The New Zealand Brown Teal: 1845–1985

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Introduction

The basic natural history of the New Zealand Brown Teal *Anas aucklandica chlorotis* has never been compiled. The facts lie scattered throughout a wide range of books and journals, covering 140 years. In this review of the literature concerning Brown Teal, I have concentrated on published information, but have also included unpublished material.

The Brown Teal, alternatively known by its Maori name of Pateke (Falla *et al.* 1979a), is currently regarded as a subspecies of the flightless Auckland Island Teal *Anas aucklandica aucklandica* (Gray 1844), along with the flightless Campbell Island Teal *Anas aucklandica nesiotis* (Fleming 1935). While these conspecifics will be discussed, they are not treated as completely as the Brown Teal. However, the inclusion of the more important information about these birds can only assist in a broader understanding of the natural history of *Anas aucklandica.*

Taxonomy

Since 1844, when the nominate race was first described, New Zealand Brown Teal, Auckland Island Teal and Campbell Island Teal have occupied four different genera and had six different scientific names. Their taxonomic status has ranged from the currently accepted three subspecies of the endemic New Zealand species *Anas aucklandica,* through being three subspecies of the Australian Chestnut Teal *Anas castanea,* to being three monospecific genera. At a higher taxonomic level they have also been split between two subfamilies of the Anatidae.

It is highly probable that Forster, the naturalist on Cook's second voyage to New Zealand, recorded Brown Teal during his stay, in 1773, in Dusky Sound on the southwest coast of New Zealand's South Island (Sibson 1984). His journal records Gadwall *Anas strepera* as being present, and shot for food. However, both Forster's and Cook's descriptions fit the Brown Teal and David Medway (pers. comm.), an authority on the ornithology of Cook's voyages, is convinced this is the earliest record of Brown Teal. It was another 67 years before Earl collected the first specimens of the Auckland Island Teal on the voyage of HMS Erebus and Terror, in 1840 (Oliver 1930). The two specimens collected were described, in London, by Gray (1844) as *Nesonetta aucklandica.* This was followed in 1845 by the description of the Brown Teal as *Anas chlorotis.* Gray (1844–49) placed *N. aucklandica* in the subfamily Erismaturinae, the spiny-tailed ducks, while *A. chlorotis* was placed in the Anatinae, or river ducks. This classification was reaffirmed by Gray in 1862, and stood (Buller 1868, 1873, 1882, 1888; Potts 1869; Hutton 1871) until the British Museum of Natural History published volume 27 of its Catalogue of Birds. Salvadori (1895) therein redescribed *A. chlorotis* as *Elasmonetta chlorotis,* forming a monospecific genus. The genus *Nesonetta* was retained for *N. aucklandica.* However, Reichenow (1882) attempted to synonymise *Nesonetta* with *Erismatura* to reflect the subfamilial classification of the day. This was not recognised and fell into immediate disuse.

This modified nomenclature was used by the authors of the major reference lists produced following the turn of the century (Hutton 1904; Buller 1905; Mathews & Iredale 1913; Phillips 1925; Oliver 1930), until Peters (1931) returned to *Anas,* instead of *Elasmonetta,* as the generic name for Brown Teal. This was then followed by Falla and Stead (1938), Fleming (1939) and Stidolph (1939).

In 1935 Fleming described the Campbell Island Teal as *Xenonetta nesiotis.* The type specimen had been collected in 1886 by Captain Fairchild of the government steamer "Stella". Subsequently it had been mounted by Jennings, the taxidermist at the Otago Museum, and labelled "Campbell Island". Fleming gained it from a Captain Donne who had received it from Fairchild. He had differentiated *Xenonetta* from *Nesonetta* on the form of the bill and the scale pattern on the tarsi. Fleming's des-

cription was reported in Britain by Mathews (1935). Stead (1938) questioned the validity of the specific description on several points. He claimed that the variation of *Nesonetta* encompassed the measurements of *Xenonetta,* the tarsi reticulations were of little reliance and the plumage of *Xenonetta* resembled a possible juvenile specimen of a *Nesonetta* female held by the Auckland Institute and Museum. Stead then went on to question the existence of a flightless duck on Campbell Island at all. He believed that if Reischek could not find it in 1888 (Reischek 1888), then it was not there. Stead had also spoken to two ex-Campbell Island shepherds who had never seen flightless teal, and he went on to say that Buller also had no knowledge of a Campbell Island Teal even though he had his own dealings with Fairchild as well as Bethune, the engineer on the "Stella". Bethune had also made collections for Buller. Stead concluded, therefore, that the Campbell Island Teal existed only through an error by Captain Fairchild or Captain Donne and "in the face of this evidence, I think we may reasonably dismiss the claim that Mr Fleming's specimen came from Campbell Island as unsubstantiated". Fleming (1938) replied by publishing a letter from Captain Donne which reaffirmed the specimen was collected at Campbell Island.

Here the matter lay until Delacour and Mayr published their extensive review of the Anatidae in 1945. Their aim was a more natural grouping of species with a better understanding of affinities. They did this by expressing relationships with the generic name and differences with the specific name. They followed Stead (1938) in synonymising *Xenonetta* with *Nesonetta. Anas chlorotis (Elasmonetta* seems to have fallen into disuse) was included as a subspecies, and *Nesonetta* was then synonymised with *Anas.* In doing so they also followed Stead in disbelieving the existence of a flightless duck on Campbell Island. They made no reference to the subspecies *Anas aucklandica nesiotis* which would have been the trinomial for such a bird, under their taxonomy. However, Marples (1946) recognised Campbell Island Teal as a distinct form and by 1956 the Campbell Island Teal's existence had been proven, forcing Delacour (1956) to admit *A. a. nesiotis.*

After 1945 the next change was by Fleming (1953) who synonymised *Anas aucklandica* with *Anas castanea,* thus combining the Australian species. But in 1970, Kinsky reverted back to specific recognition for the New Zealand forms. The nomenclature used by authors during these 17 years was not consistent. To avoid a tortured description, this period is summarised in Table 1. Since 1970 there have been nine unfortunate digressions from Kinsky's standard (Edgar 1971; Weller 1974, 1975b; Cometti 1975; Hayes 1976; Moon & Lockley 1982; Robertson 1982; Sibson 1984; Howell 1985).

