

Brown Teal Captive Management Plan

THREATENED SPECIES OCCASIONAL PUBLICATION NO. 15



Department of Conservation
Te Papa Atawhai

Brown Teal Captive Management Plan

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Grant Dumbell

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Abstract

The brown teal *Anas chlorotis*, or pateke, is an endemic New Zealand species which was historically distributed throughout the lowland freshwater wetlands of the New Zealand mainland and occurred on many offshore islands, but is now largely restricted to Great Barrier Island and the east coast of Northland. Fewer than 2000 brown teal now exist in the wild, making the species the rarest waterfowl on the New Zealand mainland. The Department of Conservation has classified it as a Category B threatened species, and, based on IUCN criteria it is internationally classified as Endangered. As a response, the Department of Conservation prepared the brown teal recovery plan to guide recovery actions in the 10 years to 2005.

A captive population of brown teal numbers at least 20 pairs of birds. Captive management has the potential to make a significant net contribution to future brown teal recovery, in spite of initial concerns that a captive population would be a net consumer of birds and about the lack of pedigree records. Captive brown teal have been shown to have a long productive life, and productivity can also be enhanced by management techniques such as multiple clutching, artificial incubation and brooding, and cross-fostering, all of which have been used successfully.

The goal of the Brown Teal Captive Management Plan is to maintain, manage and develop the brown teal captive breeding programme to retain known genetic diversity, annually supply known quality birds for release in the quantities and at the times required by the recovery programme, and to contribute to brown teal advocacy. A number of objectives to be achieved during the life of this plan are described. Within each objective a range of tasks will need to be completed, and a time frame for their completion is proposed, together with procedures for ensuring that the programme is followed.

1. Introduction

1.1 TAXONOMY OF BROWN TEAL

Vernacular name:	brown teal, pateke
Scientific name:	<i>Anas chlorotis</i>
Family/Subfamily:	Anatidae: Anatinae (Ducks)
Order:	Anseriformes
Class:	Aves

The brown teal *Anas chlorotis*, or pateke, is an endemic New Zealand species of the worldwide *Anas* genus of dabbling ducks within the family Anatidae. Within this large genus, brown teal are included in the informal grouping of Austral Teal (Delacour 1956). From New Zealand, the grey teal *A. gracilis*, Campbell Island teal *A. nesiotis*, and Auckland Island teal *A. aucklandica* are also included.

Recent authorities have differed on the specific status of brown teal. Marchant & Higgins (1990) gave it species status while Turbott (1990) classified it as one of three subspecies of *A. aucklandica*.

The brown teal recovery plan (Williams & Dumbell 1996) followed Marchant and Higgins (1990), based on unpublished genetic research which supported the bird's specific status (see Williams et al. 1991), and the adoption of species status for the flightless subantarctic teal recovery plan (McClelland 1993). For consistency, this plan follows the brown teal recovery plan.

1.2 CONSERVATION STATUS OF BROWN TEAL

DOC Status:	Category B (Molloy & Davis 1994)
IUCN Status:	Endangered (IUCN 1994)

The brown teal is fully protected by the Wildlife Act 1953. The Department of Conservation has classified it as a Category B threatened species, the second highest ranking of threat, with a current distribution within the Northland, Auckland, Wellington and Southland conservancies (Molloy & Davis 1994). It is one of 47 bird taxa in Category B and one of 98 threatened New Zealand birds. Based on IUCN criteria (IUCN 1994), the brown teal is internationally classified as Endangered (Green 1996).

Brown teal were historically distributed throughout the lowland freshwater wetlands of the New Zealand mainland and occurred on many offshore islands, as well as Stewart Island and Chatham Island. The brown teal recovery plan (Williams & Dumbell 1996) and two previous reviews of historical data (Hayes & Williams 1982, Dumbell 1986) document the species' known historic range and summarise its decline over the past 150 years.

Brown teal are now largely restricted to Great Barrier Island, where numbers are presumed to be stable between 1300 and 1500 individuals, and the east

coast of Northland, south of the Bay of Islands, where numbers are steadily declining and are now below 500.

Small populations exist on Little Barrier Island, Rakitu Island, Kawau Island, Moturoa Island, Tiritiri Matangi Island, and Kapiti Island, the last three of which derive from successful reintroductions of captive reared birds. There are a few pairs scattered in parts of Northland. A relict Fiordland population also exists, but its status is unknown as recent sightings have been of isolated pairs and single family groups. A captive population of brown teal numbers at least 20 pairs of birds.

Fewer than 2000 brown teal now exist in the wild, making the species the rarest waterfowl on the New Zealand mainland. As a response, the Department of Conservation prepared the brown teal recovery plan to guide recovery actions in the 10 years to 2005. This was approved by the Director-General of Conservation in February 1996.

1.3 HISTORY OF BROWN TEAL IN CAPTIVITY

Before 1974

Brown teal have been in captivity since at least 1957 (Hayes & Williams 1982), when two pairs were exported to the Wildfowl Trust at Slimbridge, England. Prior to 1960, small numbers were held by private New Zealand aviculturalists (Reid & Roderick 1973), but the first documented captive breeding was carried out by the Wildfowl Trust in 1960 (Fisher et al. 1969).

Between 1964 and 1974 brown teal were successfully kept and bred by the Wildlife Service at the Mt Bruce Native Bird Reserve, now the National Wildlife Centre (Reid & Roderick 1973). By 1974, nine pairs were at Mt Bruce (Roderick 1974) - three on an open pond and six in separate aviaries. That year, eight pairs (89%) laid eggs, and pair productivity ranged from one clutch of five eggs to six consecutive clutches totalling 40 eggs. Thirty one clutches contained a total of 167 eggs (mean 5.4 eggs per clutch), 98 (59%) of which were fertile. Fifty nine hatched (35%), giving an average productivity of 1.9 ducklings per clutch.

