

The land bird fauna of Stephens Island, New Zealand in the early 1890s, and the cause of its demise

DAVID G. MEDWAY

25A Norman Street, New Plymouth, New Zealand. dmedway@xtra.co.nz

Abstract Stephens Island provides the classic example in the New Zealand region of the effect that predation by feral cats (*Felis catus*) can have on an island land bird fauna. Twenty-five species of native New Zealand land birds were recorded on the island in the early 1890s when it was still forested and free of mammalian predators. It is probable that Stephens Island still had its original land bird fauna at that time. The land bird species included large populations of the extinct Stephens Island piopio (*Turnagra capensis minor*), and the endangered South Island saddleback (*Philesturnus c. carunculatus*). Cats were introduced to Stephens Island, probably in 1894. They soon became feral and multiplied rapidly. The evidence indicates that cats were responsible for the rapid demise of the native land bird fauna of the island.

Medway, D.G. 2004. The land bird fauna of Stephens Island, New Zealand in the early 1890s, and the cause of its demise. *Notornis* 51(4): 201-211.

Keywords Stephens Island; land birds; Stephens Island piopio; *Turnagra capensis minor*; South Island saddleback; *Philesturnus c. carunculatus*; forest reduction; cat predation; extirpations

Stephens Island (40°40'S, 174°00'E) lies 3 km off the northern tip of D'Urville Island and 90 km north-west of Wellington in New Zealand's Cook Strait. It is bounded on all sides by steep cliffs that rise from 60 m in the south to 270 m in the west and is exposed to the full force of gales that funnel through the Strait. Although small (150 ha), the island rises to 280 m where a number of prominent ridges intersect near the western cliffs. The land is mostly rough and broken and the valleys between these ridges, which lack permanent streams, descend steeply to the cliff edge.

Stephens Island was declared a Wildlife Sanctuary in 1966, reclassified as a Nature Reserve in 1997, and is now known as the Takapourewa Nature Reserve.

The lighthouse on Stephens Island

On 9 January 1879, John R. Blackett, Marine Engineer, visited Stephens Island on the Government steamer *Stella* to examine the island as a site for a lighthouse. He landed and attempted to ascend but without success, the slopes being too steep, and the soil and loose rock thin, slippery, and treacherous. He observed that Stephens Island was "steep all round with a moderately flat top wooded densely". A work party was sent to Stephens Island to arrange suitable access to the top of the island. When Blackett was at the island again on 2 June 1879 he ascertained that it would take at least two weeks more to cut the required track (Blackett 1873-

1881). Shortly afterwards, Blackett reported to the Secretary of the Marine Department that, although he had visited Stephens Island twice, he had "been unable to make a proper examination; it is very rough and precipitous, and cannot be ascended and examined without previously cutting a road. This has been accomplished by a party of men sent for the purpose, and I propose to make an early visit to inspect the site" (AJHR 1879: H10). Blackett did not revisit Stephens Island until 22 February 1881 when he spent three hours on shore, climbing to the top and inspecting the site of the proposed lighthouse (Blackett 1873-1881). It was subsequently reported that a suitable site for a light had been selected on Stephens Island, and a track from the beach cut to it through the bush (AJHR 1881: H.27).

In December 1890, the site for the proposed light was examined again by Captain Johnson, Nautical Adviser to the Marine Department, but no definite site could be selected until some scrub had been cut down (AJHR 1891: H.30). Sometime after 31 March 1891, a work party was sent to the island to put various facilities, such as the landing place and tramway, in place so that work could begin on constructing the lighthouse and keepers' dwellings (AJHR 1892: H.29). The Government steamer *Hinemoa* left Wellington for Stephens Island on 5 April 1892 for the purpose of landing David Scott of the Marine Department, and a staff of 10 men, to build a lighthouse there (*Auckland Weekly News* 9 April 1892). The required work was carried on thereafter, and the light was exhibited for the first time on 29 January 1894 (AJHR 1894: H.18). Stephens Island has been continuously occupied by

Figure 1 Forest cover near tramway on Stephens Island in 1903. Photo: Leonard Cockayne (Courtesy of Museum of New Zealand Te Papa Tongarewa).



humans since construction of the lighthouse began in April 1892.

Records of the land birds of Stephens Island, 1881 - 1903

Joseph R. Burton, 1881

On 16 February 1881, Sir James Hector, Director of the Colonial Museum, wrote to the Marine Department seeking a passage on the *Stella* for the museum's taxidermist, Joseph R. Burton. The *Stella* was about to depart for the Auckland Islands for the purpose of inspecting the provision depots there (*Dominion Museum Letter Book*, 1877-1883, folio 427). The *Stella*, with Burton on board, left Wellington on 21 February 1881 and called at Stephens Island the following day to allow the Marine Engineer to inspect the site of the proposed lighthouse on the island. Burton also went ashore. All that is known about what he found there comes from Buller (1887-1888:1: 32; II: 207) who said it was "worthy of remark" that Burton had obtained a specimen of "thrush" on Stephens Island, and had found diving petrel (*Pelecanoides urinatrix*) breeding there.

F.W.Ingram, 1892-1894

F.W. Ingram spent 12 months on Stephens Island between April 1892 and January 1894 assisting with the construction of the lighthouse and associated facilities. Many years later, he recollected that the following land birds were "in plenty" on the island at that time (Ingram 1926):

"The saddle-back, native thrush, native crow, the robin, two kinds of coo, one long tailed and the other with a striped breast, also kaka, pigeons, moreporks, two kinds of wrens (very small birds), and I also got one land-rail. There were hundreds of parakeets and tuis (or parson birds), also the moke moke (or bell bird)...".

The "two kinds of coo" would have been long-tailed cuckoo (*Eudynamys taitensis*) and shining cuckoo (*Chrysococcyx lucidus lucidus*) and the "two kinds of wren" were probably Stephens Island wren (*Traversia lyalli*) and South Island rifleman (*Acanthisitta chloris chloris*). Presumably, "native crow" refers to South Island kokako (*Callaeas c. cinerea*). However, the presence of kokako on Stephens Island in the early 1890s remains doubtful. Surely other interested observers would have mentioned such a distinctive bird, already very rare on the mainland, if indeed it had been present and as plentiful on the island as Ingram said it was. The only known kokako specimen in New Zealand that is attributed to Stephens Island is a relaxed mount (B4536) in the Auckland Museum. It is not known by whom or when the specimen was collected, and its true place of origin is uncertain. The museum's accession slip indicates that "1 Orange Wattled Crow" and "1 Sth Is. Thrush (poor specimen)", both said to be from Stephens Island, were purchased by the museum from C.E. Clarke (apparently of Dunedin) on 20 August 1931 (B. Gill pers. comm.). If kokako did occur on Stephens Island in the early 1890s they would not have survived for long in the presence of feral cats because, as Smith (1889) observed, the species was exceedingly tame and fell easy victim to cats and dogs.

