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SHORT NOTE

The importance of a wastewater treatment wetland to the changing status of New Zealand scaup (*Aythya novaeseelandiae*) in the Nelson/Tasman region

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The status of the endemic New Zealand scaup (*Aythya novaeseelandiae*) has recently been reviewed by Greene (2021) who concluded that the total population was probably about 11,000 birds and that the population was apparently declining, at least in part, as a result of increasing eutrophication of lakes. Here we report changes in the status of New Zealand scaup over recent decades in the Nelson/Tasman region. Our results, which demonstrate a considerable increase in the local New Zealand scaup population, contrast markedly with those of Greene (2021).

New Zealand scaup (hereafter scaup) was recorded by Moncrieff (1938) as occurring in Nelson Province, but without any further details. Walker (1987) reported it as being 'found mainly on inland lakes and ponds with some cover round the edges. Commonly seen on the main lakes of Nelson Lakes National Park and north-west Nelson'. Owen & Sell (1985) recorded it as a 'rare visitor to the coastal areas of the Nelson region', and noted one shot in 'The Traverse' between Rabbit and Rough Islands as the first record for Waimea Inlet. Butler *et al*. (1990) recorded 'small populations of scaup may be found at several lakes in the region, particularly Lake Rotoroa in Nelson Lakes National Park, Lake Matiri near Murchison, Druggans Dam in Golden Bay, and Kaihoka Lakes near Whanganui Inlet. Some birds breed, but many are transient so that it is hard to be sure of seeing them at any one location'. These descriptions reflect the mapped distribution of the species in the first New Zealand Atlas 1969–1979 (Bull *et al*. 1985).

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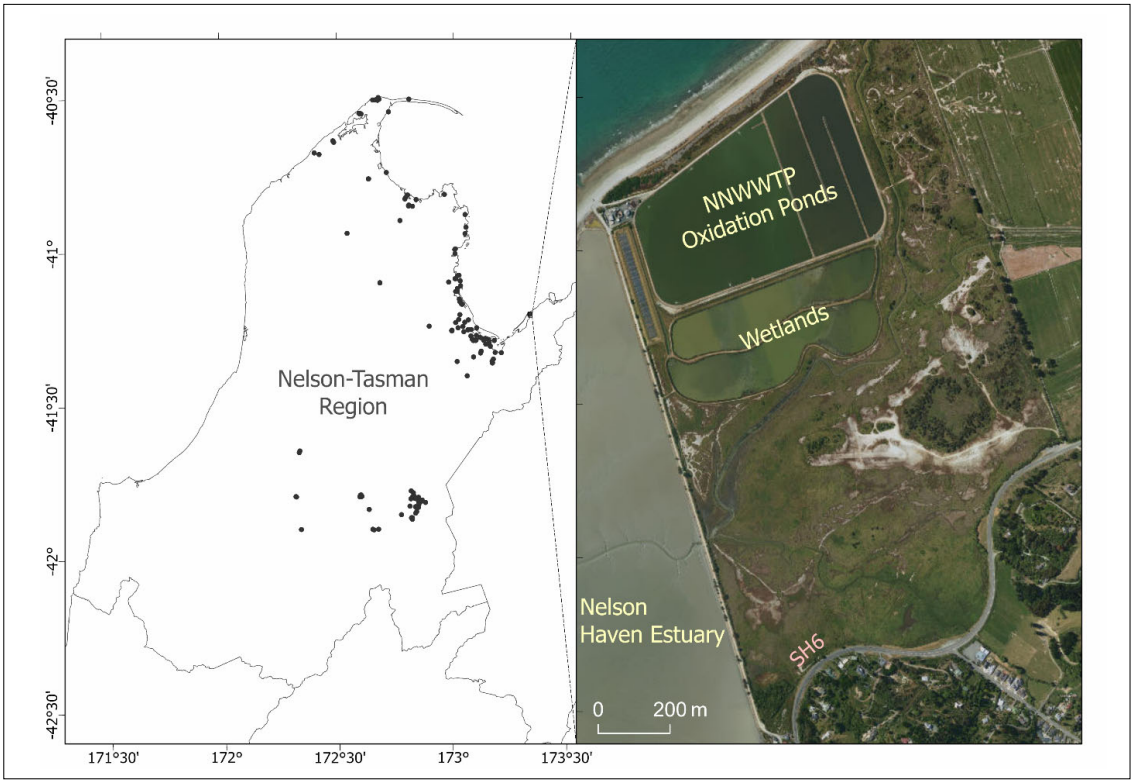

Figure 1. Distribution of New Zealand scaup (*Aythya novaeseelandiae*) in the Nelson/Tasman region (eBird records to October 2021), and location of Nelson North Wastewater Treatment Plant (NNWWTP) and associated wetlands.