Surplus birds were released on to Kapiti Island in 1968 (Williams 1969) and on several coastal Manawatu dune lakes (Appendix 1) after 1973 (Roderick 1974, Williams 1974). The Kapiti Island release of ten birds was very successful. Breeding was confirmed within four months of release, and at least 70 ducklings fledged in the first three years (Williams 1974). No further releases were made, yet brown teal persisted on the island, without management, until 1996. In 1996, 9 birds were caught and 6 were taken into captivity.

After 1974

In 1975, the Wildlife Service supplied breeding stock from Great Barrier Island to Ducks Unlimited New Zealand Inc. newly established 'Operation Pateke'. This was the beginning of a coordinated programme to breed large numbers of brown teal to fuel an ambitious release programme to attempt the re establishment of wild populations, beginning in the Manawatu (Williams 1974).

The captive management objectives of 'Operation Pateke' were to establish fifty pairs of brown teal, and to breed 1000 birds for release into suitable wild areas. The first objective was attained in 1984, and the total number of birds reared by 'Operation Pateke' participants passed through the 1000 mark in 1987 (Table 1).

Brown teal captive management received a significant boost in 1980 when Ducks Unlimited staged a captive breeding seminar. This led to the production of an avicultural handbook (Hayes 1981) covering many aspects of the bird's husbandry. It recognised the aggressive nature of brown teal and the need to house each pair in their own self-contained aviary for best breeding results. It also laid out a protocol for establishing breeding pairs by flock mating young birds to allow them to select their own mates.

With the increasing success of captive management after 1980, and the failure to establish a wild population in the Manawatu or on Matakana Island in the Bay of Plenty, the focus of the release programme shifted to Northland in 1984. Here a number of release sites have been used, all adjacent to, but not within the range of, existing wild populations.

While captive reared birds have been shown to mate, nest and fledge young in the wild (Dumbell 1988) the only successes for the release programme have been on islands. Small breeding populations have been established on Moturoa Island in the Bay of Islands (birds released in 1995 and 1996) and Tiritiri Matangi Island in the Hauraki Gulf (birds released in 1987 and 1990).

With the lack of any significant mainland release success, the Department of Conservation requested in 1994 that 'Operation Pateke' be scaled back so the production of captive reared birds more closely corresponded to the availability of departmental resources to prepare and monitor releases.

Origins of captive stock

The wild stock to support captive breeding prior to 1974 consisted of 22 birds removed from Great Barrier Island from 1960 to 1972 (Hayes & Williams 1982). A further 16 birds were removed in 1974, and when these readily adapted to captivity, an additional 23 birds were taken into captivity from the island in 1976.

No further wild stock entered captivity until 1987 when 10 birds (five males and five females) were removed from Great Barrier Island to provide an infusion of wild blood to the captive programme. These were followed in 1988 by five Great Barrier Island ducklings who were members of an orphaned brood. Therefore, the current captive breeding population is descended from 76 wild birds, all of which have originated from Great Barrier Island.

In addition to the Great Barrier Island stock, three wild male birds have come into captivity as injured birds. One was captured at the Mangere sewerage treatment plant in Auckland, suffering from botulism, and the other two were handed to the Otorohanga Kiwi House without any source location information. These birds have not entered the captive breeding population.

International captive breeding

The two pairs of brown teal exported to England in 1957 first bred in 1960. Breeding continued for the next nine years (Hayes & Williams 1982), with more than 80 birds being raised (Reid & Roderick 1973). Breeding success slowly declined, due to increasing infertility, and through the 1970s the number of birds in England decreased until only three males survived in 1979.

A further two females were received by the Wildfowl Trust in 1979, and breeding immediately recommenced with 14 young produced in 1980 and a further 16 in 1981. At the end of 1996, there were approximately 30 brown teal in Britain and a further three pairs in Germany (J. Beachman, pers. comm.).

Captive breeding summary

To mid 1996 'Operation Pateke' had fledged 1856 brown teal, but as this total includes the results from the Mt Bruce Native Bird Reserve from only 1984 onwards, it is likely that at least 2000 birds have been reared in captivity since 1964. These have originated from just 76 wild birds, and 1634 birds have been released (Appendix 1). Therefore, the first 32 years of brown teal captive breeding has resulted in 21.5 birds being released for every wild bird taken into the programme

Total internal losses (total birds fledged minus total birds released) number approximately 370 birds, so therefore 4.4 birds have been released for each bird consumed by the programme. This compares with an estimated lifetime productivity for wild brown teal of just one duckling per bird, as measured on Great Barrier Island (Dumbell 1987). Therefore, in terms of numbers of birds available to be recruited into a wild breeding population, the captive population is more than 300% more efficient at producing these birds than are wild populations

Without doubt, captive management has the potential to make a significant net contribution to future brown teal recovery, in spite of initial concerns (Williams 1976) that a captive population would be a net consumer of birds. Captive brown teal have been shown to have a long productive life, with one bird surviving for 22 years. Productivity can also be enhanced by management techniques such as multiple clutching, artificial incubation and brooding, and cross-fostering, all of which have been used successfully.

Current status of captive population

At the beginning of 1997, Ducks Unlimited recognised 16 pairs held by eight breeders as part of 'Operation Pateke', but at least eight further pairs held by four breeders are not included in this total. To this must be added the three wild males held outside the breeding programme, plus an indeterminate number of juvenile birds from the 1996 breeding season awaiting release, or pairing to replace breeding stock. These figures continue the trend of captive population reduction which has been evident since 1990 (Table 1).

Captive population management

Since the inception of 'Operation Pateke', the only records kept have been annual reports from breeders detailing breeding results for each pair. These

TABLE 1. ANNUAL BREEDING RESULTS FROM THE DUCKS UNLIMITED NEW ZEALAND INC. 'OPERATION PATEKE'.