This taxonomic wandering has made the job of locating library and museum material all the more difficult. I therefore urge all curators and authors to standardise their usage on the nomenclature as accepted by Kinsky (1970). Otherwise the morass will continue.

Relationships

Salvadori first suggested that *Nesonetta aucklandica* was a direct descendant of *Anas chlorotis* and this prompted Hector and Buller to send specimens to Professor Newton for comparison (Buller 1895). Newton concluded that *N. aucklandica* was a modified form of *A. chlorotis* and this was held as a wonderful instance of evolution as it not only represented two species diverging from a common ancestor, each exhibiting entirely different habits, but represented divergence into two separate genera (Buller & Hector 1896). A Dr Collins believed he had seen a further flightless duck on the Snares Islands and Buller and Hector thought it desirable to obtain specimens from this new locality as its development would have been along divergent lines. Unfortunately no flightless teal has ever been collected from the Snares while Buller and Hector's wonderful instance of evolution disappeared with the Delacour and Mayr (1945) review.

While the Auckland Island Teal is considered descendant from Brown Teal stock, the Campbell Island Teal is considered descendant from Auckland Island Teal stock, and the debate over relationships has centered on the similarities between the two, rather than the differences. Falla is reported as admitting that *nesiotis* is, at most, a weak subspecies of *aucklandica* (Delacour 1956). However, Turbott (1976) admitted the possibility that Campbell Island received *chlorotis* stock rather than

aucklandica stock. This seems plausible given the flightless condition of *aucklandica*.

Delacour and Mayr (1945) placed *Anas aucklandica* in an informal group they called the austral teal. They believed that *A. aucklandica, A. castanea, A. gibberifrons* and *A. bernieri* form a species complex standing near the Mallard *Anas platyrhynchos*. This was made possible by recognising *A. castanea* as a full species rather than (Ripley 1942) being synonymous with *A. gibberifrons*. Delacour (1956) also found behavioural similarities between the austral teal on the one hand and Green-winged Teal *Anas crecca* and Pintail *Anas acuta*, on the other, and he placed austral teal between the Green-winged Teal and the Mallard. Scott (1957) also saw similarities with Pintail. He believed that *A. aucklandica* was primitive, rather than degenerate, and may be near "the original duck". Two superspecies were claimed to be formed by *A. bernieri* and *A. gibberifrons* and by *A. castanea* and *A. aucklandica*. This implied *A. aucklandica* is descendant from *A. castanea* (Falla 1953) and would have precipitated Fleming's synonymy (Fleming 1953). Lack (1974) admitted *A. aucklandica* but noted it was extremely close to, if not conspecific with, *A. castanea*. Several authors have recommended further study to clarify this species complex.

Van Beneden (1876) described a fossil anatid from Otago as *Anas finschi* and Buller (1888) speculated that this may have been allied to Brown Teal. However, this is the only mention of such a relationship, and further comparison is warranted.

Status and distribution

Present

The Brown Teal is now New Zealand's rarest anatid and is recorded in the Red Data Book (Kear & Williams 1978; King 1981) as a vulnerable species, making it one

Table 1. Nomenclature usage, 1953–1970.

Author and year		Brown Teal	Auckland Island Teal	Campbell Island Teal
Falla	1953	*A. chlorotis*	*A. aucklandica*	–
Fleming	1953	*A. c. chlorotis*	*A. c. aucklandica*	*A. c. nesiotis*
Edwards	1955	*A. c. chlorotis*	–	–
Oliver	1955	*A. chlorotis*	*A. a. aucklandica*	*A. a. nesiotis*
Delacour	1956	*A. a. chlorotis*	*A. a. aucklandica*	*A. a. nesiotis*
Scott	1957	*A. chlorotis*	–	–
Bell	1959	*A. chlorotis*	–	–
Wilson	1959	*A. chlorotis*	–	–
Westerskov	1960	*A. c. chlorotis*	*A. c. aucklandica*	*A. c. nesiotis*
Johnsgard	1961a, b	*A. aucklandica*	–	–
Bailey & Sorensen	1962	–	*A. c. aucklandica*	*A. c. nesiotis*
Williams	1962	*A. chlorotis*	–	–
Bell & Braithwaite	1964	*A. c. chlorotis*	–	–
Blanshard	1964	*A. c. chlorotis*	–	–
Williams	1964	*A. c. chlorotis*	*A. c. aucklandica*	*A. c. nesiotis*
Yaldwyn	1964	–	*A. aucklandica*	–
Blackburn	1965	*A. chlorotis*	–	–
McKenzie	1965	*A. chlorotis*	–	–
McKinney	1965	*A. a. chlorotis*	–	–
Delacour	1966	*A. a. chlorotis*	–	–
Gravatt	1966	*A. chlorotis*	–	–
McKenzie	1967	*A. chlorotis*	–	–
Williams	1967	*A. a. chlorotis*	–	–
Johnsgard	1968	*A. aucklandica*	–	–
Medway	1968	*A. c. chlorotis*	–	–
Fisher *et al.*	1969	*A. a. chlorotis*	*A. a. aucklandica*	*A. a. nesiotis*
Guthrie-Smith	1969	*A. chlorotis*	–	–
Muller	1969	*A. c. chlorotis*	–	–
Williams	1969	*A. a. chlorotis*	–	–
Kinsky	1970	*A. a. chlorotis*	*A. a. aucklandica*	*A. a. nesiotis*

Abbreviations: *A. a.* = *Anas aucklandica*. *A. c.* = *Anas castanea*.

of the five rarest anatids worldwide. Hayes and Williams (1982) have reviewed the past and present distributions of the species and charted the decline in both numbers and range since the time of European settlement in New Zealand (1840–1860).