Henry H. Travers, 1892 - 1903

In 1903, Henry Travers, a well-known Wellington bird collector and dealer, recorded that he had been on Stephens Island "a number of years ago, and the number of native birds there was simply marvellous" (Travers 1903). On 11 June 1913, a letter appeared in the *Evening Post* of Wellington in which the correspondent said that "I don't care to append my name to this, but intend to sign it

"The Collector"". Henry Travers probably wrote this letter and is credited here with its authorship. In it, Travers said "Some time in the early 90's, during the time the lighthouse was being erected, I went to Stephens Island and remained there a few days collecting various native birds which were at that time very numerous - the thrush (*turnagra crassirostris*) and saddleback (*creadion carunculatus*) especially so" (Travers 1913). Shipping notices in the *Evening Post* indicate that the *Hinemoa* was regularly visiting Stephens Island (and the Cook Strait lighthouses) during the period the lighthouse was under construction. Travers could have found out about the wealth of native birds on Stephens Island from a number of sources, including crew of the *Hinemoa*.

Travers (1913) listed the land birds present on Stephens Island in the early 1890s as

"saddleback (*creadion carunculatus*), thrush (*turnagra crassirostris*), pigeon and kaka occasional visitors, robin (*miro albibrons*), grey warbler (*gerygone flaviventris*), yellow breasted tom-tit (*petroeca macrocephala*), pied fantail (*rhypidura flabellifera*), fern bird (a few), (*spinaeacus punctatus*), yellow head canary (*mohua ochrocephala*), tui (*prothemadera novae zealandiae*), bell-bird or so-called mocker (*anthornis melanura*), yellow headed parakeet (*platycercus novaezealandiae*), banded rail (*rallus philippensis*), a few, white-eye (*zosterops coerulescens*). I was told that both cuckoos visited the island occasionally".

For whatever reason, Travers did not include the Stephens Island wren in his list.

Travers was on Stephens Island at least three more times during the next decade. On 24 January 1895, he informed Ernst Hartert in England that he was making arrangements to go on a special trip to the island and its neighbourhood to obtain more specimens of the Stephens Island wren. Travers and his men were on Stephens Island for at least five days from 4-9 February 1895. His signature appears in the island's visitors book (1894-1972) on the former date. He was still on the island on the latter date when principal lighthouse keeper Patrick Henaghan advised the Secretary of Marine that there was "a party of men here at present (Mr. Travers)" (Letter Books 1894-1918). On 7 March 1895, Travers advised Walter Rothschild in England that he had recently returned from his search but "unfortunately without success - I hunted the island over and round and as I had three men with me who formed my boats crew, and some of the residents of the island, you can imagine we made a thorough search" (Travers 1894 - 1896).

Travers was on Stephens Island again in December 1895. On 24 December 1895, he

informed Hartert that since he had written on 28 November 1895 he had paid another visit to the island to look for the Stephens Island wren but "am sorry to say without success" (Travers 1894-1896). Travers' last known visit to Stephens Island was in 1903. He advised the Colonial Secretary on 21 August 1903 that he was there "a few weeks ago" (Travers 1903).

Travers was probably referring to his visit to Stephens Island in February 1895 when he wrote, on 27 December 1898, that he was on the island "about 4 years ago and the above bird (*Turnagra crassirostris*), saddle backs of both species, robins & other birds were common, but more especially the former as they were in 100s" (Travers 1898). The saddleback of "both species" would have been the adult South Island saddleback (*Philesturnus c. carunculatus*), and its "jack bird" juvenile stage which at that time was considered by some, particularly Buller, to be a separate species, *Creadion cinereus*. The Museum of New Zealand holds a specimen (DM 2465) of a typical juvenile South Island saddleback, attributed to H.H. Travers and labelled as being from Stephens Island (no date).

On one of his visits to Stephens Island, Travers collected "eight live specimens of *Turnagra crassirostris* and let them go in the bush around my house" at Paraparaumu "but after a few days I never saw them again. Had Kapiti island been a suitable place I would have turned them out there, but as there are innumerable cats & also wekas there I thought it best to turn them where I did. It is a pity I did not kill and skin them instead of affording a few dinners to cats &c" (Travers 1898). Travers sent Rothschild two eggs of the Stephens Island piopio (*Turnagra capensis minor*; see Medway 2004a) that he had collected on one of his visits to the island. They are now in The Natural History Museum, London (Knox & Walters 1994: 224).

When Travers was on Stephens Island in February 1895 he procured "a specimen or two of a *Sphenoeacus*" (fernbird (*Bowdleria punctata*)) he believed was different to the mainland species. Travers informed Hartert on 28 November 1895 that he considered "the two specimens of *Sphenoeacus* are the only ones that will ever be procured from the island as Mr Lyall has only heard one since which he could not get and that was some time ago". Travers further advised Hartert on 24 December 1895 that he had sent "the skin of the *Sphenoeacus* from Stephens island - it seems much like *S. punctatus* but the bill appears to be thicker & shorter - It is very scarce on the island - If it is valuable let me know and I will send the one in spirits and try & get some more" (Travers 1894-1896).

The Australian Museum in Sydney received a small collection of birds from Travers in October 1896. It included two specimens (Nos. 0.9076

and 0.9077) of bush wren (*Xenicus longipes*) with "Stephens Isld" given as the locality of collection (H.J. de S. Disney pers. comm.). However, there is no other evidence that indicates the presence of bush wren on Stephens Island in the 1890s. The only "wrens" mentioned by Lukins, who was on the island in October 1894, were "Rock Wren" and "Rifleman" (discussed below). Travers himself, who spent several days there in February 1895, advised Rothschild on 7 March 1895 that he had visited some places where he thought there was a chance of procuring specimens of rock wren (*Xenicus gilviventris*) and bush wren, but without success.

Edward Lukins, 1894

"It was with considerable interest I found so many of the more rare of the New Zealand birds on Stephens Island and I hope they may long continue to thrive on this inaccessible island where they will certainly be unmolested by stoats and weasels" (Lukins 1894).

Edward Lukins, "an ardent collector of natural history specimens and objects of general interest", visited Stephens Island and D'Urville Island in October 1894. A detailed account of his activities was published in a local newspaper within three weeks of his visit to the islands (Lukins 1894). Lukins has provided the only contemporaneous record of the land bird fauna of Stephens Island shortly before it underwent the irreversible changes described later in this paper.