BREEDING YEAR	BREEDING PAIRS	YOUNG FLEDGED	AVERAGE PAIR PRODUCTIVITY
1975/76	5	15	3.0
1976/77	21	19	0.9
1977/78	15	18	1.2
1978/79	20	29	1.5
1979/80	21	45	2.1
1980/81	27	101	3.7
1981/82	36	79	2.2
1982/83	37	112	3.0
1983/84	39	147	3.8
1984/85	58	127	2.2
1985/86	75	153	2.0
1986/87	53	81	1.5
1987/88	62	130	2.1
1988/89	53	133	2.5
1989/90	49	101	2.1
1990/91	53	138	2.6
1991/92	45	112	2.5
1992/93	41	109	2.7
1993/94	36	102	2.8
1994/95	24	60	2.5
1995/96	18	45	2.5
1996/97	18	41	2.3
1997/98	18	35	1.9
1998/99	17	42	2.5
Total	841	1974	2.3

have been summarised as a table of annual production for the captive population (Table 1).

No records have been kept regarding the age or parentage of the breeding stock so it has not been possible to construct a studbook for the programme, nor is it possible to calculate more detailed population statistics, such as age structure, average reproductive lifespan, or measures of genetic relatedness. Some measures of individual pair performance can be calculated over a number of breeding seasons using the individual breeder's reports.

While brown teal captive management has produced large quantities of young birds, their quality, in terms of their genetic representation of wildtype traits, is unknown. With no information about the parentage of individual birds, the number of generations the current stock is removed from wildtype birds is also unknown.

With 76 wild birds forming the founder population, it may appear that the captive population is a good representation of wild genotypes and phenotypes. However, some of these birds may not be represented in the current captive

population, and without pedigree records there is no way of knowing how much of a genetic bottleneck the captive population has been subject to.

In addition to any 'founder effect', early 'Operation Pateke' reports record how artificial selection was applied by the progeny of successful breeding pairs being used to expand the programme. Selection for high captive breeding output could be selection against wildtype traits with the result that later generations which were released were better equipped for life in captivity than for life in the wild.

Large-scale pheasant breeders recognise that high-producing captive pheasant lines do not necessarily produce high survival of released birds. In one case, released captive reared pheasant were found to only nest in the presence of wire netting (M. Powell, pers. comm.). The infusion of wildtype males often leads to reduced pheasant breeding output but a rise in the survival of released birds.

To begin to correct the lack of knowledge about the quality of captive reared brown teal, the breeding stock was rearranged in 1994 to bring the surviving wild caught birds together as two wild pairs. The progeny from these pairs, labelled F_1 wild birds, could then be paired to the progeny from existing captive pairs, labelled F_1 captive birds, to create known outcross pairs, of known age and parentage. These pairs would then produce F_2 wild birds for release.

This restructuring of the captive stock was designed so that individual life histories could be managed through a studbook, without having to restart the programme with fresh wild caught stock. To date, the change-over to F_1 wild/ F_1 captive breeding pairs has not been completed.

2. Goal, objectives, and context of brown teal captive management

2.1 CONTEXT OF CAPTIVE MANAGEMENT

The brown teal recovery plan (Williams & Dumbell 1996) has the goal:

To maintain brown teal in the wild state on the mainland and islands of the New Zealand region in sufficient numbers and at sufficient secure locations so that it has a conservation status of 'non-threatened' based on IUCN criteria.

This requires a focus on numbers of birds and the number of populations. The recovery plan has identified seven objectives as being necessary to attain this goal, and captive management has a role in five of them, as indicated below by italics. Collectively these set the context for the management of the captive population:

- (i) To maintain the current numbers and distribution of brown teal on Great Barrier Island;
- (ii) To maintain a viable breeding population of brown teal (based on existing wild birds) at a minimum of two locations on the mainland of Northland;
- (iii) To establish new breeding populations (of ten or more pairs) of brown teal on at least five further islands;*
- (iv) To initiate, by a variety of means, the establishment of new brown teal populations at a minimum of five locations on the New Zealand mainland;*
- (v) To determine the taxonomic and genetic status of teal in Fiordland relative to teal on Great Barrier Island, and if distinctive, to capture sufficient to establish a captive breeding programme capable of producing 20 pairs by 2005;*
- (vi) To maintain the existing captive breeding programme operating under a captive management plan which is capable of supplying birds for release annually;
- (vii) To broaden the public constituency of support for brown teal conservation and to involve all elements of that constituency fully in the recovery programme for brown teal.*

For further information regarding these objectives, readers are referred to Section 9 (Interpretation of conservation objectives for brown teal) of the recovery plan.

2.2 GOAL OF CAPTIVE MANAGEMENT

To develop and maintain close links between brown teal captive management and recovery, the captive management programme must address the recovery programme through its own goal:

To maintain, manage and develop the brown teal captive breeding programme to retain known genetic diversity, annually supply known quality birds for release in the quantities and at the times required by the recovery programme, and to contribute to brown teal advocacy.

The achievement of this captive management goal will require a high degree of integration between the in situ and ex situ parts of the recovery programme, and an acceptance by those involved with brown teal captive management that their contribution to brown teal recovery is a means to an end, and not an end in itself.

2.3 OBJECTIVES OF CAPTIVE MANAGEMENT

The attainment of the above goal will require a number of objectives to be achieved during the life of this plan. Within each objective a range of tasks will need to be completed. Where possible, these tasks have been identified and grouped under the relevant objective. The objectives are:

Objective 1

Establish best-practice captive management procedures.

Task 1A Appoint and support a captive management coordinator who shall be a member of the Brown Teal Recovery Group.

Task 1B Establish a brown teal studbook, using SPARKS (Small Population Animal Record Keeping System) software, and an auditable holder reporting system to provide high-quality information to the studbook.

Task 1C Liaise with all brown teal holders to ensure their individual role is understood, and is compatible with the captive management goal.

