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SHORT NOTE

How many New Zealand scaup (*Aythya novaeseelandiae*) are there?

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From an analysis of many published and unpublished counts of New Zealand scaup (pāpango, *Aythya novaeseelandiae*), Greene (2021) concluded that there are about 11,000 birds nationally and stated that the "...estimate [of] 5,000–10,000 birds (Marchant & Higgins 1990; IUCN 2016) is more accurate than the estimate of 20,000 birds (Heather & Robertson 2015)". The population size of a species is important because it is one of the factors used to determine the national and international conservation status of species (Townsend 2008; IUCN 2016) and hence management priorities. For waterbirds, a threshold of 1% of the population is used to help determine if a wetland is of international significance under the Ramsar Convention (Wetlands International 2012). To meet this 1% threshold, a wetland would have to regularly support *c*. 75, 110, or 200 New Zealand scaup, depending on which of the three population estimates for the species is accepted.

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Greene's estimate of 11,000 birds appears to be derived by simply adding the approximate numbers of birds at four principal strongholds where birds had been counted systematically over recent decades: *c*. 5,000 birds on the Rotorua Lakes (1984–2018), up to 965 birds (1987–1998) on the Bromley Sewage Ponds in Christchurch, *c*. 2,000 birds on the Ashburton lakes (1984–2018) and *c*. 3,000 birds combined on Lakes Alexandrina, McGregor, and Grasmere in the Canterbury high country (1987–1993).

The counts from the Rotorua Lakes complex shown in Figure 7 (p.120) of Greene (2021), not in Figure 5 (p.115) as stated in the text, appear to be incorrect. The total number of New Zealand scaup counted systematically on the 18 lakes between 1985 and 2018 has varied between 3,061 and 7,413 birds (Sachtleben *et al*. 2014; Department of Conservation, *unpubl. data*). The overall rate of increase has been 1.8% per annum, but the numbers showed moderate stability at *c*. 4,000 birds from 1985 to 2006, followed by a big step up to counts of *c*. 7,000 birds in 2011 and 2018 (Fig. 1).

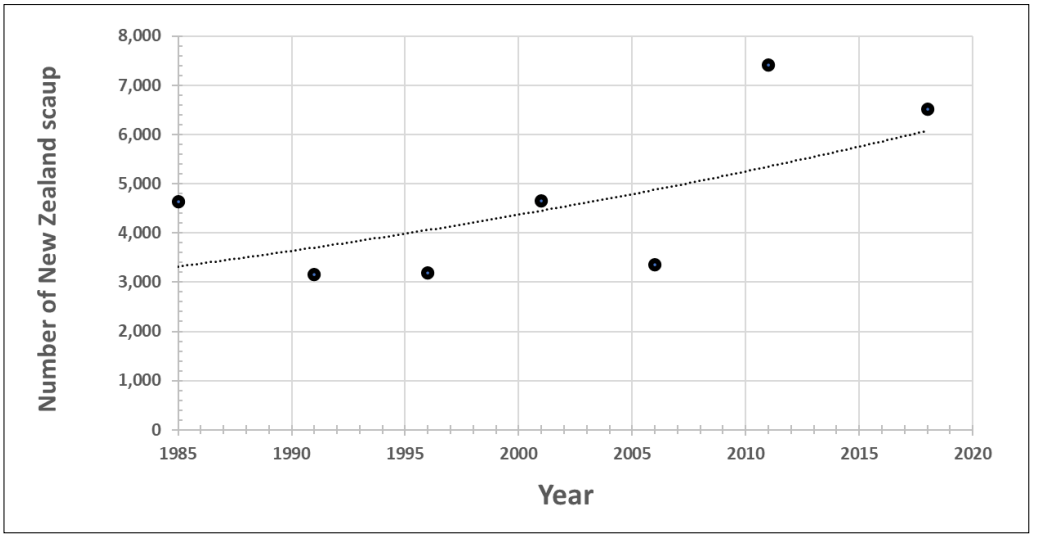

Figure 1. Changes in the numbers of New Zealand scaup (*Aythya novaeseelandiae*) recorded on 18 lakes in the Rotorua Lakes complex, 1985–2018. The average increase was 1.84% per annum between 1985 and 2018 (r = 0.68, P = 0.09, n = 7).