Lukins was on Stephens Island for just 20 hours, landing at 1pm on 11 October 1894 and departing at 9 am the next morning. The knowledge Lukins gained about the birds on the island was obtained by a combination of personal observation, and information provided to him by the lighthouse keepers and their families, probably mainly by assistant keeper David Lyall who is (in)famous for his association with the Stephens Island wren (Galbreath & Brown 2004). Lukins learned that "the native thrush, now almost extinct on the mainland, is so numerous that there was scarcely a bush in which at least one could not be seen The saddleback is almost as numerous there, rare though it generally is now. The Striped Rail, a flightless bird, finds yet a home there, so does the rare Fern Bird and the Rifleman".

Lukins listed 20 species of land birds present on Stephens Island at the time of his visit:

"Harrier Hawk (*Circus Gouldi*); Morepork Owl (*Athene Novae-zealandae*); Kingfisher (*Halcyon Vagans*); Tui (*Prothemadera Novae-Zealandiae*), occasional visitants in large flocks; Bell Bird (*Anthornis Melanura*); White Eye (*Zosterops Lateralis*), occasional visitants; Rock Wren (*Xenicus Gilviventris*); Rifleman (*Acanthisitta Chloris*); Fern Bird (*Sphenoeacus*

Punctatus); small grey bird, unknown species; Yellow-breasted Tit (*Petroeca Macrocephala*); Wood Robin (*Petroeca Albifrons*); Ground Lark (*Anthus novae-Zealandiae*); Thick-billed Thrush (*Turnagra crassirostris*); Pied Fantail (*Rhipidura Flabellifera*); Black Fantail (*Rhipidura Fuliginosa*); Saddle-back (*Creadion carunculatus*); Parakeet, red above the bill, and rest of front of head yellow; unknown species; Kaka (*Nestor Meridionalis*); Wood Pigeon (*Carpophaga Novae-Zealandiae*); Striped Rail (*Rallus Philippensis*)".

The "rock" wren would have been the Stephens Island wren. Lukins probably got the name and information about the presence of the wren on the island from Lyall, who called those birds "rock" wrens - "The rock wrens are very hard to get" (Lyall in Travers 1894-1896). The "small grey bird, unknown species" probably was the brown creeper (*Mohoua novaeseelandiae*) (discussed below), and the "parakeet unknown species" probably was the yellow-crowned parakeet (*Cyanoramphus auriceps auriceps*). Lyall described banded rail (*Rallus philippensis assimilis*) as being "very scarce" on the island at the time he sent Buller a specimen for examination, probably in early 1895 (Lyall in Buller 1905: I: 43).

Lukins exhibited specimens of birds and their eggs from Stephens Island at the annual meeting of the Nelson Philosophical Society on 10 December 1894. Included among the birds exhibited were specimens of piopio and saddleback that Lukins had collected on the island only two months earlier (Nelson Evening Mail 11 December 1894). Later, Buller (1905: II: 135-136) mentioned that the Nelson Museum held a piopio nest from Stephens Island "measuring 7in by 5in, and formed entirely by slender rootlets arranged in a circular form. The cup, which is very shallow, is lined with dry grasses". This nest had probably also been obtained by Lukins while he was on the island in October 1894.

Hugo H. Schauinsland, 1896-1897

Hugo H. Schauinsland, a German herpetologist from Bremen, arrived at Stephens Island on 31 December 1896 to study tuatara (*Sphenodon punctatus*) (Schmidt 1952; Dawson & Dawson 1958) and stayed there until at least 7 January 1897 (Letter Books 1894-1918; Webber 1953). He was accompanied by George Webber, son of Wallace Webber of French Pass (who periodically delivered mail and supplies to the island), who caught tuatara for examination and collected birds and other natural history items (Webber 1953).

The land birds collected for Schauinsland on Stephens Island, probably all in early January 1897, are now in the Übersee-Museum at Bremen, Germany. They have been recorded by Dawson & Dawson

(1958) as New Zealand falcon (*Falco novaeseelandiae*) (one), banded rail (two), South Island kaka (*Nestor m. meridionalis*) (two), yellow-crowned parakeet (one), shining cuckoo (one), long-tailed cuckoo (two), morepork (*Ninox n. novaeseelandiae*) (one), and New Zealand kingfisher (*Halcyon sancta vagans*) (two). The Übersee-Museum also holds one specimen of the Stephens Island piopio that was collected for Schauinsland on 7 January 1897. The piopio, kaka and banded rail specimens are mentioned by Duncker (1953). These Schauinsland specimens provide valuable confirmation that the species represented, particularly piopio and banded rail, were still extant on Stephens Island until at least early 1897, albeit in unknown numbers. The last known specimen of banded rail from Stephens Island is a mounted bird (DM 627) in the Museum of New Zealand, apparently collected by George Webber in 1898.

Walter L. Buller, 1892 - 1895

Buller informed the Wellington Philosophical Society meeting on 18 January 1893 that he had "recently" received a specimen of piopio from Stephens Island, as well as a fresh specimen of saddleback from there. The saddleback was of "special interest, not only as proving that the species still exists in this part of the colony, but because it is a very young bird (in the true plumage of *C. carunculatus*), with very small caruncles and a narrow yellow membrane at the angles of the mouth. The only difference in the plumage is that it is duller than in the adult. Such a specimen as this establishes beyond all doubt the validity of *Creedion cinereus* as a distinct species" (Buller 1893). The plumage of the juvenile saddleback as described by Buller, despite being from Stephens Island whose avian affinities lie with the South Island, seems identical to the plumage of a juvenile North Island saddleback (*Philesturnus carunculatus rufusater*).

Buller referred to this specimen again in 1894, when he said it was still in his possession, and in 1905 (Buller 1895a; 1905: II: 161). It is probably this very specimen that is now in the Carnegie Museum of Natural History as either CM 24764 or CM 24765. They were received by the museum as part of the Buller collection it acquired in 1905. Both specimens are recorded as having been collected on Stephens Island in February 1892. This was shortly before the work party arrived on the island to commence construction of the lighthouse. It is not known who collected them, or who collected the piopio to which Buller referred in 1893 that was probably collected at the same time. One of the Carnegie Museum's saddlebacks from Stephens Island is labelled "young", but it matches the juvenile of the North Island saddleback (Kenneth C. Parkes pers. comm.)

Andreas Reischek, when he was on Hen Island in 1883, procured specimens of North Island

saddleback "feeding their young, which were just out of the nest, the plumage being exactly like that of the parents, only a little duller, uniform black and ferruginous on the back and shoulders; the wattles are either invisible or very small". Reischek recorded that during five years of observation, in which he procured a series of specimens of North Island saddleback, both adult and young in all stages, he never noticed any difference in plumage. They were always black, with a ferruginous saddle (Reischek 1887). Wilkinson & Stidolph (1927) mentioned that a pair of saddleback on Kapiti Island in April 1926, that had been transferred to there from Hen Island the previous October, were observed feeding a "jack-bird" that was brown all over, as large as its parents, with small wattles and no saddle. This juvenile bird was, therefore, identical in plumage to a juvenile South Island saddleback. Merton (1965) considered, assuming this report to be reliable, that the "jack-bird" plumage of juvenile South Island saddleback is not entirely unknown in juvenile North Island saddleback. It also appears, on the evidence of the Buller specimen from Stephens Island, that the plumage of juvenile North Island saddleback is not entirely unknown in juvenile South Island saddleback either.