The species distribution is now severely reduced compared with its historic range and the total wild population is thought to number less than 1500 birds. The size of the mainland relict population outside of Northland is unknown as only occasional sightings are made of birds in other districts: Waikato (Ogle & Cheyne 1981), Bay of Plenty (Hayes 1981), Manawatu (Caithness & Pengelly 1973) and Fiordland (Bull & Falla 1951; Robertson 1982). The Stewart Island population (Reischek 1888; Oliver 1926; Bull *et al.* 1978, 1985) is considered extinct, although an unconfirmed sighting was made in the eastern part of the island in 1980 (J. Innes, pers. comm.). The Northland population has been in a state of decline since surveys began in 1959 (Bell 1959). This decline has been reported by McKenzie (1971) and is believed to be continuing, leaving two disjunct subgroups (Hayes 1981). The New Zealand Wildlife Service has been monitoring this Northland population and it is believed to consist of between 200 and 500 birds.

By far the largest number of Brown Teal occur on Great Barrier Island. This is New Zealand's fourth largest island situated at the entrance of the Hauraki Gulf in the North Island. This population has been surveyed in 1957 (Bell & Braithwaite 1964), 1976 (Williams 1976) and 1979 (Ogle 1980, 1981). Each survey indicated between 600 and 700 birds were present and Hayes and Williams (1982) believed that the true population may approach 1000 birds. More importantly the surveys imply the population is stable which would be very important for any future management of the species involving wild birds (Williams 1978; Mills & Williams 1984).

Past (Figure 1)

The review by Hayes and Williams (1982) utilised much unpublished material that was in personal diaries and notebooks, and it produced a very good overview of the New Zealand situation. However, it was unable to give interesting records individual treatment. Some authors (Williams 1962; Fisher *et al.* 1969) gave the Brown Teal's sedentary nature and inability to disperse to new areas as factors in the species' decline. However, many records exist that show Brown Teal can not only disperse, but also establish themselves in suitable areas.

Of the islands around the coast of Stewart Island, Brown Teal have been recorded from Ulva (Anon 1941), Codfish (Dell 1950; Wilson 1959), Ruapuke (Fleming 1953) and Big South Cape (Williams 1962). In Fiordland, Henry (1897) recorded them from Resolution Island while further north, Edwards (1955) and Prebble (1971) recorded Brown Teal on Mayor Island. Of the northern islands, apart from Great Barrier, Brown Teal have been recorded from Little Barrier (Blanshard 1964; Hayes & Williams 1982), Kawau (Cometti 1975), Arid (Bellingham *et al.* 1982) and Great Mercury (Hayes & Williams 1982). To the south-east they occurred on the Chatham Islands (Travers 1868), but became extinct there about 1915 (Fleming 1939), while to the north-west they have been recorded from New Caledonia (Delacour 1966; Hannecart & Letocart 1983) and Queensland (Phillips 1925). Many of these records also report breeding.

On the mainland other records show that Brown Teal were distributed more widely than shown by Hayes and Williams (1982; Figure 1). In the South Island Guthrie-Smith (1895) recorded them at the head of Lake Tekapo, Pierce (1980) claimed they were common at Lake Wainono during the late 18th century and Handly (1895) mentioned them while discussing the Marlborough/Kaikoura region. In the North Island Buller (1888) recorded Teal from far up the Whangaehu Valley and from the Urewera country, a locality from which Hayes and Williams had no information. Annabell (Medway 1968) recorded Brown Teal from the upper Waitotara in the mid-1880's and McKenzie (1979) stated they were plentiful in and about the streams and swamps of the Hunua Ranges, but disappeared in the early 1920's. In fact, Buller (1882) wrote: "this elegant little duck is distributed all over the country, being met with in every inland lake and often in the deep freshwater streams which run into them, where the overhanging vegetation affords ready shelter and concealment".

This additional information makes the species' decline a more spectacular disaster.

Flightless teal

The Auckland Island Teal historically occurred on all the major islands in the Auckland Island group (Chapman 1890; Ogilvie-Grant 1905; Archey 1923). However, it has since become extinct on Auckland Island (Fleming 1953; Weller 1975a, c) the only island in the group supporting cats *Felis catus* (Scott 1971). Teal remain on the offshore islands (Kinsky 1970; Figure 2) including the small and relatively isolated Dundas Island (Falla *et al.* 1979b; Jenkins 1981). Although Myers (1923) and Oliver (1930) recorded them as common, records from 1942 indicated a decline on the main island was occurring (Scott 1971). Recent estimates suggest the

Figure 1. Past distribution of Brown Teal in New Zealand. Previously published localities are cross-hatched (from Hayes & Williams 1982), new records are individually labelled.