The mapping of scaup distribution in 1999–2004 revealed birds near Nelson city for the first time but there were no breeding records (Robertson *et al.* 2007). Records from the online sightings database eBird show that scaup is now widely distributed around Nelson, with many small ponds supporting up to a few tens of birds (eBird 2021a) (Fig. 1). Up to October 2021, scaup have been recorded from 23 out of a total of 115 Atlas grid squares in the Nelson/Tasman region, including all sites where they were recorded in the 1960s and 70s (eBird 2021b).

One site in particular has shown a very dramatic increase in scaup numbers; the Nelson North Wastewater Treatment Plant (NNWWTP). The NNWWTP oxidation ponds at Wakapuaka (41.2049°S, 173.3291°E), covering 26 ha, were constructed in 1979. The pond layout, but not total area, was subsequently modified in 1996. The wastewater treatment plant had a significant upgrade in 2009, when two ~7 ha wetland areas were established. The first planting of the wetlands occurred in June 2009, but was largely unsuccessful, due in part to plants being uprooted by black swan (*Cygnus atratus*) and pūkeko (*Porphyrio melanotus*). Further planting was undertaken in January and February 2010. The original design had vegetation throughout much of the wetlands and initial planting comprised *Schoenoplectus tabernamontani*, *Eleocharis sphacelata*, and *Baumea articulata*, while along the pond margins plantings included *Cyperus* and *Carex*. Currently the ponds only have riparian vegetation, with substantial areas of flax (*Phormium tenax*) on the banks. The ponds are approximately 1.5 m deep with an earth bottom sealed with bentonite; treated wastewater circulates through them before being discharged to Tasman Bay.

Regular observations of waterfowl at the NNWWTP since January 2008 show the population of scaup growing from zero to over one thousand birds in 2021 (Fig. 2). The first record was of three birds on the oxidation ponds on 14 October 2008. In 2010 there were six records of up to three birds, all on the oxidation ponds. The first scaup recorded in the wetlands were in mid-May 2011 when 50 were reported (John Campbell *pers. comm.* to PF), and on 20 June 2011, 24 were present. Since January 2012, scaup have been recorded consistently in the wetlands, with generally smaller numbers in the oxidation ponds.

Breeding by scaup was first recorded on 28

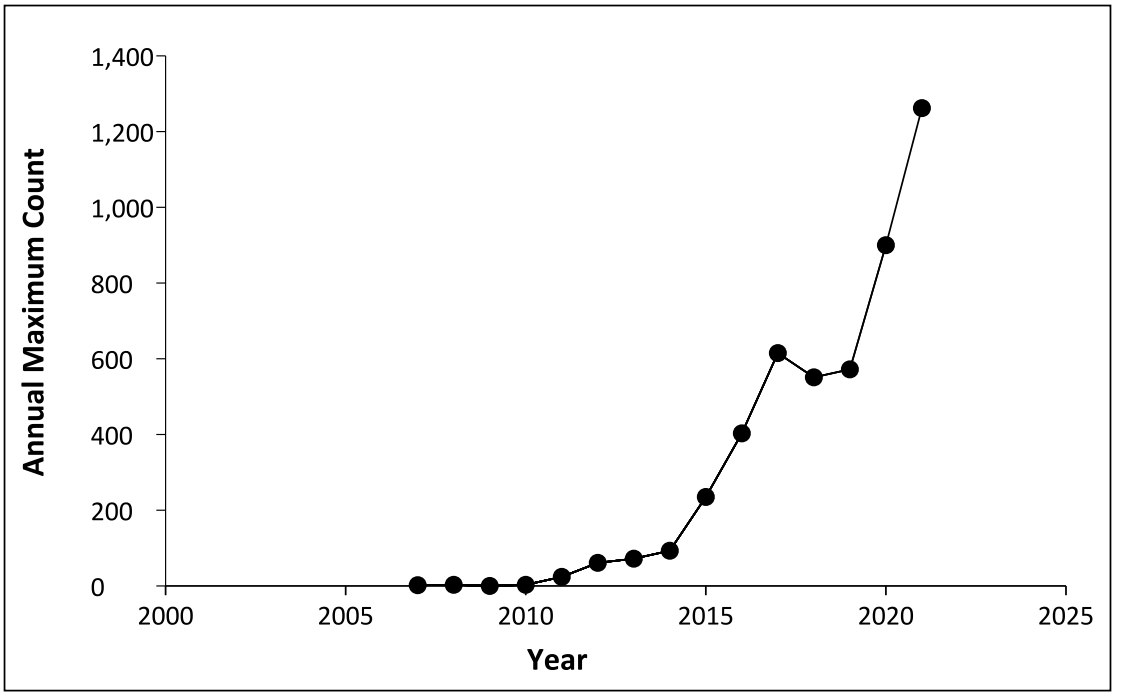

Figure 2. Maximum number of New Zealand scaup (*Aythya novaeseelandiae*) recorded each year at Nelson North Wastewater Treatment Plant and wetlands, 2007–2021.

