs to be assessed. Monitoring of deer numbers is best done through the monitoring of their impact on takahe habitat. When in low numbers, deer numbers are particularly difficult to determine by general habitat surveys. Habitat/deer monitoring is to be maintained in both the Takahe Special Area and Glaisnock reintroduction area. Vegetation is assessed both annually (during tussock seeding counts) and at a maximum of five-yearly intervals (for vegetation monitoring plots).

Principal Activities:

- Vegetation monitoring plots in areas of takahe habitat were established in spring of 1988 and 1989. The three areas being monitored are Edith Saddle (Glaisnock), Chester Bum/McKenzie Burn headwaters and Takahe Valley/Ettrick faces. Plots are to be remeasured every five years or when significant changes in deer numbers are suspected.
- Analyze data collected from the monitoring of weather and the seeding of tussocks and beech to determine factors controlling flowering and to provide information to be compared with the changes in stoat numbers.
- Habitat/vegetation monitoring data to be collected and analyzed to assess the effectiveness of current deer control activities, in relation to the recovery and

maintenance of tussock grassland and winter scrub-forest habitats of the takahe (Lee et al. 1988).

Evaluation:

A decline of 20% or more in *Chionochloa pallens* tillers would be taken as a sign of unacceptable deer browse. Results of habitat evaluation will be used to direct animal control programmes.

Key Personnel:

Conservation Officer (Protected Species) - Te Anau Field Centre.
Scientific staff as appropriate

Copies of all monitoring data records and field notes to be held by Te Anau Field Centre and science staff as appropriate.

7.2 Establish Island Populations

Explanation:

The previous management plan for takahe (Mills et al. 1982) and other reports recommended the trial liberation of takahe on predator-free islands having suitable pasture grasslands. Liberations on Maria, Kapiti and Maud Islands to date have seen takahe establish on these islands and breed, and birds have been introduced recently (1991) to Tiritiri Matangi Island. During the establishment period regular and carefully planned transfers can be used to increase the number of breeding pairs, maintain genetic diversity and reduce disease risks. It is expected that the island populations will be largely self-supporting, although this will take time. The establishment of takahe on islands therefore needs to take priority over increasing the number of places where takahe are held in captivity for display.

Concern over possible interactions between takahe and other threatened species has arisen due to incidental observations of takahe taking wetas and lizards. Takahe are known to feed invertebrates to young chicks, but invertebrate remains have not been found in faecal samples from adult birds in Fiordland despite extensive sampling (B. Lee, pers. comm.). Monitoring and possible management of these effects should be carried out to allay fears or set management in train.

Principal Activities:

- Island/display populations are to be treated as a separate population from the wild and Burwood takahe with the movement of eggs or birds restricted (see Figure 2). No eggs or birds to be moved from Islands/Display populations to the wild or Burwood.

Table 2. Estimated Carrying Capacity of Islands with Takahe

Island	Size (ha)	Habitat	Number of Takahe Pairs
Kapiti	2023	Mostly forest	<10
Mana	217	Mostly grassland	>10
Maud	309	mixed forest/grass	7-10
Tiritiri	210	mixed forest/grass	10

- 1991 was the last year takahe were transferred from the National Wildlife Centre (Mt Bruce) and Te Anau Wildlife Centre to Mana and Kapiti. Takahe on Maud and Tiritiri were all from Burwood stock, while the original birds on Kapiti and Mana came from Mt Bruce and Te Anau wildlife centres. Because of the issue of disease, no movement from Kapiti/Mana to Maud/Tiritiri was allowed. However in 1993 the Recovery Group agreed that the risk of transferring disease between islands was acceptable because all indications were that disease/parasite profiles between the island groups were the same.

- A re-assessment of the incidence of haemochromatosis (intravascular haemolysis) and/or the presence of *Campylobacter* bacteria in all takahe populations should be carried out, in liaison with Science & Research Division and Massey University veterinarian school.

- Takahe will be allowed to free range over pasture grassland areas and establish breeding territories of their choice. Management of island birds should include all recommendations in Appendix 4.

- All birds on these islands are to be individually colour banded and records kept of their parentage. Chicks produced will be measured at one year of age to determine sex (culmen, tarsus and mid-toe measurements) (Appendix 3).