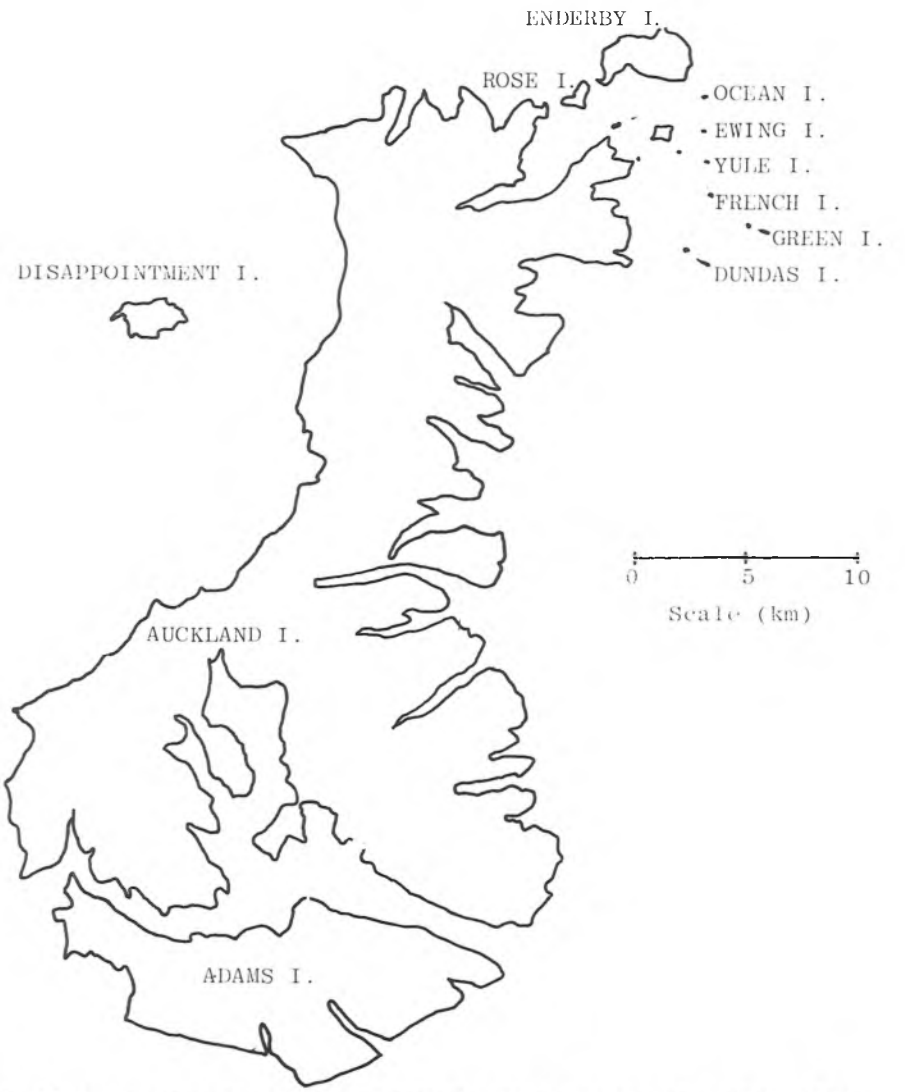

Figure 2. The current range of Auckland Island Teal indicated by boxes (adapted from Weller 1975a).

total population is at least 500 (Williams 1986) but this is considered safe with their wide distribution within the island group.

As late as the 1960's authors doubted the existence of a population of teal on Campbell Island (Westerskov 1960; Bailey & Sorensen 1962), due to the paucity of sightings. This prompted them to consider dispersal from the Auckland Islands only 240 kilometres away. Fleming (1953) recorded the subspecies as rare, while Kinsky (1970) stated it was possibly extinct. Sightings made since 1935 had all been on the main island, but in 1975 Campbell Island Teal were rediscovered, by the New Zealand Wildlife Service, on Dent Island (Robertson 1976). The population was very small and the most recent estimate (Williams 1985) is of less than 30 individuals (Figure 3).

Decline

Four reasons for the decline in New Zealand birds since European settlement – introduced predators, habitat destruction, overexploitation and disease – have all contributed to the demise of Brown Teal. Hayes and Williams (1982) believe the decline was in two phases. The first, in the

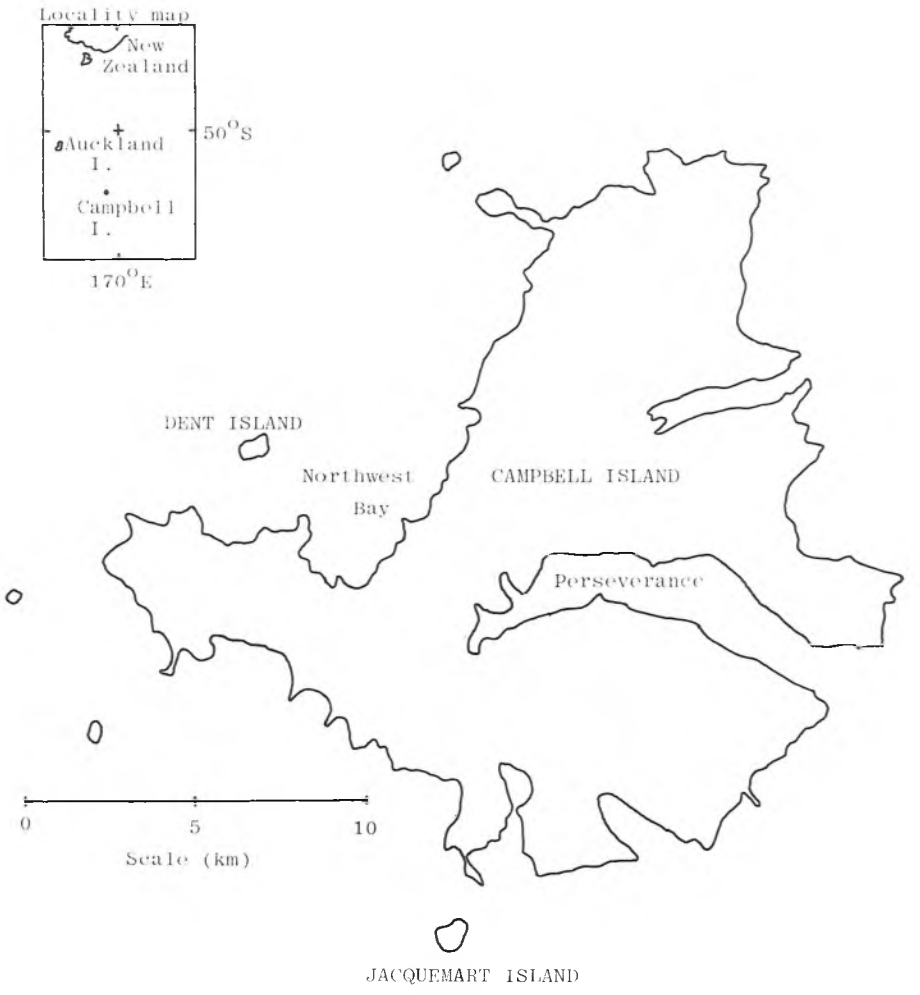

Figure 3. The current range of Campbell Island Teal, indicated by boxes (adapted from Westerskov 1960).

last quarter of the 19th century, has been attributed to land clearance and drainage, while the second came in the 1920's and 1930's. McKenzie (1971) has invoked an introduced poultry disease as the agent responsible for this second decline, and while diseases can decimate waterfowl populations (Clark 1979) their effect is generally local. Hayes and Williams (1982) do not believe this agent accounts for reduction in the range of Brown Teal south of Hawke Bay. They consider continued hunting and more active land development following World War I as major reasons.