We also note that the 965 birds at Bromley Sewage Ponds from 1987–1998 now appears to be an underestimate. After the first pair bred there in 1991, the breeding population on islands in the ponds had built up to over 200 pairs by 2002 (Crossland 2005). Systematic monthly counts between August 2009 and July 2010 recorded a mean of 4,051 New Zealand scaup (range, 2,594–5,739) in and around the ponds (Crossland 2013).

Given that Greene (2021) collated data from 12,145 site visits spread across New Zealand, the approach to derive a national estimate from a very limited part of the species' range is surprising because it ignores all the New Zealand scaup living away from these four principal strongholds. This would be akin to estimating the number of bar-tailed godwits (*Limosa lapponoica*) in New Zealand by adding up the mean numbers seen at the top four sites (Kaipara Harbour, Manukau Harbour, Farewell Spit, and the Firth of Thames) in the summers of 2005–2019. This would have given a national population estimate of 42,307 birds rather than the mean of 77,796 birds from all sites counted (Riegen & Sagar 2020).

The current New Zealand Bird Atlas, organised by Birds New Zealand, and displayed on the eBird website (https://ebird.org/atlasnz/map/nezsca1), provides an up-to-date picture of the distribution and numbers of New Zealand scaup nationally. Perhaps an atlas scheme such as this prompts ornithologists to visit more sites than usual, including visits at a range of seasons and, especially, to record the numbers of all bird species seen. Many of the eBird records with New Zealand scaup are, however, spot counts or travelling counts that do not purport to systematically cover the entire wetland. We expect that counts at most sewage ponds and at small lakes with clear margins are likely to be complete counts, but many of the counts from lakes with complex shorelines and overhanging trees are likely to be underestimates.

Many New Zealand scaup are found outside of the four strongholds identified by Greene (2021). In the North Island, an analysis of all NZ Bird Atlas eBird records from 1 June 2019 to 30 November 2021 reveals that ≥100 New Zealand scaup have been recorded at 11 sites (Table 1) away from the Rotorua Lakes complex that was used by Greene (2021) to estimate the national population. At one of the 11 sites, Lake Taupo, counts of ≥100 New Zealand scaup were recorded at each of eight different locations around the lake at various dates, with a maximum single estimate of 620 birds at Tokaanu Wharf (38°57′S, 175°46′E) in November 2021. This suggests that the population has grown since 136 adult and 35 subadult New Zealand scaup were counted in a lake-wide survey in January 1986 (John Innes *pers. comm.*). The highest count away from the Rotorua Lakes complex was of 770 birds at Lake Horowhenua, Levin, in May 2020, followed by another count of 560 birds less than a week later. Twenty-one other North Island sites each had maximum counts of 50–99 New Zealand scaup between June 2019 and November 2021 (Table 1).

Table 1. North Island sites, excluding the Rotorua lakes complex, with maximum counts of ≥50 New Zealand scaup in NZ Bird Atlas eBird records between June 2019 and November 2021. The province, site, maximum count, and date of the maximum count is given. SP = Sewage Ponds