It is not known from whom Buller obtained the eight live piopio from Stephens Island that he shipped to Rothschild on 18 October 1894 (Buller 1895c). Buller informed Rothschild on 10 February 1895 that "The Stephen's Island man", who must have been Lyall, "sends for my inspection specimens of the Rail, which turns out to be nothing but *Rallus philippensis*. The "grey bird with a banded tail" proves to be *Certhiparus Novae-Zealandiae*. He has not sent me yet any specimens of *Xenicus islandicus*, but seems confident about getting them" (Buller 1895b). The "grey bird with a banded tail" is probably the "small grey bird, unknown species" to which Lukins referred in the account of his visit to Stephens Island that had taken place only four months before Buller's letter to Rothschild. It seems that Lukins' information about the occurrence of this "unknown" species on Stephens Island was obtained by him from Lyall, who sent a specimen to Buller in order to have its identity properly determined. *Certhiparus novae-zealandiae* is the brown creeper.

The land bird fauna of Stephens Island in the early 1890s

In summary, 25 land bird species (all native to New Zealand, including representatives of three endemic families) were reliably recorded on Stephens Island in the early 1890s. They are Australasian harrier (*Circus approximans*), New Zealand falcon, banded rail, New Zealand pigeon (*Hemiphaga n. novaeseelandiae*), South Island kaka, yellow-crowned parakeet, shining cuckoo, long-

tailed cuckoo, morepork, New Zealand kingfisher, South Island rifleman, Stephens Island wren, New Zealand pipit (*Anthus n. novaeseelandiae*), South Island fernbird (*Bowdleria punctata punctata*), yellowhead (*Mohoua ochrocephala*), brown creeper, grey warbler (*Gerygone igata*), South Island fantail (*Rhipidura fuliginosa fuliginosa*), South Island tomtit (*Petroica m. macrocephala*), South Island robin (*Petroica a. australis*), silvereye (*Zosterops l. lateralis*), bellbird (*Anthornis m. melanura*), tui (*Prosthemadera n. novaeseelandiae*), South Island saddleback, and Stephens Island piopio.

No fossil or midden avian remains have been found on Stephens Island, nor evidence of permanent Maori occupation of the island (Brown 2000: 159). The presence of the Stephens Island wren on the island into the 1890s is probably adequate confirmation of itself that kiore (*Rattus exulans*) never obtained a foothold there. In the early 1890s, it seems, Stephens Island still had its original land bird fauna, unlike other New Zealand inshore islands that had been occupied by Maori, and/or populations of kiore (Holdaway *et al.* 2001).

Stephens Island as a habitat for piopio and saddleback

Potts (1882:199) observed that the South Island piopio (*Turnagra c. capensis*) was "indifferent" as to food, feeding on insects when procurable, or on grasses, seeds, or fruit. Reischek included berries, plants, and young leaves among its foods, but insects and other invertebrates clearly formed a significant part of its diet. Indeed, Reischek said that both species of piopio lived mostly on insects. He often saw them in the forest using their bill to turn foliage, rotten wood, and moss "under which insects hide". A pair of piopio visited one of Reischek's bush camps daily, inspecting the turned-over soil for insects and larvae (Reischek 1886, 1892). Buller (1905:II: 135) saw one foraging for worms and grubs.

Saddleback feed on berries and some nectar in season, but they largely subsist on insects and other invertebrates (e.g. Blackburn 1967; Pierre 2000).

It appears that, when its forest cover was intact, Stephens Island provided an abundant invertebrate fauna for piopio and saddleback, and for other avian insectivores. For example, Edward Wilson recorded in 1915 that the then very numerous blackbirds (*Turdus merula*) and song thrushes (*Turdus philomelos*) existed solely on insects "of which the island abounds" (Dominion Museum 1913-1931). Harold Hamilton, entomologist at the Dominion Museum who visited Stephens Island in September 1916, found a surprisingly rich invertebrate fauna (Hamilton 1916), despite the reduction in forest and undergrowth, and trampling of ground by stock. Hamilton collected or recorded a variety of

lepidoptera, and thought that the locality would be rich in those insects later in the season. He reported that the coleopterous fauna "is remarkably rich and the abundance of certain species is remarkable... Every stone and fallen tree shelters an incredible number of insects. Nothing like it has ever been seen in my previous experience as a collector". He found every hollow log or decaying tree stump to be crowded with weta, and observed that a small land snail was common under stones and decaying logs. Lukins (1894) also recorded that two species of large land snail were to be found on the island when he was there in 1894.

Lukins (1894) and Travers (1898, 1913) indicated that saddleback and piopio were the two most numerous land birds on Stephens Island in the early 1890s, and that large populations of both were living there at that time.

Saddlebacks, which occupy small territories and have broad habitat requirements, from shrubland to tall forest, can achieve large populations on suitable small islands (Lovegrove 1996b). For example, in January 2003 a population of saddlebacks estimated at 1265 occupied c. 105 ha of suitable habitat on mammal-free Cuvier Island off the east coast of Coromandel Peninsula (Rob Chappell pers. comm.).

The large saddleback population living on Stephens Island in the early 1890s probably occupied all suitable forest and scrub habitat on the island. In 1898, Thilenius (discussed below) found dense vegetation, c. 3 m tall, covering Stephens Island to the cliffs (see Fig 1). Presumably, all that portion of Stephens Island, totalling c. 80 ha, together with any adjoining scrub areas, provided suitable habitat for saddleback. The saddleback population of Stephens Island in the early 1890s may have been c.1000 if its density then was similar to that of Cuvier Island in 2003 (12.05 / ha).

Nineteenth century accounts indicate that piopio could be very plentiful in suitable habitats. For example, Buller (1873: 139-140) recorded they used to be "excessively abundant" in all the elevated wooded country; Hector (in Buller 1873: 140) found them to be "very abundant" during his exploration of the West Coast in 1862-1863, and on one occasion counted no less than 40 in the immediate vicinity of his camp; Smith (1889) said they had existed in "great numbers" on the Maori Gully goldfield; and Potts (1882: 198-199) said piopio "fairly teemed" in their favorite haunts in the Upper Rakaia. He also saw them "in abundance" on bluffs between Ross and Okarito, and they were "equally numerous" up the river flats.