Task 1D Seek advice from captive management specialists to ensure the programme is effectively structured and managed, e.g. New Zealand Conservation Management Group (CMaG), Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), Conservation Breeding Specialist Group (CBSG).

Task 1E Prepare a husbandry manual in accordance with guidelines.

Task 1F Liaise with the Biodiversity Recovery Unit to ensure the captive breeding programme continues to meet policy guidelines, e.g. Captive Management Guidelines, Wildlife Health Management Guidelines.

Objective 2

Develop a captive management capability for Fiordland brown teal

Task 2A Develop a contingency plan to allow the establishment of a captive management subprogramme for Fiordland brown teal, should birds be brought into captivity.

Objective 3

Retain existing genetic diversity and produce quality birds for release

Task 3A Complete the breeding stock restructuring so that all pairs, except the wild pairs, are outcrosses of known age and parentage.

Task 3B Maintain the existing genetic diversity in captivity by ensuring all current pairs are represented in the restructured programme.

Task 3C Mate the unpaired wild males with captive reared females to establish an additional three unrelated 50% wild lines to provide additional outcrosses for the two existing wild pairs.

Objective 4

Annually produce sufficient birds for release within the required Time frames

Task 4A Determine captive population performance measures.

Task 4B Liaise with the Brown Teal Recovery Group to determine annual production targets with a 24 month lead time.

Objective 5

Use captive birds to advocate brown teal conservation

Task 5A Ensure that holders with birds on public display make the visiting public aware of the recovery programme and how the captive management programme is contributing to it.

2.4 TIME FRAME OF CAPTIVE MANAGEMENT PLAN

While the recovery plan was written to cover a ten-year period, this captive management plan should be reviewed after five years as the above tasks should all be completed by then. As this plan is implemented it is likely that further tasks will be identified and added. A review at five years will allow a re-assessment of the objectives to ensure that ex situ brown teal captive management continues to meet the demands of the in situ recovery programme.

3. Captive management strategy

3.1 TASK TIME FRAMES AND REVIEW

Thirteen tasks have been identified as needing to be completed for the brown teal captive management programme to achieve its goal within the five year life of this plan. Each of these are set out below with a supporting explanation, and a suggested time frame for their completion. The lifetime of the plan and the time frame for each task is also graphically summarised Figure 1.

It is important that the progress of implementing this plan is reviewed at least annually by the Brown Teal Recovery Group, of which the Brown Teal Captive Management Coordinator will be a part. Not only will this help ensure the captive management programme can be adequately resourced through the overall recovery programme, but also it will provide accountability to check that prescribed tasks are being successfully completed on time. In turn this will help the in situ and ex situ parts of the recovery programme become, and then remain, closely integrated.

TASK	MONTHS FOLLOWING PLAN APPROVAL											
	0	6	12	18	24	30	36	42	48	54	60	
1A Captive management coordinator												
1B Studbook and reporting system												
1C Liaison with brown teal holders												
1D Specialist advice												
1E Husbandry manual												
1F Policy guidelines												
2A Fiordland contingency plan												
3A Breeding stock restructuring												
3B Maintain existing genetic diversity												
3C Unpaired wild males												
4A Performance measures												
4B Production targets												
5A Advocacy through public display												

FIGURE 1. SUGGESTED TIME FRAMES FOR COMPLETION OF IDENTIFIED TASKS WITHIN THE FIVE-YEAR LIFE OF THE BROWN TEAL CAPTIVE MANAGEMENT PLAN.

3.2 CAPTIVE MANAGEMENT COORDINATOR

Task 1A Appoint and support a captive management coordinator who shall be a member of the Brown Teal Recovery Group.

Explanation

The appointment of a captive management coordinator is crucial, as this person provides the link between the captive management programme and the recovery programme. The duties of captive management coordinators are set out in the draft captive management guidelines (Tisdall et al. 1997, Section 1.2).

The major functions of the Captive Management Coordinator include liaison with holders, maintenance of the studbook, preparation of annual reports, and advice to the Department of Conservation regarding management of the programme. At all times the Department retains the statutory responsibility for brown teal. Accordingly, the Captive Management Coordinator will need an understanding of brown teal aviculture, how to develop and manage the captive breeding programme to meet the objectives of this captive management plan, and access to the necessary computing resources to establish and support the studbook.

Responsibility: DOC Regional General Managers

Time frame: Within six months of plan approval

3.3 STUDBOOK AND AUDITABLE REPORTING SYSTEM

Task 1B Establish a brown teal studbook, using SPARKS (Small Population Animal Record Keeping System) software, and an auditable holder reporting system to provide high quality information to the studbook.

Explanation

The need for a studbook recording all birds within the captive management programme is central to its successful management. The SPARKS programme compiles a comprehensive database to provide demographic and genetic information about the captive population. It allows forecasting so that the Captive Management Coordinator can project the likely repercussions of management decisions. It also interfaces with related software, such as ARKS and MEDARKS, to allow specific behavioural, housing, feeding and veterinary information to be recorded against each bird over its lifetime. The programme also continues to record the details of birds which have died to ensure that pedigree information is as complete as possible.

With the captive population spread over much of the country it is important the Captive Management Coordinator receives accurate information on a timely basis. Therefore, breeders need to be supplied with standardised record sheets on which they can record the necessary data from the birds they hold. This manual recording system must then be traceable to allow the Captive

Management Coordinator to identify duplications, omissions or errors to ensure that studbook entries are accurate.

The minimum data requirements include an annual return detailing the breeding performance of each pair, and a method of individually banding and recording the identity, parentage, location, pairing and fate of all birds within the programme. Additional data collection will be required, and can be designed, as and when specific issues need to be addressed.

Responsibility: Captive Management Coordinator

Time frame: Within one year of plan approval, then at least annually

3.4 LIAISON WITH HOLDERS OF BROWN TEAL

Task 1C Liaise with all brown teal holders to ensure their individual role is understood, and is compatible with the captive management goal.