- Other research and management techniques (e.g. radio tagging) and research projects in general should have the endorsement of the Recovery Group.

- Annual records of the parentage, pairing and offspring of all Island/Display birds is to be kept. Transfers may be made between locations to prevent loss of genetic diversity, and for other management purposes (Appendix 6). This will be coordinated by an appointed member of the Recovery Group.

- Only when necessary are eggs or birds to be introduced from Burwood to maintain genetic diversity. Priority at Burwood is directed towards the Fiordland reintroduction programme.

- Mana Island has the largest area of grassland habitat of the islands currently holding takahe. It is recommended that maintenance of this habitat be emphasised in the management plan for this island.
- All records will be forwarded to the Recovery Group leader responsible for coordinating takahe conservation.
- Collection and analysis of takahe scats should be carried out where it is suspected takahe are preying on other threatened species. Results will assist future management of takahe on islands, particularly for habitat requirements and interactions with other species.

Evaluation:

Any factor which may affect long term survival of takahe on islands, or if takahe are having a detrimental effect on other species, will result in a re-assessment of that island for takahe.

Key Personnel:

Conservation Officers - Kapiti, Maud, Mana and Tiritiri Matangi Islands.
 Conservation Officer (Burwood).
 Conservancy Recovery Group representatives.

7.3 Promote Public Awareness of Takahe and Their Conservation

Explanation:

Takahe are held in captivity at Te Anau Wildlife Centre and National Wildlife Centre (Mount Bruce). Because these birds are held primarily for public display, only a small number of pairs need to be held. The display of these birds and regular release of news on the takahe and management activities are needed to promote public awareness of the takahe and work being undertaken to save this species.

Principal Activities:

- Paired takahe to be held at Mount Bruce and Te Anau Wildlife Centre. These birds are to be held in pens that provide natural grass and tussock feed, with appropriate interpretive material nearby.
- All takahe held in captivity are to be banded and records kept of the parentage, pairings and offspring (see Island Populations section).
- When major events in takahe conservation occur, press releases are to be made. These should be cleared with the Recovery Group leader or Threatened Species Unit coordinator in the interests of accuracy and consistency nationwide.

Key Personnel:

Conservation Officer (Protected Species) - Te Anau Field Centre.
Conservation Officer (Threatened Species Unit).
Conservation Officer - National Wildlife Centre.
Conservation Officer - Te Anau Wildlife Centre.

7.4 Monitor Takahe Recovery Programme

The Takahe Recovery Group is needed to provide coordinated implementation of the Takahe Recovery Plan. Members of the group will report to meetings of the group on the implementation of this plan and results. Group meetings will assess any need for deviation from it, especially in the areas of new management procedures or research needs. Day to day co-ordination of the implementation of this plan will be the responsibility of the Recovery Group leader.

Principal Activities:

- The group will be made up of 6-8 members, with specialists invited to attend meetings when appropriate.
- Each member will be responsible for representing specific management activities or locations:
 - Conservation Officer (Threatened Species Unit) - to provide coordinating role.
 - Conservation Officer (Protected Species) - Te Anau Field Centre - to represent field programmes for wild populations.
 - Conservation Officer (Protected Species) - Burwood.
 - Conservation Officers (Protected Species) - to represent Conservancies as needed.
 - Conservation Officer - to represent Island and Captive populations programme.
 - Scientist (involved in related research).
 - Relevant expertise as required (science or management).
- Each area of management activity will be reported to the Recovery Group leader prior to meetings. These reports will be discussed at group meetings and progress on the implementation of this plan is to be reviewed at least annually.
- Preparation of a revised Takahe Recovery Plan will occur five years after approval of the current plan.

7.5 Research Needs for Takahe Conservation

The following questions have been noted under the relevant management section, but are brought together here for the convenience of research planners. Relevant sections are indicated. '*' identifies projects which should have the highest priority.

What effect are stoats having on the Fiordland takahe population (7.1.3b)?

What is the diet of chicks in the wild, and what parental behaviour do adults exhibit; can artificial rearing techniques be improved (7.1.5c)?

- * Can an improved colour band be developed which will withstand the harsh Fiordland environment (7.1.5e)?

What is the survivorship, dispersal and recruitment of released birds in Fiordland (7.1.5e, 7.1.6c)?