It appears that the largest concentrations of Brown Teal inhabited the lowland kahikatea *Podocarpus dacrydioides* swamp forests. Buller (1888) recorded large numbers in the Manawatu Kahikatea swamps where he believed they were more common than generally supposed (Buller 1878), due to their retiring habits during the day. Oliver (1930) records Maori hunters snaring birds by day particularly in the Kahikatea forests. These forests have been virtually eliminated from New Zealand having been converted to lowland pasture. Buller (1888, 1892) and Oliver (1930) also describe Brown Teal's use of raupo or cattail *Typha orientalis* swamps for daytime concealment. This habitat has also been relentlessly drained and converted to pasture. On Great Barrier Island Brown Teal use manuka *Leptospermum sco-*

parium, and other streamside vegetation for their daytime roosting (Williams 1977). Further habitats used include intertidal streams, mangrove *Avicennia resinifera*, swamps and quiet inlets of the sea (Williams 1964); slow flowing streams having isolated pools with weeds, reeds and muddy shallows (Guthrie-Smith 1969) and small swampy tidal creeks (Williams 1974). With the near total demise of kahikatea swamps, it is impossible to return Brown Teal to their supposed "optimum" habitat.

Although Brown Teal has been a protected species since 1921, hunting has continued. Before this date hunting pressure must have been enormous (Turbott 1976). Potts (1869) considered the slaughter would make the Brown Teal a rarity within a few years, and in 1882 he reported that of 422 birds shot in nine days in Canterbury, none were Brown Teal, thus vindicating his prediction. Kirk (1895) reported that Brown Teal were especially sought by sportsmen and a Rangitikei correspondent informed Buller (1898) that Brown Teal had almost disappeared from that district, due to shooting. Stidolph (1939) attributed the loss of Brown Teal from the Wairarapa to protection arriving too late. Immediately after protection, Thompson (1922) considered Brown Teal well worthy of conservation as it was a fine game bird. Myers (1923) reported it was still being shot. Prior to 1949 Brown Teal numbers on Great Barrier Island were low, in fact Hutton (1868) failed to record them. Bell and Braithwaite (1964) considered this was due to heavy exploitation by local residents and Edgar (1973) and Pirani (1982) reported Brown Teal were still being recovered from duck shooters on the mainland.

Hayes and Williams (1982) state that the role of mammalian predators can never be properly assessed and only indirect evidence is available. They believe cats were responsible for the local extinction of Brown Teal on Stewart Island, as the decline coincided with a rise in cat numbers after 1950. Wilson (1959) slated stoats *Mustela erminea* as the chief predator, due to their ability to track Brown Teal on to nests. He believed the Auckland isthmus has slowed stoat movement northward accounting for the continuation of the Northland Brown Teal population. Ogle (1981) believed it is significant that Brown Teal are in large numbers on Great Barrier Island, in the absence of mustelids and Norway rats *Rattus norvegicus*. Ship rats *Rattus rattus* are present but are more arboreal and avoid wet areas. Kirk (1895) recorded the impact that rats made, soon after their spread in New Zealand. Native predators, such as Weka's *Gallirallus australis* and Harriers *Circus approximans*, must also have some impact, but the introduced mammals would be capable of frustrating any form of active management.

The final analysis seems to show massive reduction of Brown Teal over about 60 years (1870–1930) through habitat destruction and overhunting, followed by a continual decline under the pressure of efficient predation and continued shooting. Contracting habitat is preventing relict populations from expanding, and there is an insecure future for the species without human intervention.

Biology

Published information on the species' biology suggests that some authors have relied on the work of their predecessors, creating the false impression that a large data base has been built up over many years. New research is required and may show that the Brown Teal is not as typical as some believe. The Auckland Island and Campbell Island Teals are certainly atypical in that they are the only flightless subspecies in their cosmopolitan genus.

All three forms are diminutive and exhibit the reduced dichromatism common to most island waterfowl (Weller 1980). Williams (1985) gave their length as 480 mm, but this does not indicate the smaller size of the subantarctic forms. Todd (1979) recorded weights of 665 g for male Brown Teal and 600 g for females, while female Auckland Island Teal weigh only 450 g.

Wings, plumages and moults

Falla (1953) recorded the relatively short wings of the Brown Teal, compared with its presumed relative, the Chestnut Teal. Measurements were given by Oliver (1955) and Phillips (1925). Gadow (1902) believed that the wing area of the Auckland Island Teal was further reduced by a simultaneous decrease in the number and size of the primaries. However, he also noted they were not entirely flightless and several

records suggest that Auckland Island Teal retain rudimentary powers of flight (Waite 1909; Guthrie-Smith 1936; Scott 1971). This may also apply to Campbell Island Teal, as Bailey and Sorensen (1962) recorded a "smallish duck which made a short flight from a brackisk pool ... to the sea". Certainly the subantarctic forms have similar-sized wings (Oliver 1955).

Many detailed plumage descriptions exist (Gray 1844–75; Buller 1873, 1888; Salvadori 1895; Phillips 1925; Oliver 1930, 1955; Delacour 1956; Williams 1985). Overall the vernacular name is well suited. In their nuptial plumage the head of the male is dark brown with a conspicuous green sheen in the ear region (*chlor* = green, *otis* = ear). The dark iris is surrounded by a white eye ring and there is sometimes a narrow white collar around the front and sides of the neck. Below this the breast is bright chestnut, paling towards the belly which is light brown or buff. Contour feathers in these regions have a darker subterminal spot giving a mottled appearance. The flanks show fine vermiculations of buff and dark brown. The undertail coverts are black posterior to the vent, with conspicuous white patches finely barred with brown on either side. The back, upper wings and upper tail are brown while the speculum is largely black with metallic green on the upper part and a thin white posterior bar. The lower wing is mostly brown with white axillaries. The bill is bluish with black blotches anterior to the nares, and the legs are slate grey. Auckland Island Teal males are generally not as richly coloured as Brown Teal males, their legs and feet are dark brown, and the abbreviated wings alter their overall body proportions. Campbell Island Teal adults lack the vermiculations and specula of their conspecifics and are coloured in shades of sepia rather than brown.