Explanation

To date, the roles of all brown teal breeders and holders of breeding pairs have been the same, in that birds have been housed and bred to provide young birds for release in large groups. Similarly, it has been assumed that all holders of brown teal have been willing participants in the captive management programme.

With captive management touching so many recovery plan objectives it is now possible for holders to fill differing roles. Some breeders may hold wild stock and produce birds for pairing as breeding stock, while others may breed from this stock to provide birds which are grouped for release. Other holders may not want direct involvement with breeding and may hold birds specifically for display. Another group of holders may be located at selected brown teal release sites to produce birds for direct release from the breeding aviary. While releases have traditionally involved groups of birds released together, a trickle of birds released over a longer period may provide better opportunities for them to establish in the wild.

With brown teal captive management having been successful at producing large quantities of birds over many years, this division of labour would yield greater opportunities to test different models of releasing birds into a range of different habitats. It would also allow different avenues for interested people to be able to contribute to brown teal conservation in ways their skills and abilities allowed.

Liaison between the Captive Management Coordinator and brown teal holders could be facilitated through personal visits, telephone calls, or the establishment of a newsletter. Initial contact should be made once the Captive Management Coordinator has been appointed, and at least two contacts should be made each year, in addition to the annual breeding return as part of Task 1B above. These could include information about annual production targets, the overall performance of the programme, and updates on recovery programme achievements.

Responsibility: Captive Management Coordinator

Time frame: Within one year of plan approval, then at least triannually

3.5 SPECIALIST CAPTIVE MANAGEMENT ADVICE

Task 1D Seek advice from captive management specialists to ensure the programme is effectively structured and managed, e.g. New Zealand Conservation Management Group (CMAg), Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), Conservation Breeding Specialist Group (CBSG).

Explanation

The knowledge and information about the management of small captive populations is growing rapidly. While the Captive Management Coordinator needs significant expertise with brown teal, and a knowledge of small population management, they also need to interface with similar programmes both in New Zealand and overseas. Organisations such as ARAZPA and CBSG employ population biologists with specialist captive management skills. Having these available to brown teal will enhance the programme and allow a more rapid transfer of high level expertise to brown teal captive management.

Once a brown teal studbook has been established using SPARKS software, and the initial restructuring of the programme, as prescribed by Tasks 3A, 3B and 3C, has been completed, it should be a priority to have the studbook analysed by a captive management specialist, such as is available through ARAZPA. This analysis will examine the structuring of breeding pairs within the programme and be able to make specific management recommendations in order to minimise the loss of genetic diversity and the accumulation of inbreeding within the programme.

The results of this analysis may lead to some further restructuring and will assist with the determination of captive population performance measures as part of Task 4A. It may also determine that additional wild stock needs to be brought into the programme to widen the genetic base of the captive population. Any such recommendation would need to be considered by the Recovery Group and through normal Department of Conservation channels for the permitting of a transfer of wild animals to captivity.

Responsibility: Captive Management Coordinator

Time frame: Within eighteen months of plan approval

3.6 HUSBANDRY MANUAL

Task 1E Prepare a husbandry manual in accordance with guidelines.

Explanation

Two previous publications (Hayes 1981, Hayes & Dumbell 1990) have summarised much brown teal avicultural information. These provide the basis

for the preparation of a formal husbandry manual in accordance with Department of Conservation guidelines (Tisdall et al. 1997, Appendix 2).

A development of a husbandry manual will allow the review of current captive management techniques and identify possible improvements. It will also allow the establishment of minimum standards for housing, health care, feeding and breeding management so the captive management programme can meet its obligations in terms of departmental policy for both captive management and wildlife health management.

The establishment of standards for recording information, and notifying and investigating deaths, will assist the Captive Management Coordinator to maintain an accurate studbook and provide the feedback necessary to assist the programme to meet its annual production targets. It will also allow the collection of veterinary information to provide both a better understanding of, and improvements in brown teal health management.

Responsibility: Captive Management Coordinator
DOC Biodiversity Recovery Unit

Time frame: Within two years of plan approval

3.7 POLICY GUIDELINES

Task 1F Liaise with the Biodiversity Recovery Unit to ensure the captive breeding programme continues to meet policy guidelines, e.g. Captive Management Guidelines, Wildlife Health Management Guidelines, Quarantine Workbook.

Explanation

The Department of Conservation has statutory responsibility for the conservation of brown teal and a range of policies provide a framework for the recovery programme, including the Quarantine Workbook that covers requirements for transfer. Policy changes and ongoing development may impact on how approvals are granted, or on minimum specifications that must be met. This may affect specific holders through the permitting system to hold, transfer or release birds, or may affect the captive management programme more widely through the Captive Management Guidelines or Wildlife Health Management Guidelines. Regular liaison between the Captive Management Coordinator and the Biodiversity Recovery Unit will allow policy changes to quickly flow through to the captive management programme.

Responsibility: Captive Management Coordinator

Time frame: Annually

3.8 FIORDLAND BROWN TEAL CONTINGENCY PLAN

Task 2A Develop a contingency plan to allow the establishment of a captive management subprogramme for Fiordland brown teal, should birds be brought into captivity.

Explanation

Available information suggests that Fiordland brown teal are phenotypically quite distinct from birds from northern populations, but that genetic differences are minor. The number of birds remaining in Fiordland is extremely low and this relict population may become extinct before definitive answers about its taxonomic status are available. The recovery plan has identified the option of securing Fiordland birds in captivity to retain their characteristics and to provide a source of birds for liberation at suitable southern sites.

The development of a contingency plan to establish a captive breeding subprogramme for Fiordland brown teal would allow the necessary resources to be identified ahead of time. This should include guidance on the minimum number of birds required to establish the programme, preselected holders able to house the birds and manage their transition to captivity, and a course of action to scale up the number of pairs to meet the recovery plan objective of producing 20 pairs by 2005, while minimising the loss of genetic diversity and the accumulation of inbreeding.