- * What is the recruitment of juvenile takahe, and what is the cause of recruitment failure in Fiordland (7.1.6c)?

- * What were the population dynamics (egg success/failure, juvenile recruitment and loss, adult breeding success and survival) of the takahe population in the period up to 1984 (7.1.6c, 7.1.5b, 7.1.6a)?

Can population modelling provide useful information for takahe management (7.1.6a)?

- * What are the climatic parameters which will predict beech and tussock seeding (7.1.6e)?

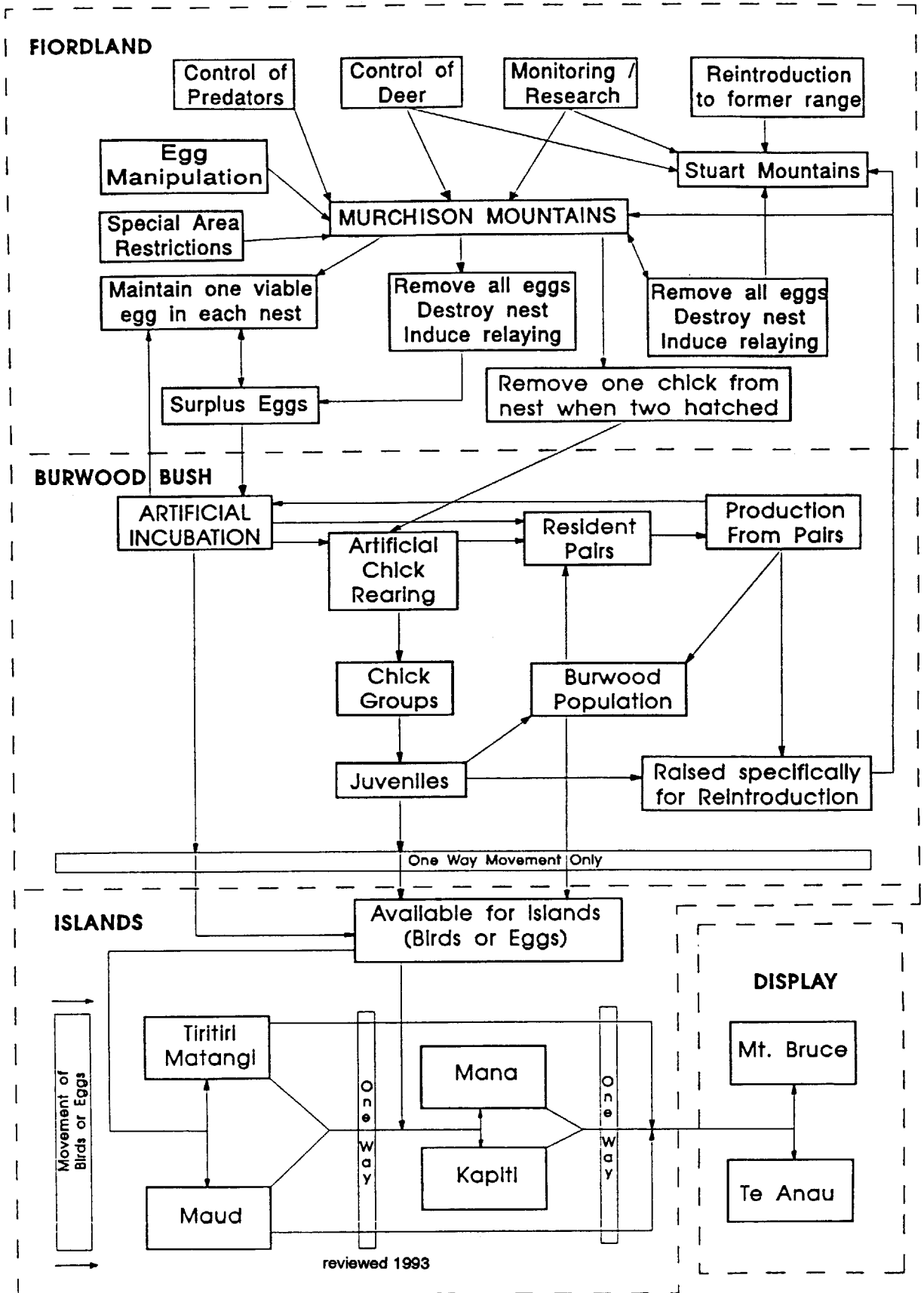
What do takahe eat on islands, and how do they use their habitat (7.2)?