Piopio were said to be more numerous than saddleback on Stephens Island in the early 1890s, and there was "scarcely a bush" in which at least one piopio could not be seen (Lukins 1894). Therefore, the piopio population living on the island at that time may have numbered at least 1000, a figure not

inconsistent with Travers' (1898) comment that piopio were in "100s", probably at the time of his visit to the island in February 1895.

Reduction of forest on Stephens Island

In August 1839, Dieffenbach observed from offshore that Stephens Island "seemed to be covered with a dense forest from the waters edge to the summit" (Dieffenbach 1843:I: 22). Blackett found the island to be "wooded densely" when he first visited it on 9 January 1879 (Blackett 1873-1881). Lukins (1894) noted that the vegetation on Stephens Island was similar to the vegetation found on the other islands in the locality, but "the gnarled cedars", kohekohe (*Dysoxylum spectabile*), "and other dwarfed trees indicate that high winds are customary there".

The first known human alteration to the vegetation of Stephens Island was made in May-June 1879 when an access track was cut from the beach to the top of the island. Years later, some "scrub" was cut down to enable a definite site for the proposed lighthouse to be selected. Construction of the tramway, lighthouse, keepers' dwellings, and associated facilities in 1891-1893 would have necessitated the removal of some forest cover, but Travers recalled that the island was well covered with "vegetation" at that time (Travers 1913).

In March 1894, the keepers were felling and clearing bush to create a paddock. They hoped to have the area burnt and sown down with grass before winter set in. The clearing and burning continued during May 1894 (Letter Books 1894-1918). The island was still "bush clad" when Lukins was there in October of that year (Lukins 1894). In August 1895, the keepers erected some fences to prevent cattle from trespassing in that part of the bush situated between the first assistant's house and the lighthouse. Principal keeper Henaghan considered it advisable to reserve that portion of the bush for shelter. He noticed that the margin of the bush appeared to be dying out where it had been opened up for the keepers' dwellinghouses (Letter Books 1894-1918).

It is clear from Thilenius (1899), another German herpetologist, who was on Stephens Island from 20 October 1898 until 30 November 1898 (Letter Books 1894 - 1918), that there had been very little reduction in the overall extent of forest cover on the island by then:

"A dense vegetation, about 3 m tall, covers the island right to the cliff ... With the building of the lighthouse, the keeper's houses etc., the island's vegetation has altered insofar as the construction of zigzag tracks, a cable railway, and a fairly long rail track sliced through the bush, and they had embankments which have been overgrown with grass".

Leonard Cockayne visited Stephens Island on 3 March 1903. His botanical notes from the visit survive (Cockayne 1903), but they do not give any real indication of the extent of forest cover on the island at that time. However, Cockayne informed a meeting of the New Zealand Institute Board of Governors on 22 January 1904, no doubt with reference to the situation at the time of his visit 10 months earlier, that the bush on Stephens Island was "so rapidly disappearing that the island would soon be fairly bare" (M1 25/611, pt 1 - Archives New Zealand, Wellington). Cockayne's visit was only 4½ years after Thilenius had found the island to be covered with a dense vegetation about 3 m tall. Cockayne later wrote that the forest remaining on Stephens Island should be preserved from further destruction (Cockayne 1910: 83). Cockayne took the first known photographs of the island, including an exterior view of the kohekohe forest (see Cockayne 1921: pl.13, fig.18; Oliver 1944), and an interior view of the forest with its undergrowth destroyed by stock (see Cockayne 1907: pl.3, no.2; 1910: fig.37). A third photograph is recorded by Cockayne (1903) as being a general view of forest on the island. This photograph (Fig. 1), not previously published, gives an indication of the nature and extent of the forest cover near the tramway on Stephens Island at the time of Cockayne's visit.

In March 1905, principal keeper George Greig advised that the bush was fast disappearing from Stephens Island (Letter Books 1894-1918). Travers (1913) attributed the destruction of the bush to the lighthouse keepers, and to the sheep and cattle kept by them. Richie Smith (pers.comm.) estimated that only about one-third of the island was still covered in bush when he lived there as a boy in 1914-1916.

The reported dying of the bush on Stephens Island prompted E. Phillips Turner, Inspector of Scenic Reserves, to visit the island in March 1916. He found the forest was confined then to a belt along the summit of the island, and narrow tongues descending the eastern slopes. The rest of the island was covered in grass. Captain Bollons of the *Hinemoa* informed him that most of the grassed area was formerly covered with those kinds of small trees that were growing on the wooded part of the island. Turner found no evidence of fire having played a part in the reduction of the forest, but he considered that the presence of numerous moribund trees and the paucity of seedlings were convincing evidence that forest reduction was still proceeding (Turner 1916).

In September 1916, Hamilton had no doubt that "great changes in the floral features have been effected by the introduction of stock and the other results of settlement" (Hamilton 1916). In August 1917, principal keeper Percy Malthus considered that "any damage done to the bush by stock is as

nothing compared to the injury inflicted by severe southerly gales, such as we have had this winter". An unusually severe gale on 11 June 1917 had "smashed limbs off trees, and blackened all the vegetation". On 19 March 1918 there was another severe gale which "played havoc with the bush on the Island and the parts that suffered most were in places that escaped damage in the southerly gales last winter" (Letter Books 1894-1918). By the time Oliver visited Stephens Island in January 1922, only small patches of the original forest and scrub remained. The largest remnant of forest on the island covered c.20 ha, was 5-6 m tall, and consisted of trees with dense flat-topped heads of foliage that made up a compact forest roof. This remnant was unfenced, and most of its undergrowth had been destroyed by stock. A smaller, fenced-in patch of forest provided an interesting example of what Oliver considered to be the former forest cover of the island. Although the vegetation there was not as tall, other species were present which showed that stock had materially altered the larger forest remnant. He noted that "tussock country" covered the greater portion of the island (Oliver 1922, 1944).

Arrival and eradication of cats on Stephens Island

It is not clear by whom, or when, cats (*Felis catus*) were first taken to Stephens Island. The Secretary of Marine advised his Minister in July 1916 that cats were introduced by one of the men employed in building the lighthouse (M1 25/611, pt 1 - Archives New Zealand, Wellington). However, there is no definite evidence that any cats were taken there between April 1892 and January 1894 when the lighthouse and associated facilities were under construction. Ingram (1926) recalled that there was no occasion to take cats to Stephens Island "as there was not a rat or a mouse on the island" during the 12 months he was there helping with construction of the lighthouse.