Region	Site	Max count	Date
Northland	Kai Iwi Lakes	114	23 June 21
Auckland	Western Springs	66	8 January 20
South Auckland	Mangere SP	62	8 August 21
Bay of Plenty	Golden Cross Mine	64	15 May 21
	McLaren Falls Park	125	25 October 20
	Tauranga SP	76	28 June 20
	Kawerau SP	51	26 July 20
	Lake Aniwhenua	94	24 October 20
Waikato	Lake Taharoa	160	18 July 19
	Whakamaru Dam	51	5 January 20
	Aratiatia Dam	90	23 June 19
Volcanic Plateau	Waikato River exit, Lake Taupo	145	7 November 20
	Taupo Waterfront, Lake Taupo	204	10 September 20
	2/3 Mile Bays, Lake Taupo	128	21 June 20 & 24 November 20
	Motuoapa, Lake Taupo	150	1 May 20
	Tokaanu Wharf, Lake Taupo	620	2 November 21
	Kinloch, Lake Taupo	125	4 March 21
	Whahaipo Bay, Lake Taupo	135	27 June 21
	Acacia Bay, Lake Taupo	126	27 March 21
Gisborne	Tuai Power Station	55	8 July 20
Hawkes Bay	Lake Lopez	65	13 July 19
Wairarapa	Henley Lake, Masterton	124	29 May 20
	Kourarau Dam	112	17 June 19
	Pounui Lagoon	150	2 May 20
Taranaki	Lake Managamahoe	112	29 April 20
	Leperton SP	57	2 June 20
	Stratford SP	110	13 October 20
	Eltham SP	50	21 April 21
	Lake Rotokare	80	31 May 21
	Lake Opunake	64	22 July 21
	Patea SP	60	3 & 17 April 21
Whanganui	Standalone Pond	53	2 July 19
	Donovan's Wetland	72	10 December 19
Manawatu	Lake Omanu, Foxton	52	23 July 20
	Palmer Rd Ponds, Foxton	131	1 May 21
	Lake Horowhenua	770	14 May 20
	Waikawa Ponds	64	25 May 21
Wellington	Otaki SP	88	18 April 21
	Waikanae SP	89	11 February 21

In the South Island, New Zealand scaup have been recorded in large numbers at many sites outside of the three strongholds used by Greene (2021) to calculate the national population. At 31 different sites, ≥100 New Zealand scaup have been counted, and at a further 27 lakes or ponds ≥50 birds have been recorded between June 2019 and November 2021 (Table 2). Most notable, given that the sites were not mentioned by Greene (2021), were the sewage ponds serving Nelson, Blenheim, and Invercargill, each of which have had maxima of 600 birds or more. At the Nelson Sewage Ponds, over 450 New Zealand scaup have been recorded in NZ Bird Atlas eBird records in every season, and a maximum of 1,262 birds was estimated to be present in June 2021 (Field *et al*. 2022). Up to 600 New Zealand scaup were seen at the Blenheim Sewage Ponds in February 2021; and 605 were seen at the Invercargill Sewage Ponds, also in February 2021. Another important South Island site not mentioned by Greene (2021) was the Te Nohoaka o Tukiauau/Sinclair Wetlands, south of Dunedin; New Zealand scaup were the most common waterfowl species there, with a maximum of 617 birds counted in winter 2015 (Thompson & McKinlay 2021).

Greene (2021) claims that populations of two other diving birds that share similar habitats, Australasian crested grebe (*Podiceps cristatus*) and dabchick (*Poliocephalus rufopectus*), have declined nationally, and suggests that the New Zealand scaup population is also likely to be in decline due to a deterioration in water quality nationally. Although we agree that the quality of many freshwater wetlands has declined because of land management practices in their catchments, the populations of all three species have increased over recent decades. The Australasian crested grebe population increased in the South Island from a low of *c*. 250 birds in 1980 to *c*. 350 in 2004 (Jensen & Snoyink 2005) and to *c*. 600 birds by 2012 (Heather & Robertson 2015), and they have recently re-established in Marlborough (NZ Bird Atlas). Dabchicks have increased in the North Island to the point where their national conservation status was downgraded from 'Nationally Vulnerable' in 2012 (Robertson *et al*. 2013) to 'At Risk – Increasing' in 2016 (Robertson *et al*. 2017), and they have started to re-colonise the northern South Island (Heather & Robertson 2015). Part of the increase in the numbers of dabchicks, at least in the southern North Island, has been attributed to the construction of sewage oxidation ponds that provide conditions that favour wintering birds (Stidolph & Heather 1988). Dabchick numbers on the Rotorua Lakes complex have doubled from 364 birds in 1985 to 757 birds in 2018 (Sachtleben *et al*. 2014; Department of Conservation *unpubl. data*). It is perhaps no coincidence that many of the sites favoured by dabchicks and New Zealand scaup are sewage oxidation ponds where the water quality, as perceived by humans, is exceedingly low. Attributing a decline in New Zealand scaup numbers to a lowering of water quality nationally is not supported by data showing an overall population decline, and nor does it fit with the observation that many of the strongholds used by the species today are sites with exceptionally poor water quality rather than pristine lakes.