- * What precise impacts do takahe have on other species (7.2)?
- * Can a reliable, inexpensive method of takahe sexing be developed (7.2)?
- * Is the current policy for movement of takahe with respect to disease prevention adequate, unnecessarily restrictive, or are other options (quarantine, etc.) available (7.2)?

- * What factors are affecting survival of young chicks (7.1.6.b)?

- * Can effective techniques for large scale control of stoats be developed (7.1.3b)?

Figure 2. Critical Path:Takahe Management and Allowable Takahe Movement



8. BUDGET

ESTIMATED BUDGET 1994/95

(\$000)			Person-Weeks
17.6	*	Deer Control, Murchison Mountains	21
29	*	Fiordland Field Management	84
		9 Field Expenses	
		18 Transportation	
		2 Equipment	
12	*	Burwood Rearing Unit	122
		2.5 Equipment purchase & maintenance	
		4.0 Food supplies & fertiliser	
		4.0 Facilities maintenance	
		1.5 Professional & service fees	
4	*	Island management (all islands)	55
		Includes food, shipping, vet bills etc.	
62.6			

NOTES ON FOLLOWING YEARS

- * Deer Control

Changes to the funding requirements cannot be easily estimated. The commercial viability of aerial venison recovery is highly dynamic, and subsidies increase or decrease from year to year.

- * Fiordland Field Management

Little change is expected except that a period of more intensive field monitoring in the western Stuart Mountains will be required, costing perhaps \$6000.

- * Burwood Rearing Unit

Little change in funding requirement likely.

- * Island Management

This estimate of time is based on the close management being carried out on Maud Island, which maximises chick production. Little change in funding anticipated.

Figures not adjusted for inflation.

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Appendix 1.

General reading on the takahe, its ecology and management procedures.

- Takahe (*Notornis mantelli*), Information sheet : updated annually. Unpublished handout produced by Takitimu District, Department of Conservation.

- Good Prospects For Takahe. 1986. Forest & Bird, Volume 17 Number 4.

- Understanding Takahe Habitat. 1989. Forest & Bird, Volume 20 Number 1.

- Takahe. 1984. A booklet by Roger Lavers and Jim Mills, published by John McIndoe and NZ Wildlife Service.

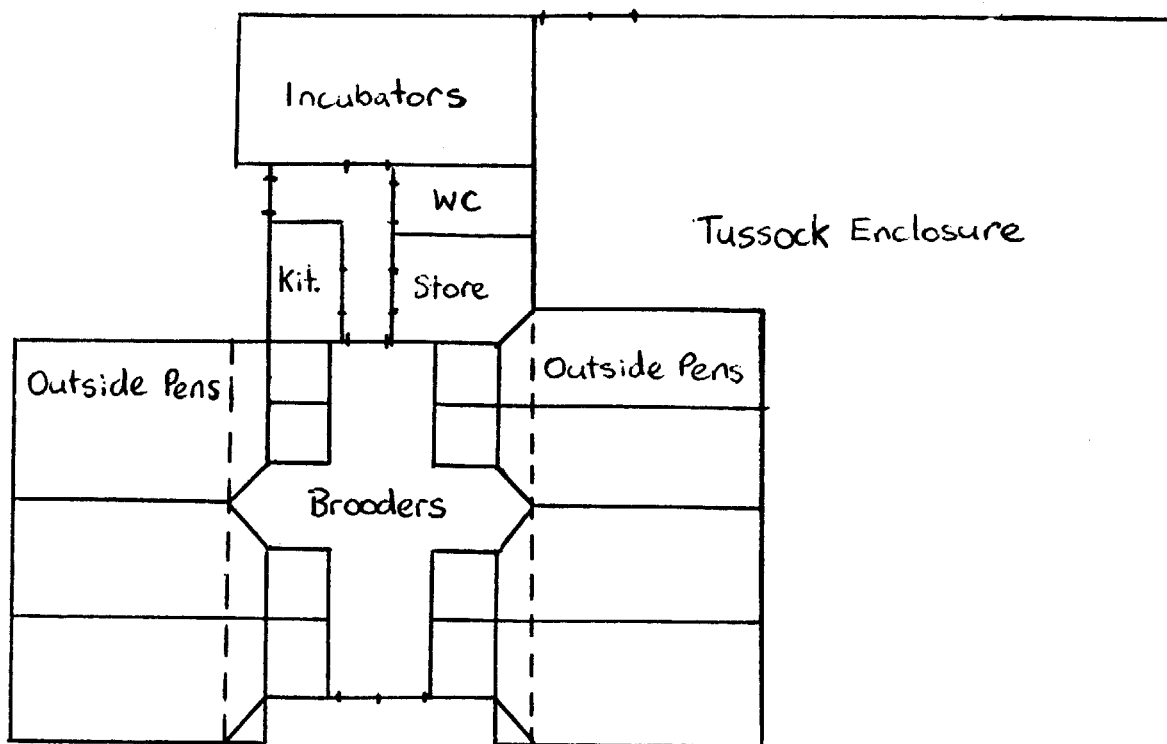
- Complete Book of New Zealand Birds. 1985. Published by Reader's Digest.