December 2012 when a female with four nearly fully grown young were seen in the wetlands. Breeding has been recorded every year since, with at least 22 broods seen on 16 November 2020; one in the oxidation ponds, the others in the adjacent wetlands. A total of 162 broods have been recorded between 2013 and 2021, 97.5% of which were in the wetlands, with the remainder in the oxidation ponds. Scaup favour nesting in dense cover near water (Williams 2005), and Guthrie-Smith (1927) noted them nesting among the base of flax plants, thus the spreading and maturing of those planted at the wetlands is likely to provide increasingly favourable conditions.

No studies have been made of the aquatic invertebrate communities in the Wakapuaka oxidation ponds and wetlands. On 17 September 2021, we collected five core samples from within 5 m of the edge of the wetland ponds. These were washed over a 1 mm mesh sieve and all living organisms retained. We recovered small oligochaete worms, and chironomid larvae ('blood worms') of two species: *Chironomus zealandicus* (64.2% of individual larvae counted) and the currently undescribed *'Chironomus* sp. A' (35.8%). The density of chironomid larvae averaged 3,310 per m^2 (range 1,655–4,329 per m^2), and oligochaetes averaged 815 per m^2. *Chironomus zealandicus* is the commonest midge occurring at wastewater treatment plants (WWTPs) in New Zealand (Garton & Bickers 2016; Macdonald *et al*. 2017) and can occur at very high densities; for example, Robb (1966) recorded densities of third and fourth instar larvae of up to 16,380 per m^2 at the Bromley WWTP ponds, Christchurch.

Little is known of the diet of scaup, but Wakelin (2004), who examined gizzard samples of 19 birds, found that food taken varied between sites but was similar within sites – main items included snails, chironomid larvae, and Trichoptera larvae. Williams (2005) also recorded scaup taking the tips of aquatic vegetation and also suggested that they may eat zooplankton, which are present in WWTPs. Chironomids may comprise an important part of the diet of *Aythya* ducks elsewhere (Bengtson 1971; Nilsson 1972; Laughlin 1973; Gardasson & Einarsson 2004). Giles (1990), in a laboratory situation, found that ducklings of the tufted duck (*Aythya fuligula*) aged 14–25 days could fulfil their daily food requirements by 36 minutes of underwater foraging at a density of chironomid larvae of 16,000 per m^2. Full grown tufted ducks average *c.* 17% heavier than New Zealand scaup (Robinson 2005) and so food requirements of scaup ducklings may be less than recorded for tufted duck. Day-old New Zealand scaup ducklings can dive to about 2

m (Oliver 1955) so most, if not all, of the wetland floor would be available for foraging. We therefore suggest that the population of chironomids in the Wakapuaka wetlands is contributing to the large, and increasing, population of scaup at this site.

Observations at NNWWTP are similar to those by Crossland (2013) who reported very high numbers of scaup at the Bromley oxidation ponds, Christchurch, which also have associated extensive wetlands. The current population in Nelson and the numbers reported in Christchurch by Crossland (2013) account for about half of the global population estimated by Greene (2021). Robertson & Makan (2022) have questioned this figure, and suggested that the population estimate of 20,000 birds given by Heather & Robertson (2015) may be conservative. Whatever the actual number, it is apparent that the number of scaup at the Nelson and Bromley WWTPs account for a significant proportion of the global population. Both sites are of international importance, meeting Criterion 6 [supporting 1% or more of a population of one species] of the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Secretariat 2010).

Greene (2021) suggested that eutrophication and worsening water quality in lakes may be adversely affecting scaup numbers. In contrast, it would appear that the high nutrient conditions in wetlands associated with WWTPs are favouring scaup. Pond-based WWTPs are designed to remove nutrients through assimilation in plants and microbial activity in sediments and depend upon a balancing of algal production and phytoplankton grazers (principally cladocerans and rotifers) for optimal operation. Climate change, in particular increase in temperature, is expected to affect the biological operation of WWTPs (Hughes *et al.* 2021); if chironomid populations decline this could potentially impact scaup.

Most WWTPs in New Zealand are pond-based (Ministry for the Environment 2020), with over 200 waste stabilisation pond (oxidation pond) water treatment plants across the country (Archer 2015). Differences in design and operating practices probably account for what appear to be highly variable numbers of scaup occurring at WWTPs. It is notable that scaup are only rarely recorded from the Bell Island WWTP (41.2924°S, 173.1720°E) located *c.* 16 km from Wakapuaka WWTP (a record of 152 on 13 November 2021 was exceptional). Both of these facilities have stabilisation ponds with clay bottoms and embankments that are concrete-faced for wave protection, but the Bell Island site has no associated wetland area.

Wetlands have been incorporated into a number of treatment plants across the country (Archer & Mara 2003). There would be value in undertaking a national assessment of scaup occurring at WWTPs and associated wetlands across New Zealand.

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