Most likely cats were introduced to Stephens Island by one or more of the original keepers. Three keepers and their families lived on the island from the time the light was first exhibited in January 1894. Seventeen people were living there nine months later (Lukins 1894). There was at least one cat in the keepers' possession before the winter of 1894, because Travers was told when he was on the island in February 1895 that the most likely time to find the Stephens Island wren "was the winter, as it was during that time the cat brought most of the specimens to the house" (Travers 1894-1896). However, it appears that Lyall's family may not have possessed a cat at that time, or that any cat it did possess was not responsible for bringing in the wrens, because, on 7 March 1895, Travers informed Rothschild that "Mr Lyalls boy gave me a specimen that had been found just alive by the owner of the cat that had caught the others" (Travers 1894-1896).

Lukins (1894) does not mention the presence of cats on Stephens Island in October 1894, but feral cats living in the forest may not have been very evident then. However, probably by early 1895, feral cats were having a noticeable effect on birdlife there. In 1905, Buller (1905:I: 43) quoted from a letter received from Lyall informing him, *inter alia*, that "the cats have become wild and are making sad havoc among all the birds". The clear inference to be drawn from this statement is that it was the keepers' domestic cats that had gone wild. Unfortunately, Buller does not give the date of this letter, and the letter itself does not seem to have survived. Galbreath (1989: 211, 301) dated it as early 1895.

The feral cats to which Lyall referred would have thrived and multiplied rapidly. Principal keeper Henaghan advised the Marine Department on 31 July 1897 that, as there was "a large number of cats running wild on the island", he thought it would be advisable to employ some means to destroy them. Henaghan requested a couple of shotguns and a supply of ammunition. There must still have been a large number of feral cats on Stephens Island when Robert Cathcart arrived there on 24 November 1898 to replace Henaghan as principal keeper. Travers (1898) said that the island was "swarming" with cats at that time. On 1 August 1899, just eight months after Cathcart arrived on Stephens Island, he advised that he had "shot over a hundred cats since I arrived here and they seem as plentiful as ever". The keepers must have continued to kill cats after then because, on 8 May 1900, Cathcart advised that they were anxiously looking out for the *Hinemoa* as "we have expended all our ammunition and cannot shoot any cats at present" (Letter Books 1894-1918).

Despite these efforts, a large number of feral cats continued to live on Stephens Island. On 1 April 1902, David Partington, who was principal keeper by then, advised that the "keepers have shot a good few cats lately, but still they flock around the dwellings, either in search of water or keepers fowls among which they are doing some damage. Our supply of shooting powder has just about run out" (Letter Books 1894-1918). The Secretary of Marine advised his Minister on 3 February 1904 that during the previous three years the Department had been endeavouring to exterminate the cats on Stephens Island, but "owing to the rough country and the scrub it is a very difficult matter" (M1 25/611, pt 1 - Archives New Zealand, Wellington).

At least 419 cats were killed, nearly all by the keepers, between 1 January 1902 and 31 December 1905. 301 were killed in 1905 alone. On 1 September 1905, principal keeper George Greig advised the Secretary of Marine that "there are not many cats to be seen on the top of the island, but there are still a good many on the cliffs where it is difficult to get

at them". There must have been a "good many" because assistant keepers George Thwaites and William Murray between them killed 132 cats in the following three months to 30 November 1905. However, their efforts were obviously producing the desired result because they killed only nine cats in December 1905, and only three in January 1906. No doubt Greig was pleased to report on 1 February 1906 that "very few cats are now left on the island, there may be a few stray ones on the steep sides but we have not seen any lately". Fifteen months later, on 1 June 1907, Greig could still report that there were very few cats on Stephens Island, and "when one is seen it is invariably hunted down" (Letter Books 1894-1918). Bounties totalling £13.0.6d were paid for 511 cats killed on Stephens Island in the period 1901-1910 (*M1 25/611, pt 1* - Archives New Zealand, Wellington).

Feral cats persisted on Stephens Island for many more years, but in considerably reduced numbers. Principal keeper Elisha Tutt said there were not many cats there in October 1913, and Assistant keeper Percy Willers reported there were few cats on the island in October 1914 (Dominion Museum 1913-1931). Richie Smith recalled (pers. comm.) that the few remaining cats all lived near the top of the island, and he never saw any near the houses or lighthouse. About 12 cats were caught while he was there (1914-1916), all in traps set for harriers which were then the subject of a bounty system (Brown 2000: 209). Turner (1916) indicated that cats had been almost exterminated by the time he was on Stephens Island in March 1916 and, in June 1916, principal keeper Edward Wilson reported that he had not seen any cats recently (Dominion Museum 1913-1931). Hamilton saw only one wild cat during his six-day stay on Stephens Island in September 1916. He was assured by the keepers that not more than a dozen cats were to be found but that the reward paid for cat tails did not make it worth their while to try and exterminate the few remaining (Hamilton 1916). On 3 February 1925, acting principal keeper N.H. Harvey advised the Secretary of Marine that, during the 10 months he had been on the island, he had not seen a cat, or heard any of the keepers' children say they had seen any (*M1 25/611, pt 2* - Archives New Zealand, Wellington). On 30 October 1925, the Under-Secretary of the Department of Internal Affairs was able to advise the Director of the Dominion Museum that, as far as the keepers were aware, there were no cats on Stephens Island (Dominion Museum 1913-1931).

The demise of the native land bird fauna of Stephens Island, and its cause

Henry Travers had first-hand knowledge of the changes taking place on Stephens Island in the 1890s.

He consistently attributed the rapid demise of the native land bird fauna of the island to the depredations of feral cats. On 27 December 1898, Travers - "to show the effect of the cat as a factor in the destruction of birds" - wrote that piopio and saddleback were no longer to be found on Stephens Island, and that there were only very few robins and other birds that used to be common there (Travers 1898).

Habitat loss as a result of reduction of forest on the island was almost certainly not a contributing factor in the rapid demise or diminution in number of those birds (*contra* Worthy & Holdaway 2002: 551), because it is clear from the evidence of Thilenius (discussed earlier) that very little reduction in the overall extent of forest cover on Stephens Island had taken place by the end of 1898. Nor would collecting have been a contributing factor in the demise of the wren, saddleback and piopio on the island (*contra* Worthy & Holdaway 2002: 551). Travers is the only professional bird collector known to have visited Stephens Island during the 1890s. Travers was not successful in his searches for wren, and removal of the small number of saddleback and piopio he is known to have collected would not have been detrimental to the viability of their large populations on the island at the time of his earlier visits.

It appears that the demise of the native land bird fauna of Stephens Island was complete by 1903. Travers mentioned, shortly after his visit to Stephens Island in 1903, that there was "not a native land bird left on the island in consequence of the depredation of the cats" (Travers 1903). He considered that the wren and other native birds on Stephens Island were rapidly destroyed by cats (Travers quoted in *New Zealand Times* 23 January 1906). Travers was able to "safely say" that piopio and saddleback did not exist five years after the lighthouse there was under construction, "due to their extermination by cats, and nearly all the other native birds disappeared also" (Travers 1913).