Males in their eclipse plumage resemble females, although they do retain a small white patch on the posterior flank. Some males resemble females even in the nuptial phase and it is possible that younger males are brighter than older birds (M. Fingland, pers. comm.). This has also been recorded for the Hawaiian Duck *Anas platyrhynchos wyvilliana* (Weller 1980).

Females lack the green crown and nape, bright chestnut breast, vermiculations, black undertail coverts, and white patches. The upper parts are very dark brown, with the feathers having pale edges. Below they are paler brown with dark blotches, while the breast is dull blotched chestnut. The female's eye ring is never as prominent as the male's, otherwise, wings, iris, bill and legs are like the male.

Some adults have been recorded exhibiting aberrant plumages. Although Buller (1878) recorded a complete albino, which was a dull cream all over, most records (Kirk 1880, 1884; Buller 1888, 1892, 1894a, 1905; Cometti 1975) are of partial albinos. Many had white heads and necks, either pure white or with some brown feathers. Some records show the white extended onto the back, upper wings and abdomen, either as irregular blotches or as a band running across the wings or tail. Kirk (1884) suggested his record could have been a hybrid resulting from a cross between a Brown Teal and a Paradise Shelduck *Tadorna variegata*. Buller (1896) recorded a bird from Nelson with, in addition to a white head, a large "top knot" of feathers standing above the plumage on the hind part of the head. Otherwise the plumage was normal.

Ducklings are dark brown above and paler below with a whitish spot at the base of the tail. The head is dark on top with a black stripe through the eye and a lighter stripe above. Buller (1891) described an Auckland Island Teal nestling. Juvenile birds also resemble the female, but have heavier blotching on the chest. In the hand they can be recognised by the typical "notched" tips to the retrices, while on the water their plumage looks fresh beside the unmoulted adults (M. Williams, pers. comm.).

Little is known about the timing and duration of the moult. Williams (1976) banded moulting birds in late October while Reid and Roderick (1973) report that some birds delay their moult until March. Both Brown Teal and Auckland Island Teal males have two annual body moults (Falla & Stead 1938; Williams 1985). The first incorporates the wing and tail moults, leaving the Brown Teal flightless, and follows the breeding season when Brown Teal congregate at large traditional roost sites.

Flocking

The large roost sites currently used by Brown Teal occur in quiet tidal reaches of streams and are characterised by overhead

vegetation, undercut stream banks and adjacent escape cover. Ogle (1980, 1981) is in no doubt that these communal roosts are vital to the birds' continuance in a watershed. They appear to be fundamental to a population's social structure, given the number of interactions that occur. It is at the roost that pair bonds are most likely established and reinforced.

Although Teal will travel across valleys, once they are displaced from a watershed they do not return, even if they are present in adjacent catchments (Oliver 1955; Fisher *et al.* 1969). Guthrie-Smith (1969) believed that trampling by cattle on the sides of streams was a major factor in their displacement at Tutira, while McKenzie (1967) thought that Pukeko *Porphyrio porphyrio* predation was responsible for eliminating Brown Teal from a reserve at Waipu in Northland.

McKenzie (1971) gave the flocking period as November to May, and Wilson (1959) reported that a flock remained on a stream near Whangarei throughout the year, except when they were breeding. This is reinforced by counts reported from Great Barrier Island roost sites (Reed 1972; Bell 1976; Williams 1977; Ogle 1980, 1981). Bell and Braithwaite (1964) believed that flocks seen in June were composed mainly of males and juveniles, indicating a non-breeding component in the population. This was substantiated by Weller (1975b). However, in the same month, Williams (1977) found almost all the Brown Teal encountered were associated with roost sites. Searches made away from roosts failed to locate further birds. Although this seems anomalous, the total number of birds encountered by Williams is much lower than the totals reported during the flocking period by other authors. The population was most likely breeding but nesting activity was not detected. Weller (1975a) also recorded small flocks of non-breeding birds in the Auckland Islands. These flocks maintained feeding areas on the coast adjacent to territorial breeding pairs, and were composed of social individuals in contrast to territorial birds.

Nesting and brood rearing

The nest and eggs of Brown Teal were first described from Canterbury, by Potts, in 1869. He found the nest was made of grass thickly lined with down, and was often situated close to the edge of a swampy creek or beneath large clumps of *Carex*. Buller (1888) added that the nest site was dry and secluded, so much so that Guthrie-Smith (1910) admitted not knowing the Teal's breeding habits and Oliver (1930) wrote that the nest of the Brown Teal had seldom been found. Nests have since been located in long grass, dead manuka and roadside ditches (Oliver 1955). The nest bowl is open and raised above the ground (Delacour & Mayr 1945), possibly for flood protection. Nests are usually associated with water as females walk to the nest, apparently using a constant route (Wilson 1959). Buller (1888) believed nests were sited adjacent to roosts, and while this undoubtedly occurs, other nests are sited away from roost sites, in the upper reaches of streams and in swampy gully-heads (Oliver 1955; McKenzie 1971; Ogle 1981). In these situations the association with water is maintained, and in all situations nests are well spaced (Reid & Roderick 1973).

Oliver (1955) noted that eggs are laid in July and August but Bell and Braithwaite (1964) believed the nesting season was much longer, and could extend from May through to November. Reid and Roderick (1973) have reported that captive Brown Teal are capable of laying eggs throughout the year. Potts (1869) noted that the eggs were creamy coloured and were large, given the size of the female. Delacour (1956) reported an average egg size of 58 mm x 43 mm and Reid and Roderick (1973) gave an egg weight of 64.5 g. This represents approximately 11% of the female's body weight and is close to the upper limit for waterfowl (Lack 1974). Wild clutches are generally between five and eight eggs (Buller 1888; Delacour 1956; Falla *et al.* 1979a) and this fits the trend for island waterfowl to lay fewer, but larger, eggs (Weller 1980).