Consideration should also be given to preventing cross breeding between the northern and southern parts of the captive management programme. This may require the repatriation of breeding pairs of northern origin to the North Island, and the retention of Fiordland birds and their offspring solely in the South Island.

Responsibility: Brown Teal Recovery Group
Captive Management Coordinator

Time frame: Within one year of plan approval

3.9 BREEDING STOCK RESTRUCTURING

Task 3A Complete the breeding stock restructuring so all pairs, except the wild pairs, are outcrosses of known age and parentage.

Explanation

The establishment of best-practice captive management procedures through Tasks 1A to 1F will only deliver benefits to brown teal captive management if the breeding stock is correctly organised. Given the limitations of information about the existing breeding stock it is only possible to manage the programme as if the population were a colony. Moving to known ages and relationships of breeding pairs would provide a significant advantage for the future management of the programme. It would also allow a more objective

assessment of the structuring of the programme, as prescribed in Task 1D, which in turn may dictate further selected restructuring of breeding pairs.

With two pairs of wild brown teal breeding successfully there are wildtype birds available, but as the ages of this wild stock are unknown so is the length of time that young F_1 wild birds will continue to be available. Therefore, it would be prudent to use these birds to restructure the breeding stock as quickly as possible. This can be done by pairing the F_1 wild birds with birds of the same age produced from the captive stock (F_1 captive birds). As the parents of the F_1 wild birds are known, it can be assumed that these F_1 wild/ F_1 captive pairs are outcrossed with an inbreeding coefficient no higher than the average found in wild populations, even though the wild birds and the captive stock were both originally sourced from Great Barrier Island.

Once the wild caught birds stop breeding the programme again becomes a closed system where genetic diversity will be lost through a combination of management limitations and chance events. Having good representation of the wild stock in the programme will slow, but not halt, this process.

Responsibility: Captive Management Coordinator

Time frame: Within one year of plan approval

3.10 MAINTENANCE OF EXISTING GENETIC DIVERSITY

Task 3B Maintain the existing genetic diversity in captivity by ensuring all current pairs are represented in the restructured programme.

Explanation

The existing captive stock is known to be the product of breeding from 76 wild birds through an indeterminate number of generations with an unknown representation from this founder stock. Some wild birds have been introduced within the past decade so the existing captive stock may still contain a reasonable genetic representation from the founders. Without undertaking an expensive, and time consuming, genetic analysis of the captive stock, a high degree of the remaining genetic diversity can be captured by ensuring all existing pairs are represented in the restructured programme through at least one offspring from each being paired with an F_1 wild bird to form the new F_1 wild/ F_1 captive pairs.

Responsibility: Captive Management Coordinator

Time frame: Within one year of plan approval

3.11 UNPAIRED WILD MALES

Task 3C Mate the unpaired wild males with captive reared females to establish an additional three unrelated 50% wild lines to provide additional outcrosses for the two existing wild pairs.

Explanation

Restructuring the breeding stock using F₁ wild birds from the two wild pairs will result in the programme being composed of two family lines. Once the wild pairs stop breeding the only option for forming pairs will be to cross between these two family lines. This will provide an outcross for the next generation, but beyond that, inbreeding will begin to accumulate, unless additional wild stock is available.

The three unpaired wild males in captivity* can provide flexibility to the management of the programme if they are mated with females from the existing captive stock. These pairs would then produce an additional three 50% wild family lines to augment the two 100% wild family lines, thereby providing more options for pair formation in future generations. Having this flexibility will further slow the accumulation of inbreeding, once the wild birds stop breeding, and reduce the programme's future reliance on additional wild stock. The importance and management of these pairs, and their offspring, also needs to be carefully considered as part of the analysis of the programme under Task 1D.

Responsibility: Captive Management Coordinator

Time frame: Within one year of plan approval

3.12 PERFORMANCE MEASURES

Task 4A Determine captive population performance measures.

Explanation

The development of a studbook will lead to the collection of a greater amount of more detailed information regarding brown teal in captivity. This will include data on individual birds (survival, age of first breeding, inbreeding), pair productivity (fertility and hatching rates, egg and clutch production) and demography of the whole population (size, sex ratio, age structure).

Captive breeding performance measures can be developed from this information, and from the results of the studbook analysis prescribed under Task 1D, to ensure that improved management techniques can be identified and addressed. This has already been achieved for black stilt, and a similar approach to brown teal would allow more objective assessments of the success of captive management.

One factor which should be considered as part of this task is the need to debate and set a minimum captive population size. As the probability of the chance loss of genetic variation increases in smaller populations, and with the time that a population remains low in numbers, the adoption of a minimum population level will assist the preservation of the captive population's existing genetic variation and reduce the possibility of the captive management programme needing to seek further genetic input from wild birds. The studbook analysis will provide data for consideration as part of this debate.

* Note that two of the unpaired wild males died, so there is only one left in the system.

Responsibility: DOC Biodiversity Recovery Unit
Captive Management Coordinator

Time frame: Within two years of plan approval

3.13 PRODUCTION TARGETS

Task 4B Liaise with the Brown Teal Recovery Group to determine annual production targets with a 24 month lead time.

Explanation

The release of captive-bred brown teal is a factor in four of the seven recovery plan objectives. While translocated birds may be used, it is likely that captive bred birds will play a large role in the release programme. If a separate subprogramme is established for Fiordland brown teal, this will lead to separate releases at southern sites. Releases at sites such as Chatham Island may demand large numbers of birds in a short period, while releases on smaller islands may need a steady supply of birds over a longer period. As yet there is no way of forecasting what the annual demand for birds may be, as a structured release programme has not been formulated. With the captive management programme now reduced in size, it is possible to gear production to the requirements of the release programme.