Because there have been only five band recoveries of wild New Zealand scaup (unpublished data in the FALCON database of the NZ National Bird Banding Scheme), little is known about the seasonal movements of New Zealand scaup. Four recoveries were within 25 km of the banding site and one (S-51627) was 194 km away but, because the bird had been banded at a captive-rearing facility at Pukaha Mt Bruce, the bird may have been released closer to the recovery site in Taranaki. Given the magnitude of fluctuations in counts at particular sites that are easy to census (e.g. Otaki Sewage Ponds, HAR *pers. obs*.), we expect that there will be at least local movement between nearby sites such as between the Bromley Sewage Ponds and the Pegasus lakes, Kaiapoi lakes, and Northbrook near Rangiora, all within 25 km of one another. There may be much longer seasonal movements judging by the exceptional influx of up to 770 New Zealand scaup to Lake Horowhenua in May 2020, where very few New Zealand scaup are normally present (HAR *pers. obs*.).

Regardless of movements within or between regions, it seems very likely that the 11,000 birds estimated by Greene (2021) is an underestimate of the true national population, and the estimates of 5,000–10,000 birds by Marchant & Higgins (1990) and Wetlands International (2012) are likely to be serious underestimates. Heather & Robertson (2015) repeated their earlier estimate of 20,000 birds from the 1990s (Heather & Robertson 1996) but noted that the population was increasing. They attributed this to the construction of hydroelectric dams, irrigation dams and oxidation ponds which all provided valuable new habitat, and through new populations being established from a captive-breeding programme run by Ducks Unlimited. A nationwide increase in predator control in and around wetland habitats is also likely to have contributed to an increase in New Zealand scaup.

The national distribution of New Zealand scaup appears to have increased substantially between the 1969–1979 NZ Bird Distribution Atlas (Bull *et al*. 1985) and the 1999–2004 NZ Bird Distribution Atlas (Robertson *et al*. 2007), and then again to the current distribution shown on the NZ Bird Atlas eBird website.

Table 2. South Island sites, excluding the three strongholds identified by Greene (2021) at Bromley SP, Ashburton Lakes, and Lakes Alexandrina, McGregor and Clearwater combined, with maximum counts of ≥50 New Zealand scaup in NZ Bird Atlas eBird records between June 2019 and November 2021. The region, site, maximum count, and date of the maximum count is presented. SP = Sewage Ponds.

Region	Site	Max count	Date
Nelson	Nelson SP	1,000	26 June 20
	Bell Island SP	152	13 November 21
	Best Island SP	87	10 September 19
West Coast	Lake Brunner	66	26 November 20
	Hokitika SP	122	8 November 20
Marlborough	Grovetown Lagoon	65	8 March 21
	Opaoa River/ Blenheim SP	600	2 February 21
	Taylor Dam	80	6 October 19
	Delta Lake	54	18 September 21
	Lake Elterwater	220	18 August 21
Lowland Canterbury	St Anne's Lagoon	200	9 June 19
	Cheviot SP	50	2 July 20
	Pegasus Wetlands	271	15 July 20
	Tutaepatu Lagoon	77	10 September 19
	Northbrook, Rangiora	115	17 June 19
	Kaiapoi lakes	169	22 March 20
	Travis Wetland	50	13 June 21
	Westlake Reserve, Halswell	71	22 March 21
	Lincoln Wetlands	88	27 July 21
	Lake Crichton, Dunsandel	70	1 August 21
	Lake Forsyth	365	21 September 21
	Lake Ellesmere	501	29 July 20
	Cooper Lagoon	50	24 April 20
	Lake Hood, Ashburton	360	22 March 20
	Otipua Wetland, Timaru	51	28 May 20
	Lake Wainono	144	23 November 19
	Bell's Pond, Glenavy	60	21 July 21