- Takahe Project, Handbook For Field Workers. 1985. Booklet by Roger Lavers and Dave Crouchley. Produced by NZ Wildlife Service, Te Anau (unpubl).

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Appendix 2. Burwood Rearing Unit

Plan of Brooder-room:



Some Key Features of Rearing Procedure

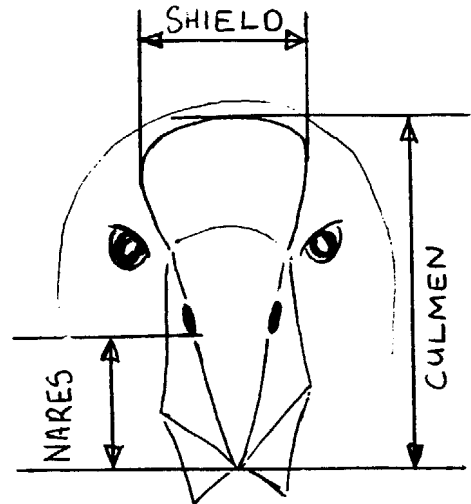
- Strict cleanliness standard and separate footwear for use in Brooder-room.
- Temperature and light regulation in incubation room and brooders.
- Accurate monitoring and adjustment of incubation humidity and temperature to obtain desired daily weight loss.
- Taped brooding calls played to pipping eggs.
- Brooders serviced through hatches and observation without human contact by use of

oneway glass.

- Brooders contain pond, selected vegetation and heated nest with model takahe providing brooding cover.
- Initial feeding of soft food with handheld puppet model approx. every 30 min to 1 hour. After two weeks every two hours. From four weeks some solid food introduced and access to outside pens given from about six weeks, also puppet feeding reduced.
- Taped takahe feeding and brooding calls played through speakers in feeding puppets and brooding models when appropriate.
- At three months, chicks moved to two 30 x 60 m red tussock enclosures near Brooder-room. At approx. five months, chicks moved to 10-40 ha pens within main reserve to over winter.
- During their first winter the birds are penned over a small area of *Hypolepis* fern to encourage grubbing and feeding on the rhizomes of this fern. The pulling of tussock tillers appears to be innate or easily learnt feeding behaviour.

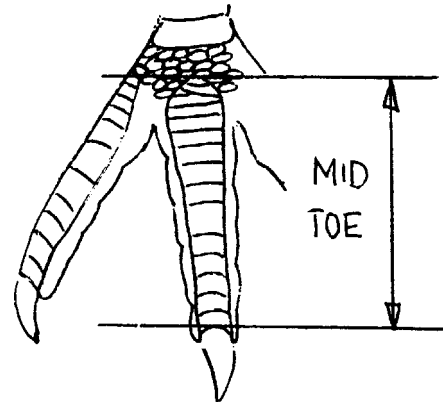
Appendix 3 Sexing Methods

In most cases female takahe are proportionally smaller than males. This can be calculated using measurements of the culmen, bill depth and tarsus lengths. There are overlaps between the sexes for the individual measurements, particularly the culmen length. However, a discriminant function analysis (Eason 1992) using any one measurement will confirm the sex with at least 80% accuracy. This accuracy will be further increased if a combination of these variables are used. From the age of three months the tarsus length will be adult size, however, the bill dimensions grow considerably until at least the age of one year.