Piopio and saddleback were among the land bird species of Stephens Island that would have been particularly vulnerable to predation by cats.

Buller (1873: 140) considered that piopio, because of their ground-feeding habits, were an easy prey to cats. Piopio evidently obtained much of their food from on or near the forest floor. Buller (1905:II: 135) saw one hopping about on the ground under shelter of roadside vegetation, foraging for worms and grubs "just as we see the English thrush on our lawns in this country". Reischek (1892) also saw piopio hopping around on the ground, and Potts (1882: 199) recorded that they might be observed either hopping along the ground, or fluttering about the lower sprays of shrubs.

Other early accounts give prominence to the confiding nature of South Island piopio. For example, Potts (1882: 199, 201) described them as

being a “very sociable” bird and “as bold as the robin or tit, without their intrusive friendliness”. Haast (1861: 140) found them to be very inquisitive and social birds, generally making their appearance as soon as the traveller halted. Douglas noted that sometimes a dozen piopio would be around his tent eating off his plate, or even out of his hand - “they take food out of a man’s hand with an indifference to his presence” (Pascoe 1969: 264). Henry (in Ogilvie-Grant 1905) said piopio were “remarkably tame”. The piopio on Stephens Island was as sociable as its mainland congener. Travers (1913) saw the cook snare them when they went into the cook house to pick up crumbs, and let them go, and snare them again, and Lukins (1894) observed they could be caught without difficulty.

Saddlebacks in a flock were “exceedingly tame”, and searched eagerly for food among the ferns and mosses covering the ground (Smith 1889). Saddlebacks spend a significant portion of their time foraging on the ground (e.g. Blackburn 1967; Pierre 2000). They readily use ground cavities for roosting if tree holes are lacking. Saddlebacks spend a lot of time at roosts that may be used for several months or even years, and the accumulated excreta and moulted feathers may attract mammals hunting by scent. They also use ground cavities for nesting, and many of their nests are within 2-3 m from the ground (Lovegrove 1996a).

CONCLUSION

Stephens Island provides the classic example in the New Zealand region of the effect that predation by feral cats can have on an island land bird fauna (Medway 1972). Feral cats were responsible for the rapid demise of the native land bird fauna on Stephens Island. “The destruction of an avian paradise”, as conservationist Perrine Moncrieff (pers. comm.) called the catastrophe on Stephens Island, was complete by 1903. By 1915, a decade after the feral cat population had been considerably reduced, about half of the 25 native land bird species recorded from Stephens Island in the early 1890s were occurring there again, and several introduced land bird species had appeared and occupied the island’s changed habitat (Medway 2004b). Although some of those native land bird species could have successfully re-colonised the island from nearby D’Urville Island, the unique components of the 1890s avifauna had gone forever. The 11 native land bird species that occur there now (Brown 2000: 239) are species common elsewhere in New Zealand.

ACKNOWLEDGEMENTS

Most research for this paper was undertaken 30 and more years ago. I am grateful to the (then) Marine Division,

Ministry of Transport, for allowing me in 1972 to examine Marine Department records held at Seaview in Lower Hutt. Unfortunately, my research there, and elsewhere, confirmed that most early Marine Department records in connection with Stephens Island, some of which may have been of material value to this study, must have been destroyed in the two major fires that ravaged departmental records. Fortunately, sufficient early records have survived to enable the story to be told, and I am grateful to Archives New Zealand, that holds most of them, for access to those records at various times over the years. I am also grateful to the late Fred Kinsky and other members of the staff of the (then) Dominion Museum for their assistance in my search for early records relating to Stephens Island held by that repository, and, much more recently, to Alan Tennyson for the opportunity to re-examine the Travers juvenile Stephens Island saddleback specimen and records relating to it. I also thank the Museum of New Zealand for permission to reproduce the Cockayne photograph that accompanies this paper. I thank Brian Gill of the Auckland Institute and Museum for providing details of the South Island kokako specimen that is attributed to Stephens Island. I am grateful to Ross Galbreath for drawing my attention to some Travers letters in Archives New Zealand and to the Buller/Rothschild correspondence in The Natural History Museum, London, and for providing relevant copies. I also thank Graeme Taylor, Jason Roxburgh, and in particular Rob Chappell, all of the Department of Conservation, for providing me with an estimate of the population of saddleback on Cuvier Island. I am grateful to my reviewers, Colin O’Donnell and Brenda Greene, and to Murray Williams, for constructive comments that have resulted in improvements to this paper.

LITERATURE CITED

- AJHR. 1879-1894. *Appendices to the journal of the House of Representatives*. Wellington, Government Printer.
- Blackburn, A. 1967. Feeding stations and food of the North Island saddleback in November. *Notornis* 14: 67-70.
- Blackett, J. R. 1873 - 1881. MS journals and letters, Volume 4: 1 January 1873 - 31 December 1881. Parliamentary Library, Wellington.
- Brown, D. 2000. *Stephens Island. Ark of the light*. Blenheim, The Author.
- Buller, W.L. 1873. *A history of the birds of New Zealand*. 1st ed. London, John van Voorst.
- Buller, W.L. 1887-1888. *A history of the birds of New Zealand*. 2nd ed. 2 vol. London, The Author.
- Buller, W.L. 1893. Further notes on the birds of New Zealand. *Transactions & proceedings of the New Zealand Institute* 25: 63-88.
- Buller, W.L. 1895a. Notes on the ornithology of New Zealand; with an exhibition of rare specimens. *Transactions & proceedings of the New Zealand Institute* 27: 104-126.
- Buller, W.L. 1895b. Letter of 10 February 1895 to Lord Walter Rothschild. Rothschild correspondence in The Natural History Museum, London.
- Buller, W.L. 1895c. Letter of 12 September 1895 to Lord Walter Rothschild. Rothschild correspondence in The Natural History Museum, London.
- Buller, W.L. 1905. *Supplement to a history of the birds of New Zealand*. 2 vol. London, The Author.