It is important that the Brown Teal Recovery Group provide guidance to the captive management programme by setting annual production targets two years ahead, and then working to maintain this lead time. As the annual requirements of the release programme are likely to be highly variable, meeting these will be a challenge. A two-year lead time will allow any necessary adjustments in the level of the breeding stock to flow through into the production of birds for release.

Using these forward production targets, and the fact that the long-run average productivity for captive brown teal is 2.4 ducklings per pair per year (Table 1), the Captive Management Coordinator will be able to estimate the required number of breeding pairs for each breeding season. This can then be communicated to holders through their regular contacts and decisions made as to whether the targets will be met by manipulating the number of pairs held, or the number of pairs allowed to make a breeding attempt. This flexibility allows performance measures, such as a minimum captive population size, to continue to be met while also preserving the programme's ability to meet increased demands in later years.

Responsibility: Brown Teal Recovery Group
Captive Management Coordinator

Time frame: Within one year of plan approval, then annually

3.14 ADVOCACY THROUGH PUBLIC DISPLAY

Task 5A Ensure that holders with birds on public display make the visiting public aware of the recovery programme and how the captive management programme is contributing to it.

Explanation

Brown teal are on public display at a number of zoos and wildlife parks. This represents a significant opportunity to raise the public awareness of the recovery programme. While the recovery plan does not prescribe any particular course of action it emphatically states (its sections 6.3 and 9.7) that the involvement of the wider community should be promoted.

The captive management programme can contribute through visitors gaining up to date information about brown teal recovery while visiting participating institutions. This could be achieved through signage attached to display aviaries, the provision of brochures or fact sheets, or by providing resources for institutions to include brown teal in education programmes offered to schools and other groups.

Institutions which do not currently hold brown teal could be canvassed to assess which may be willing to join the captive management programme. Significant advocacy gains could be made by recruiting new participants, especially those with large visitor numbers, or those in areas important for brown teal conservation.

Responsibility: Captive Management Coordinator

Time frame: Within three years of plan approval

4. Work plan

4.1 PRIORITIES

Each of the thirteen tasks identified for completion within the five year life of this plan (Figure 1) can be characterised as being either a programme restructuring task or a programme management task. Accordingly, they can be prioritised within each of these two broad categories. Similarly, the programme restructuring tasks should be prioritised ahead of the programme management tasks as the completion of these are fundamental to the efficient ongoing management of available brown teal captive management resources.

Restructuring tasks

These should be implemented in the following order:

- Task 1A Appoint and support a captive management coordinator who shall be a member of the Brown Teal Recovery Group
- Task 1B Establish a brown teal studbook, using SPARKS (Small Population Animal Record Keeping System) software, and an auditable holder reporting system to provide high quality information to the studbook.
- Task 3A Complete the breeding stock restructuring so all pairs, except the wild pairs, are outcrosses of known age and parentage.
- Task 3B Maintain the existing genetic diversity in captivity by ensuring all current pairs are represented in the restructured programme.
- Task 3C Mate the unpaired wild males with captive reared females to establish an additional three unrelated 50% wild lines to provide additional outcrosses for the two existing wild pairs.
- Task 1D Seek advice from captive management specialists to ensure the programme is effectively structured and managed, e.g. New Zealand Conservation Management Group (CMAg), Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), Conservation Breeding Specialist Group (CBSG).

Management Tasks

These should be implemented in the following order:

- Task 4B Liaise with the Brown Teal Recovery Group to determine annual production targets with a 24 month lead time.
- Task 1C Liaise with all brown teal holders to ensure their individual role is understood, and is compatible with the captive management goal.
- Task 2A Develop a contingency plan to allow the establishment of a captive management subprogramme for Fiordland brown teal, should birds be brought into captivity.
- Task 1F Liaise with the Biodiversity Recovery Unit to ensure the captive breeding programme continues to meet policy guidelines, e.g.

Captive Management Guidelines, Wildlife Health Management Guidelines.

- Task 4A Determine captive population performance measures.
- Task 1E Prepare a husbandry manual in accordance with guidelines.
- Task 5A Ensure that holders with birds on public display make the visiting public aware of the recovery programme and how the captive management programme is contributing to it.

Because this plan seeks to raise the overall standard of brown teal captive management, and generate a greater degree of integration between ex situ captive management and in situ recovery actions there are many questions which do not yet have clear answers. These will clarify themselves as the proposed restructuring of the captive management programme proceeds, and as the Brown Teal Recovery Group begins to more fully integrate captive management with their recovery actions. Accordingly, it is important that each task be completed on time as outlined in Figure 1.

Currently the captive management programme is being managed to produce approximately 40 birds annually for release. Accordingly, the size of the programme has been drastically reduced compared with its historical highs. However, there is no clear answer to the simple question of how big should the captive management programme be? This will depend on the outcome of both Task 4B and Task 2A, and will probably be a moving target.

4.2 BREEDING RESOURCES

The correct size of the captive management programme will not only depend on its required output (Tasks 4A and 4B), but also on the willingness of breeders to commit resources to brown teal captive management. Accordingly, Task 1C is important as the successful implementation of this plan will depend on a productive partnership between the Department of Conservation and captive managers.

Whatever size of programme is implemented, an absolute minimum size should be debated and adopted. Any future genetic input from wild stock is not assured, but needs to be critically assessed during the studbook review (Task 1D). However, it is important that the rate of loss of existing genetic diversity from within the captive population be slowed as far as possible. This is best achieved by maintaining a minimum number of individuals in captivity, even if they are not breeding. This minimises the chance loss of diversity through the captive population being forced through a bottleneck as would happen in the event of even a temporary restriction of the population to low numbers.

In this respect, fluctuations in the size of the programme may best be facilitated by manipulating the number of pairs each breeder holds, rather than the number of breeders in the programme. This approach retains the accumulated skills and experience of breeders when the size of the programme fluctuates downwards.