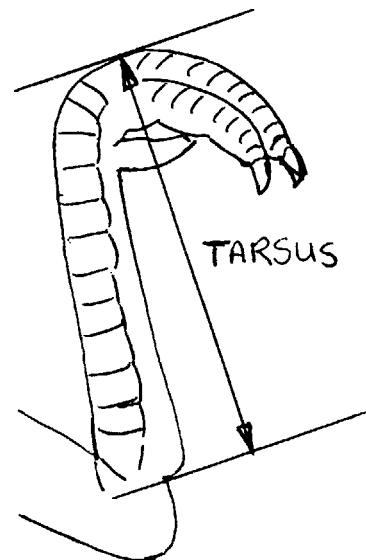
The measurements must be precise, to the nearest 1/10 mm. The tarsus length is taken while the leg is bent, from the small notch under the hock joint, to the base of the tarsus with the toes bent down. The two tarsus lengths are averaged to provide greater accuracy.

The culmen length is taken from the top of the shield to the tip of the beak. The bill depth is the vertical height at the base of the mandible (with the calliper in alignment with the interface of the bill and facial feathers) to the point on the culmen directly above.



The following equations can be used:

1. Tarsus length, useful for birds aged 3-12 months;
 $(\text{Tarsus} \times 0.72) - 67.92$
2. Culmen length; $(\text{Culmen} \times 0.7) - 60.46$
3. Bill depth; $(\text{Depth} \times 1.99) - 1003$
4. Culmen + Tarsus; $((C \times 0.48) + (T \times 0.56)) - 94.09$
5. Culmen + Depth + Tarsus; $((C \times 1.4) + (D \times 2.8) + (T \times 0.3)) - 2953$



The individual is classified as a female if the calculated value is <0 , and a male if >0 .

Takahe may also be sexed accurately using karyotype analysis of individual blood samples from birds of any age; however, this is costly. Plasma sex steroid analysis is useful for identifying sexually mature birds only.

Appendix 4 Care of Takahe on Islands

Takahe sometimes have a high rate of eggs failing to hatch. Normally two eggs are laid per clutch, with one egg clutches also being common. If two eggs of a clutch hatch, the likelihood of one of the chicks being lost is high. Most takahe will re-nest if their first nesting attempt fails, especially if early in the breeding season. With supplementary feeding during the breeding season and small scale egg monitoring and manipulation, chick production is easily increased.

1. Supplementary feeding

Non-breeding takahe should be monitored at least once a month, at which time they can be given a small helping of poultry pellets. This will maintain their trust in people allowing easier observation and catching if necessary. During breeding, pellets should be available frequently at a small, easily mobile, covered feeding tray which is handy to the birds' high use area. With the presence of chicks, additional chick food should be available daily for their first four to six weeks, after this age only pellets will be necessary. The regularity depends on the condition of the chicks and abundance of natural food available. Takahe are easily overfed and should not require greater than 100 g of pellets per bird daily, under normal circumstances. A healthy adult weight can range from 1.9 to 3.1 kg.

Chick food: 60:40 mix of vegetables and farex (plain baby cereal) or poultry mash mixed with water to a firm, but not sticky consistency.

Vegetable: 70% green mix of cabbage, clover, chickweed, spinach, etc and 30% carrot and potato. Finely chopped or blended with a teaspoon of vegetable oil.

Approximately 1-2 cups/day with 2-3 handfuls of pellets. Even if the parents don't feed this to their chicks, the supplementary food allows them more time to collect food for their chicks.

2. Egg Monitoring

Eggs should be candled after 10-15 days to determine viability. Dead or infertile eggs should be removed to promote re-nesting. If age is unknown, eggs can be measured and weighed with the following calculation applied. This usually gives an accurate ageing of an egg, which will take 30 days to hatch.

Length (mm) x width (mm) squared x 0.000554 = Fresh weight (FW)

FW - Actual weight/(FW x 0.18/30) = Age (days)

Dud eggs should be opened and inspected for fertility or state of development.