- Cockayne, L. 1903. *Hinemoa lighthouse excursion 1903*. Notebook No. 20. MS 74 in Library, Auckland Institute & Museum, Auckland.
- Cockayne, L. 1907. Report on a botanical survey of Kapiti Island. *Appendices to the Journal of the House of Representatives*: C-8: 1-23.
- Cockayne, L. 1910. *New Zealand plants and their story*. 1st ed. Wellington, Government Printer.
- Cockayne, L. 1921. *The vegetation of New Zealand*. 1st ed. Leipzig, W. Engelmann.
- Dawson, G.E.; Dawson, E.W. 1958. Birds of the Cook Strait islands, collected by Professor Hugo Schauinsland in 1896 and 1897. *Notornis* 8: 39-49.
- Dieffenbach, E. 1843. *Travels in New Zealand*. 2 vol. London, John Murray.
- Dominion Museum. 1913-1931. Miscellaneous correspondence and memoranda relating to tuataras and frogs on Stephens Island. D.M. File 14/2/21. Museum of New Zealand, Wellington.
- Duncker, H. 1953. Mitteilungen aus der Bremer Vogelsammlung. *Abhandlungen Naturwissenschaftlichen Verein Bremen* 33: 211-241.
- Galbreath, R. 1989. *Walter Buller. The reluctant conservationist*. Wellington, G.P. Books.
- Galbreath, R.; Brown, D. 2004. The tale of the lighthouse-keeper's cat: Discovery and extinction of the Stephens Island wren (*Traversia lyalli*). *Notornis* 51(4): 193-200.
- Haast, J. 1861. Report of a topographical and geological exploration of the western districts of the Nelson province, New Zealand, undertaken for the provincial government. Nelson, Nelson Provincial Government.
- Hamilton, H. 1916. Report on visit to Stephens Island. Unpubl. report dated 21 September 1916 to Director, Dominion Museum, Wellington (D.M. 14/2/3, Museum of New Zealand, Wellington).
- Holdaway, R.N.; Worthy, T.H.; Tennyson, A.J.D. 2001. A working list of breeding bird species of the New Zealand region at first human contact. *New Zealand Journal of Zoology* 28: 119-187.
- Ingram, F.W. 1926. New Zealand birds. *Evening Post* 17 April 1926.
- Knox, A.G.; Walters, M.P. 1994. *Extinct and endangered birds in the collections of The Natural History Museum*. The British Ornithologists' Club Occasional Publications. No. 1.
- Letter Books. 1894-1918. Stephens Island letter books, outwards letters. Vol. 1: 8 February 1894-9 August 1910. Vol. 2: 2 February 1913-2 April 1918. *ML - Stephens Island, series 3*, Archives New Zealand, Wellington.
- Lovegrove, T.G. 1996a. A comparison of the effects of predation by Norway (*Rattus norvegicus*) and Polynesian rats (*R. exulans*) on the saddleback (*Philesturnus carunculatus*). *Notornis* 43: 91-112.
- Lovegrove, T.G. 1996b. Island releases of saddlebacks *Philesturnus carunculatus* in New Zealand. *Biological conservation* 77: 151-157.
- Lukins, E. 1894. Stephens Island. The French Pass and vicinity. *Colonist* 27 & 30 October 1894, 1 November 1894.
- Medway, D.G. 1972. A visit to Stephens and Maud Islands. *Forest & Bird* 183: 3-8.
- Medway, D.G. 2004a. Taxonomic status of the Stephens Island piopio (*Turnagra capensis*). *Notornis* 51(4): 231-232.
- Medway, D.G. 2004b. The land bird fauna of Stephens Island, New Zealand 1915-1933. *Notornis* 51(4): 229-230.
- Merton, D.V. 1965. Transfer of saddlebacks from Hen Island to Middle Chicken Island. January, 1964. *Notornis* 12: 213-222.
- Ogilvie-Grant, W.R. 1905. On the birds procured by the Earl of Ranfurly in New Zealand and the adjacent islands. *Ibis* 5 (8th ser.): 543-599.
- Oliver, W.R.B. 1922. *Expedition to Stephen Island*. Unpubl. memorandum dated 28/1/1922 to Acting Director, Dominion Museum, Wellington (Museum of New Zealand, Wellington).
- Oliver, W.R.B. 1944. The vegetation and flora of D'Urville and Stephen Islands. *Records of the Dominion Museum* 1: 193-227.
- Oliver, W.R.B. 1955. *New Zealand birds*. 2nd ed. Wellington, A.H. & A.W. Reed.
- Pascoe, J. (ed.). 1969. *Mr. Explorer Douglas*. Wellington, A.H. & A.W. Reed.
- Pierre, J.P. 2000. Foraging behaviour and diet of a reintroduced population of the South Island saddleback (*Philesternus carunculatus carunculatus*). *Notornis* 47: 7-12.
- Potts, T.H. 1882. *Out in the open: a budget of scraps of natural history gathered in New Zealand*. Christchurch, Lyttelton Times.
- Reischek, A. 1886. Observations on the habits of New Zealand birds, their usefulness or destructiveness to the country. *Transactions & proceedings of the New Zealand Institute* 18: 96-104.
- Reischek, A. 1887. Ornithological notes. *Transactions & proceedings of the New Zealand Institute* 19: 188-193.
- Reischek, A. 1892. *Turnagra crassirostris*. Neu Seeland-Drossel. Die Pio-pio der Maori. *Mittheilungen des ornithologischen vereines in Wien* No. 17: 195-196.
- Schmidt, K.P. 1952. References to the Tuatara in the Stephen Island Letter Book. *Fieldiana. Zoology* 34 (1): 1-10.
- Smith, W.W. 1889. On the birds of Lake Brunner district. *Transactions & proceedings of the New Zealand Institute* 21: 205-224.
- Thilenius, G. 1899. Vorläufiger bericht über die eiablage und erste entwicklung der *Hatteria punctata*. *Sitzungsberichte Akademie der Wissenschaften Berlin* 1: 247-256.
- Travers, H.H. 1894-1896. Letters to Lord Walter Rothschild & Ernst Hartert, 3 October 1894-13 May 1896. Rothschild correspondence in The Natural History Museum, London.
- Travers, H.H. 1898. List of native birds & prices dated 27 December 1898. MS IA1 1898/2511. Archives New Zealand, Wellington.
- Travers, H.H. 1903. Letter of 21 August 1903 to Colonial Secretary, Wellington. MS IA 1903/2723. Archives New Zealand, Wellington.
- Travers, H.H. 1913. Ancient reptile. The disappearing tuatara. Efforts at preservation. *Evening Post* 11 June 1913.
- Turner, E. P. 1916. Report on the dying of the bush on Stephen Island. Unpubl. report to Department of Internal Affairs, Wellington. Copy in Auckland Museum, MS 309.
- Visitors Book. 1894-1972. Stephens Island visitors book. *ML - Stephens Island, series 6*, Archives New Zealand, Wellington.
- Webber, G.W. 1953. Tuatara quest. The doctor from Bremen. *The Weekly News* No. 4674 (24 June 1953).
- Wilkinson, A.S.; Stidolph, R.H.D. 1927. Saddlebacks and 'jackbirds'. *New Zealand journal of science & technology* 9: 235-236.
- Worthy, T.H.; Holdaway, R.N. 2002. *The lost world of the moa. Prehistoric life in New Zealand*. Christchurch, Canterbury University Press.