Similarly, a division of labour amongst brown teal breeders may provide greater management flexibility. The type of contribution each breeder is willing, or

able to make can be accommodated by having a hierarchical arrangement of breeders ranging from a few, highly skilled breeders managing the most important birds, to a larger group of breeders operating at lower levels of intensity.

Breeders who hold any Fiordland birds which come into captivity will need to be separate from those holding stock of Great Barrier Island origin. This could be extended to the point where southern birds are held in the South Island while the existing stock is repatriated to the North Island to prevent any possible cross breeding of the two stocks. Similarly breeders who produce birds for release may be divided into those who produce birds for release in large groups and those who produce birds for on-site trickle release.

4.3 ADVOCACY RESOURCES

Brown teal advocacy is an as yet undefined area even though both this plan and the Brown Teal Recovery Plan include advocacy amongst their objectives. Accordingly, a specific advocacy and education strategy should be developed to maximise this undeveloped area for brown teal conservation. Developing a clear direction and measurable outcomes for this area will not only increase public understanding of the plight of brown teal it may even lead to an increase in the resources available for brown teal conservation through private sector sponsorship.

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7. Appendix 1

SUMMARY OF BROWN TEAL RELEASES (1968 - 99)

DATE	LOCATION	TOTAL	MALES	FEMALES
01-04-99	Parorerahi Bay	22		
31-03-99	Waihoanga Stream	10		
00-00-98	Parorerahi Bay	28		
00-00-97	Waihoanga Stream	27		
11-10-95	Tawheranui Regional Park, Auckland	8	4	4
05-08-94	Hokianga Harbour, Northland	56	20	36
05-08-94	Moturoa Island, Bay of Islands	10	5	5
05-08-94	Urupukapuka Island, Bay of Islands	7	3	4
05-08-94	Waikino, Bay of Islands	30	15	15
14-10-93	Hokianga Harbour, Northland	54	19	32
18-08-92	Urupukapuka Island, Bay of Islands	6	3	3
17-08-92	Purerua, Bay of Islands	46	16	30
14-02-92	Purerua, Bay of Islands	64	30	34
31-10-91	Purerua, Bay of Islands	19	5	14
08-06-91	Mimiwhangata, Northland	33	18	15
15-01-91	Purerua, Bay of Islands	39	17	22
08-07-90	Tiritiri Matangi Island, Auckland	6	2	4
02-04-90	Purerua, Bay of Islands	67	35	32
02-04-90	Urupukapuka Island, Bay of Islands	6	3	3
22-10-89	Purerua, Bay of Islands	25	12	13
18-01-89	Purerua, Bay of Islands	70	36	34
29-10-88	Mimiwhangata, Northland	24	11	13
15-10-88	Mimiwhangata, Northland	23	8	15
30-07-88	Mimiwhangata, Northland	39	15	24
30-07-88	Urupukapuka Island, Bay of Islands	6	2	4
28-10-87	Tiritiri Matangi Island, Auckland	6	3	3
08-10-87	Mimiwhangata, Northland	11		
26-09-87	Mimiwhangata, Northland	45	31	14
22-08-86	Kaeo River, Northland	21		
26-07-86	Mimiwhangata, Northland	104	37	45
00-07-86	Kerikeri Farm Ponds, Bay of Islands	4		
00-07-86	Moturoa Island, Bay of Islands	6		
00-11-85	Moturoa Island, Bay of Islands	6	3	3
00-07-85	Te Anau Wildlife Centre, Southland	6	4	2
22-06-85	Takou Bay, Northland	45	28	17
09-04-85	Matapouri, Northland	30	15	15
04-08-84	Matapouri, Northland	54	29	25
04-08-84	Mimiwhangata, Northland	42	22	20
30-10-83	Nga Manu Trust, Wellington	16	9	7
12-08-83	Nga Manu Trust, Wellington	16	10	6
00-03-83	Nga Manu Trust, Wellington	25	13	12
00-01-83	Nga Manu Trust, Wellington	16	9	7
82/83	Kaikokapu Lagoon, Manawatu	60		
00-12-82	Pukepuke Lagoon, Manawatu	34	16	18
14-02-82	Pukepuke Lagoon, Manawatu	30	13	17

(continued overleaf)

DATE	LOCATION	TOTAL	MALES	FEMALES
81/82	Lake Koputara, Manawatu	49		
23-12-81	Pukepuke Lagoon, Manawatu	25	12	13
22-12-81	Matakana Island, Bay of Plenty	5	4	1
09-08-81	Pukepuke Lagoon, Manawatu	12	4	8
07-03-81	Matakana Island, Bay of Plenty	19	9	10
16-02-81	Matakana Island, Bay of Plenty	8	3	5
20-01-81	Matakana Island, Bay of Plenty	5	2	3
06-12-80	Matakana Island, Bay of Plenty	32	16	16
00-01-80	Pukepuke Lagoon, Manawatu	14		
00-01-80	Pukepuke Lagoon, Manawatu	16		
00-01-80	Pukepuke Lagoon, Manawatu	10		
00-00-79	Pukepuke Lagoon, Manawatu	11		
00-00-78	Kaihoka Lakes, Nelson	20		
00-00-78	Lake Koputara, Manawatu	20		
00-00-77	Lake Koputara, Manawatu	20		
00-00-77	Pukepuke Lagoon, Manawatu	32		
00-04-76	Lake Koputara, Manawatu	16		
00-00-75	Lake Koputara, Manawatu	23		
00-07-74	Lake Omanuka, Manawatu	17		
00-06-74	Lake Koputara, Manawatu	23		
00-00-74	Pukepuke Lagoon, Manawatu	15		
00-00-73	Pukepuke Lagoon, Manawatu	17		
00-00-68	Kapiti Island, Wellington	10	4	6
TOTAL BIRDS RELEASED		1721		