3. Egg Manipulation

Should a pair consistently fail to produce viable eggs and are actively nesting, one or two eggs may be 'donated' from a productive pair if available. This may mean distributing eggs so that each pair has at least one viable egg, or the donor pair may have both eggs removed to encourage re-nesting. Consideration should be taken of how old the donor egg is and for how long the foster parents have been incubating a dud egg or empty nest. It may be wise to use a dummy egg and/or transfer the egg close to hatching, to prevent desertion, if birds have been incubating for a long period.

Often male/male or more usually female/female pairs will form in the absence of the opposite sex. This can create a perfect situation for egg fostering to increase production.

Appendix 5. Egg handling guidelines

Takahe eggs lose approximately 18% of their fresh weight (as water loss through the shell) during a 30 day incubation period. Age and viability can be determined using a mathematical formula and by candling (viewing the internal development) of an egg. This will age most eggs reliably to within two or three days.

The fresh weight (FW) of an egg is obtained using the formula
Length x width squared x 0.000554 = FW

Once the fresh weight is determined the actual weight (W) is subtracted and this figure divided by the egg's calculated daily weight loss (DWL) results in its age.

$$FW - W / (FW \times 0.18 / 30) = \text{Age, days incubated.}$$

At a nest remove one egg at a time and weigh, candle and mark it (with an x o or z at each end using a pencil). This must be done carefully and quickly, handling the egg with the utmost care as a developing embryo can be killed if shaken, jolted, chilled or heated. The incubating bird should not be made to leave the nest.

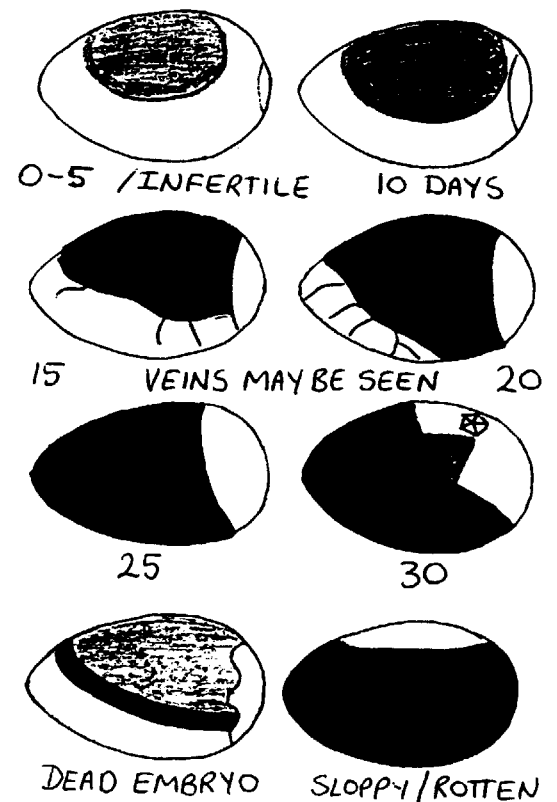
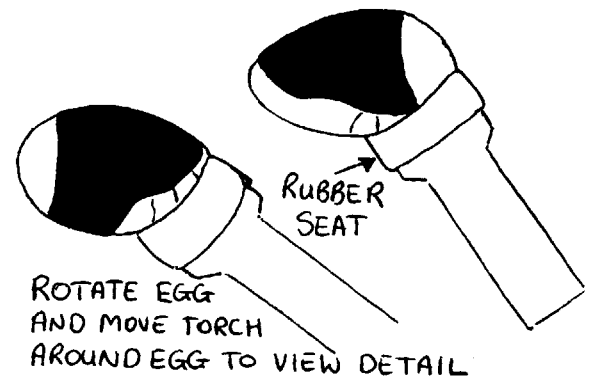
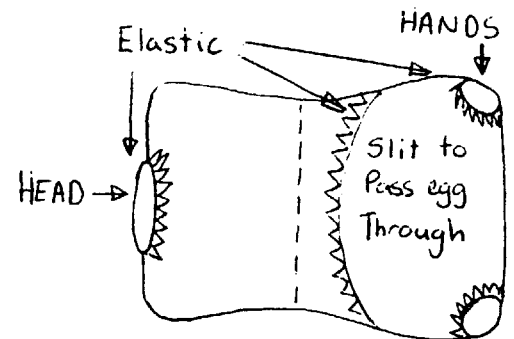
Measure eggs with vernier callipers to the nearest tenth of a millimetre. Width is obtained at the widest point, rotate the egg carefully for this. Weigh eggs in a small plastic bag using 100 g or 300 g scales. Record to the nearest 10th of a gram, remembering to subtract bag weight.