Table 2. *continued*

Region	Site	Max count	Date
Inland Canterbury	Lake Pearson	180	15 August 20
	Lake Sarah	105	14 February 21
	Lake Evelyn	152	7 February 21
	Lake Selfe	69	9 August 20
McKenzie Basin	Lake Pukaki head	100	2 April 21
	Wairepo Arm, Lake Ruataniwha	270	24 November 21
	Lake Middleton, Lake Ohau	200	11 August 21
	Lake Benmore	319	28 July 19
	Birchwood Ponds, Upper Ahuriri	66	17 October 21
Southern Lakes	Wanaka Waterfront	80	23 December 20
	Lowburn Inlet, Lake Dunstan	170	20 December 20
	Lake Hayes	89	5 October 20
	Queenstown SP	170	13 February 21
	Queenstown Waterfront	69	23 July 19
	Glenorchy Lagoon	83	2 July 20
	Te Anau Downs	345	6 March 20
	Te Anau SP – Upukerora River	83	22 September 21
	Te Anau Marina & Waterfront	141	4 July 20
	Supply Bay, Lake Manapouri	80	17 April 21
Lowland Otago	Tomahawk Lagoons, Dunedin	128	28 July 21
	Lake Waihola	307	30 May 20
	Lake Tuakitoto	65	11 April 21
	Clutha Lagoons, Balclutha	373	23 May 20
	Greenall Road Pond, Balclutha	79	5 July 20
Southland	Waituna Lagoon	100	23 May 21
	Invercargill SP	605	9 February 21
	Tip Lagoon, Invercargill	452	12 May 21
	Oreti Estuary	78	1 May 20
	Riverton SP	90	2 June 20
	Te Waewae Lagoon	72	6 November 21
	Redcliff/Lake Rakatu	425	9 August 20

In the first atlas to 1979, New Zealand scaup were recorded from just ten 10,000-yard grid squares in the North Island south of a line from about New Plymouth to Napier, and in 13 squares in the lowland eastern and southern South Island between about Blenheim to Riverton, to the west of Invercargill. By the time the second atlas was completed in 2004, there were records of New Zealand scaup from 78 10-km grid squares in the southern North Island and 90 squares in the lowland eastern South Island. Estimates of local occupancy probability increased significantly (more than doubled) in both the North Island and the South Island between the first two atlases (Walker & Monks 2018). Even though the current atlas had run for only 27 months to 30 November 2021, there had already been records from 86 southern North Island squares and >170 squares in the lowland eastern and southern South Island, suggesting an ongoing range expansion of the species.

The population in the Rotorua Lakes complex appears to be increasing (Fig. 1), as does the Ashburton Lakes population (see Fig. 7 of Greene [2021]), and there was a 30-fold increase in New Zealand scaup numbers in and around Christchurch, from *c*. 200 birds in the 1980s to almost 6,000 in the early 2000s, with the Bromley Sewage Ponds being an important breeding site (Crossland 2005). Together with the numerous eBird records of many New Zealand scaup at sites away from these strongholds, the 20,000 birds estimated by Heather & Robertson (2015) may be conservative. In the New Zealand Threat Classification System (Townsend *et al*. 2008), New Zealand scaup has long been assessed by expert panels as being 'Not Threatened' (Miskelly *et al*. 2008; Robertson *et al*. 2013; Robertson *et al*. 2017; Robertson *et al*. 2021) and, with their numbers and range apparently increasing, we see no reason to change that classification.

A good estimate of the national population of New Zealand scaup could be obtained by Birds New Zealand working with organisations such as Fish & Game New Zealand, Ducks Unlimited, and the Department of Conservation, to undertake a coordinated and systematic national count. This should be done over as short a period as possible at as many sites as possible, but especially including the four strongholds identified by Greene (2021) and the 90 sites nationwide with maxima of ≥50 New Zealand scaup identified in this paper. Large sites, such as Lake Taupo, and sites within 25 km of one another, should be counted within the space of a few hours to reduce double-counting or under-counting. At the same time, it would be useful to count both Australasian crested grebes and dabchicks, which often share the same habitats, to better estimate their current national populations.

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