The female alone incubates the eggs which hatch 27–30 days after incubation began (Todd 1979). In a captive situation, ducklings can be fully grown and capable of flight within 55 days. Juveniles reach sexual maturity in their first year (Reid & Roderick 1973) but it appears that some males delay breeding until their second year, as evidenced by the composition of winter flocks.

Virtually no information has been published about broods and brood-rearing. Oliver (1955) indicated that pairs nesting away from the roost gradually move

downstream with their broods, to attach themselves to the roost. Certainly large numbers of ducklings still associated with both parents have been recorded at roosts (Williams 1976). Pair bonds are strong, and appear to be longer than normal for *Anas* ducks, as the male has an active role in brood-rearing. Cometti (1975) reported the male undertook surveillance and protection of the brood, and also appeared to maintain a feeding area for the female. In captivity, Brown Teal are openly belligerent to conspecifics, as well as other waterfowl (Reid & Roderick 1973). Fighting is very prevalent among wild flocks as well.

Weller (1975a, c) recorded nesting and brood-rearing of Auckland Island Teal. The one nest he found was located in *Blechnum* fern, was down-lined and contained four light tan eggs. These had an average size of 65 mm x 44 mm. The nest site was adjacent to a watercourse and close to the coast, a major feeding area for Auckland Island Teal. The female was very broody, and a male was regularly found within 4 m of the nest. Broods were seen in the wet areas close to dense escape cover and in most cases either a male or a female was in attendance. Of six broods, all but one were associated with fresh water. Nothing is known of the breeding of Campbell Island Teal.

Several hybrids have been recorded, apart from the most unlikely suggestion of Kirk (1884) mentioned above. Buller (1888) recorded a possible hybrid involving a domestic duck, and further examples of this are known from Great Barrier Island (P. Mitchener, pers. comm.). In captivity, Reid and Roderick (1973) reported hybrids between Brown Teal and Grey Teal, and fertile hybrids between Brown Teal and Mallard. A Brown Teal also attempted to copulate with a New Zealand Scaup *Aythya novaseelandiae,* but was foiled by the Scaup's frequent diving.

Food and feeding

A further characteristic of Brown Teal roost sites is their proximity to feeding areas, and the teal's nocturnal feeding habits have been recorded by many authors (Buller 1878, 1888; Guthrie-Smith 1910; Oliver 1930; Wilson 1959; Bell & Braithwaite 1964; McKenzie 1971; Williams 1977; Bellingham *et al.* 1982). There is no quantified record of diet. The food items mentioned suggest that Brown Teal have a generalised invertebrate diet that includes: insects and worms (Ogle 1981), small black mussels (Heather 1980), insect larvae (Weller 1974), marine molluscs (B. Reid, pers. comm.), and small crustaceans (Gravatt 1966). Weller (1974) had no evidence to suggest that Brown Teal used aquatic plants, in spite of many reports of them either feeding over boggy pasture or dabbling amongst emergent stream vegetation. However, Sanderson (1945) recorded small hard seeds and water weeds as food items.

The bill structures have been described (Gravatt 1966) and the strongly developed lamellae were specifically mentioned by Delacour and Mayr (1945) as being suitable for sieving food. This is probably the major feeding method used by Brown Teal. They employ it in both salt water and fresh water and over substrates ranging from mud (McKenzie 1971) to gravel, either walking and dabbling, swimming with their heads submerged or upending (Weller 1974). They can also dive in deeper water (Buller 1882). An investigation of Brown Teal feeding sites revealed an abundance of ostracods (Gravatt 1966). The stomach contents of two specimens held by the Auckland Institute and Museum is listed simply as silt.

Feeding in marine situations probably occurs only during the summer non-breeding period. During this time almost all suitable estuarine areas on Great Barrier Island were used by Brown Teal (Heather 1980) and feeding was diurnal in response to the tides. Diurnal terrestrial feeding was also recorded during this period (Weller 1974). However, in late winter neither estuarine nor daylight feeding was recorded by Weller (1975b). He attributed this to reduced estuarine production and population dispersal. It would now appear that nesting accounted for the reduced population Weller recorded, given the information of other authors (see above).

During the breeding season Brown Teal emerge from their roosts at dusk and move on to nearby boggy pasture where they feed amongst clumps of *Juncus* (Williams 1977). Nesting birds also feed at night and McKenzie (1971) recorded them flying from high gullies to the lowlands to feed on the grass flats. Ogle (1980, 1981) pointed out that drainage or use of pesticides in these areas would be detrimental to Brown Teal, and these practices have probably con-

tributed to their decline on the mainland.

Auckland Island Teal feed predominantly on the coast where they forage on algae and invertebrates taken from windrowed kelp. Filter feeding for plankton and diving for sea lettuce *Ulva* sp is also recorded (Weller 1975a, c). Coastal feeding occurs at any time of the day as some activities are tide-regulated. Birds also feed in the coastal forest, probing soil by night, but Weller (1975c) reported that freshwater feeding was rare.

No specific feeding information is available for Campbell Island Teal, however, they too have been seen on the coast (Westerskov 1960). The birds on Dent Island (Robertson 1976) may not have access to the coast as it is very rugged, and they may have to feed in wet areas amongst vegetation. While individual food items are probably dissimilar, there is no reason to assume that Campbell Island Teal diet is qualitatively different from that of Auckland Island Teal feeding in similar areas.

Behaviour and calls

The behaviour of the anatidae has received extensive treatment over the last 35 years (Lorenz 1951–53; Johnsgard 1959, 1961a, b; McKinney 1965). However, little Brown Teal behaviour has been documented, primarily due to a lack of specimens in overseas waterfowl collections. Behaviourally they are similar to Mallard and show all the major displays common to *Anas* ducks (Johnsgard 1961a; Williams 1967). Williams recorded that bridling and burping occurred as independent acts and although he did not record Head-up-tail-up's or Down-up's, these have since been seen during releases of captive birds (M. Williams, pers. comm.).

The most common call used by male Brown Teal is the Krick-whistle while the only call Williams (1967) recorded from the female, other than the Inciting call, was the Decrescendo. Sanderson (1945) described this as a harsh quack which is repeated very quickly and carries a long distance. Cometti (1975) recorded a pair maintaining contact with soft whistles and chortles.