Candling: Use a torch inside a dark bag to trans-illuminate the egg. Gently roll the egg to obtain the best view of the contents and air cell. *Never roll the egg in one direction for long as this will damage it.* Results of candling will vary depending on the shell pigment, thickness and strength of the torch. A fresh egg will look clear and a tiny air cell may be seen. As the embryo develops the size of the air cell increases and the yolk area enlarges and darkens. Shortly before hatching the chick breaks the air cell and can be heard cheeping in the egg, and pipping fractures may be seen on the shell above the aircell.

While candling look for hairline cracks in the shell. A cracked egg will lose weight at a faster rate and provides an easy entry

BLACK CANDLING BAG

60x60 cm



for bacteria, reducing the egg's chances of survival. A crack can be sealed with clear nail varnish (over the crack only) to increase chances for survival. A cracked egg often gives a false age calculation.

Dead eggs may candle sloppy or have a fuzzy or absent air cell, while an infertile egg will remain as a fresh egg. Another helpful indicator of the length of time birds have been incubating is the size of the 'latrine' next to the nest. If in doubt of an egg's viability, return it to the nest.

Eggs should be transferred in individual, well padded and insulated containers, standing up on their pointed ends. If the time will be greater than half an hour out of the nest then a portable incubator is required.

Appendix 6 Transfer Methods

Catching:

Birds can be captured with little stress on the bird if done properly. Inexperienced people should contact Department of Conservation staff at Te Anau well before birds are moved.

Transfer Boxes:

Takahe cope well with transfer by road, helicopter, plane or boat. They can be held inside a dark cool box for several hours.

Boxes should be sturdy 50 x 30 x 40 cm deep with the top opening as a lid. Insulating the exterior with a layer of 1 cm closed cell foam reduces noise and vibration during travel. It must be easily cleaned and sterilised after use. Good air ventilation is required, but should not allow beaks or toes to fit through, and still keep the interior reasonably dark. House foundation air vents at each end are ideal. The base must be well drained (takahe are messy travellers) and should be lined with newspaper and a thick layer of grass. The grass will also serve as food. For a long trip pottles of water and pellets should be fixed in a corner.

Releasing Takahe:

The site requires a sufficient area of good quality grass and a permanent water source (a trough large enough for bathing is adequate) and some scrub cover. It should be away from other pairs to reduce territorial disputes. Takahe are very territorial and can be quite brutal to one another, especially if forced to live within another bird's territory. If they can see but can't physically harm each other because of a fence, then they are likely to suffer a great deal of stress and do a lot of fence pacing. Generally two birds that do not know each other can be penned together even if the same sex, but one unknown bird should not be added directly to a group of birds.

For initial release birds can either be placed in a temporary pen (shade cloth) at least 12 m² for 2-3 days, to familiarise with the area and each other (usually the best method). Or they may be released directly, though they often become scared of people for some time after this. Supplementary feeding helps to calm the birds and they have a 'base' to return to, as they explore their new patch. A release site centred on a good water supply is the best option.

If a new pairing is required it is usually worthwhile to pen the two birds together in at least a 12 m² pen for up to a month, but beware of stress or aggression.

PUBLISHED RECOVERY PLANS

Takahe (\$20)	Approved 1994
Dotterel (\$20)	Approved 1993
Tuatara (\$20)	Approved 1993
Mohua (\$20)	Approved 1993
Subantarctic teal (\$20)	Approved 1993
Kowhai ngutukaka (\$20)	Approved 1993
Chevron skink (\$20)	Approved 1993
Black stilt (\$20)	Approved 1993
Whitaker's and robust skinks (\$20)	Approved 1992
North Island kokako (\$20)	Approved 1991
Kiwi (\$15)	Approved 1991
Yellow-eyed penguin	Approved 1991
Available: from Otago Conservancy, Department of Conservation, Dunedin	
Blue duck (\$10)	Approved 1991
Available: <i>Science & Research Internal Report No.30</i> Science & Research Division, Department of Conservation, Wellington	
Kakapo	Approved 1989
Out of print	

Copies may be ordered from:

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