Parasites

Weekes (1982) does not record any helminths from Brown Teal, presumably through a lack of examinable host material. However, Pilgrim and Palma (1982) record 3 species of Mallophaga from *Anas aucklandica.*

An undescribed species of *Anaticola* and specimens of *Anatoecus icterodes* have been taken from Brown Teal while *Holomenopon leucoxanthum* has been collected from Auckland Island Teal. No Campbell Island Teal have yet been examined for ectoparasites.

R. L. Palma (pers. comm.) believes this is an incomplete faunal list from *Anas aucklandica* and he expects to find further species once ectoparasite collections are made in the wild. This will eliminate the risk of cross-infection from other wildfowl in a captive situation.

It is interesting to note that Brown Teal appear to host a specific anaticolid while the specimens of *Anatoecus icterodes* examined vary in measurements and morphology from the type. However, Pilgrim and Palma (1982) do not consider them sufficiently different to warrant specific description. Further study of the parasitic fauna of *Anas aucklandica* may prove useful in clarifying its relationships both inter- and intraspecifically.

Conservation

Brown Teal has been a protected species since 1921 (Williams 1985). However, this has not been sufficient to halt their decline and intervention is now required to ensure their continued survival. As early as 1885 Martin recommended the use of offshore islands for preservation of Brown Teal but it was not until 1968 that trial liberations began (Williams 1969). The overall strategy employed by the New Zealand Wildlife Service and Ducks Unlimited (N.Z.) Inc. involves large-scale aviculture and release of teal into suitable habitats, combined with habitat improvement. A Brown Teal recovery plan has also been drafted to identify the resources required for the species' successful conservation (Anderson 1983). Outside of Northland this programme has had only limited success to date.

Brown Teal readily adapt to captivity (Williams 1974), and successful avicultural techniques are well documented (Reid & Roderick 1973; Hayes 1981; Hayes & Williams 1982). The first successful captive breeding at Slimbridge was in 1960 (Fisher *et*

al. 1969) and since then Brown Teal have been raised in large numbers at the Mt Bruce Native Bird Reserve (Roderick 1973, 1974) and by private aviculturists (Reid & Roderick 1973; Hayes 1981). Previous to 1960, small numbers of Brown Teal were bred by collectors in New Zealand (M. Williams, pers. comm.). In 1976 Ducks Unlimited adopted Brown Teal as a special project and aimed to raise 1000 birds for liberation within ten years (Hayes 1976). Breeding stock for "Operation Pateke" was provided in 1976 when 23 pairs of Brown Teal were removed from Great Barrier Island (Pirani 1976) and in 1979 two females were sent to Slimbridge. The English stock had become inbred (Kear & Williams 1978) and by 1979 consisted of only three males (Pirani 1979). Up to September 1985 Ducks Unlimited had raised over 670 Brown Teal (Hayes 1985b) and most of these have been reintroduced to the wild.

The initial 1968 release, on to Okupe Lagoon on Kapiti Island, involved ten birds, nine of which were captive-raised. Breeding was confirmed within four months and a small population has since persisted (Howell 1985). However, the hope of it forming a nucleus for re-establishing the species in the Manawatu coastal lake system, where Brown Teal bred as recently as 1930 (Mills & Williams 1984), has not materialised, even though dispersal to the mainland has been recorded (Caithness & Pengelly 1973). A total of 320 Brown Teal has now been liberated in the Manawatu and, although breeding was confirmed in 1980, the birds have dispersed and disappeared. A similar fate has met birds liberated in the Wairarapa, Taranaki, Hawke Bay, Bay of Plenty, and Nelson areas (Roderick 1973; Williams 1978; Pirani 1981; Mills & Williams 1984). More recently, birds have been released into Northland in an effort to halt the species' decline and maintain a viable population on the mainland (Hayes 1984b). A programme of habitat improvement has also begun in Northland in an attempt to maintain the all-important roost sites, and to create suitable areas into which the population could expand (Hayes 1985a, c).

Some authors (Williams 1978; Mills & Williams 1984) consider that successful liberations could be achieved by supplementing captive-reared birds with wild birds cropped from Great Barrier Island. It is thought that captive birds, denied the experience of the roost, could be maintained in an area by wild birds able to identify and establish a suitable roost site. To do this, the size and dynamics of the Great Barrier Island population must be known, as all risks to this other jise stable population must be avoided. Work is currently in progress to document the species' ecology in the wild (Hayes 1984a, b; 1985c).

Auckland Island Teal have also been subject to breeding attempts. As early as 1894, Buller (1894b) sent live specimens to England and these were exhibited at the London Zoo in 1895 (Fisher *et al.* 1969; Scott 1971). Twelve Teal were transferred to Kapiti Island in 1907 (Drummond 1908; Waite 1909; Scott 1971), but they did not persist there. A further three were sent to the Wildfowl Trust at Slimbridge in 1955, but these too failed to reproduce (Scott 1971). Currently the New Zealand National Wildlife Centre holds live specimens of both Auckland Island and Campbell Island Teal. These are the only individuals known outside the subantarctic.

What of the future? The increased awareness of the plight of Brown Teal has prompted widespread efforts o ensure the species' continuation. The encouraging results from recent releases into managed Northland habitat could see a halt to the decline in the mainland population. This, coupled with a greater understanding of the species' ecology, could see Brown Teal reestablished in areas of its historical range, with a concomitant reduction of its endangered status.

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Summary

The New Zealand Brown Teal is one of three subspecies of *Anas aucklandica* endemic to the New Zealand region. It is currently one of the world's rarest waterfowl. Its decline is attributed to habitat destruction, introduced predators, overhunting and disease following European

settlement in New Zealand. This review marks the 140th anniversary of the species' description and traces its taxonomic wandering in the interval. Its relationships within the Anatidae, past and present status, and reasons for its decline are also reviewed. Information on the species' biology and natural history is assembled from a fragmented literature and the species' conservation and management is discussed. Where appropriate, information on the Brown Teal's subantarctic conspecifics is also presented.

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