

SHORT NOTE

A significant remnant population of whio (blue duck, *Hymenolaimus malacorhynchos*) bridging the gap between Fiordland and West Coast Recovery Sites, South Island, New Zealand

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Whio (blue duck, *Hymenolaimus malacorhynchos*) is a globally Endangered/Nationally Vulnerable, New Zealand endemic species, characteristic of clear fast-flowing upland rivers and streams (Baillie & Glaser 2005; Robertson *et al.* 2021; IUCN Red List 2022). The South Island whio is now mostly confined to high-altitude segments of rivers in the Southern Alps Kā Tiritiri o te Moana and Fiordland (Checklist Committee OSNZ 2022). There have been some recent substantial population increases where persistent riparian mammalian predator control exists such as in central North Island and Te Anau-Milford areas (Checklist Committee OSNZ 2022). The only member of its genus (Robertson &

Goldstien 2012), the whio is regarded by Kāi Tahu¹ as a highly valued traditional food source, with strong cultural and historic connections over many generations (P. Tamati-Elliffe *pers. comm.* 2022). The presence of whio is deemed to be an indicator of riverine ecosystem health and the completeness of ecological relationships within that ecosystem (Glaser *et al.* 2010).

The long-term goal of the Department of Conservation Whio Recovery Plan (2009–2019) is to ensure the retention of viable wild whio populations throughout their natural range with the identification of new recovery sites for whio management within the under-represented parts

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¹ Kāi Tahu and Ngāi Tahu are names for the iwi (tribe) of Māori people in New Zealand's South Island. The K is an important feature of the Kāi Tahu dialect, but is interchangeable with the use of the 'Ng'.

of their former range (Glaser *et al.* 2010). There are currently eight identified who recovery sites within the South Island of New Zealand where birds are actively managed (Glaser *et al.* 2010; A. Smart *pers. comm.* 2023). Previously, who in the Landsborough Valley (43°59'0"S, 169°29'0"E) were included as a recovery population but this ended in 2015 (A. Smart *pers. comm.* 2023). Consequently, there is a significant gap (c. 350 km), between the who recovery sites in Fiordland (45°17'0"S, 167°42'04"E) and the West Coast (42°50'55"S, 171°15'30"E) which might hinder natural dispersal and gene flow between populations.

Who management does not currently include birds of the Makarora (originally known by Māori as Makarore) region (Glaser *et al.* 2010; S. Sutton *pers. comm.* 2022). Who in this site form an important population, which is not only a remnant population of South Island who but also one that may bridge the gap between the Fiordland and West Coast Recovery Sites. Despite the importance of the Makarora who population, there has been little comprehensive survey effort undertaken for who in the Makarora catchment since the 1980s (Child 1981; Williams 1989). Consequently, little is known about the current population status, distribution, and potential breeding areas of who within the Makarora catchment. Furthermore, who from the Makarora catchment were not included in past phylogeographic studies of the species (Robertson *et al.* 2007; Robertson & Goldstein 2012; Grosser *et al.* 2017), hence the relationship of this population to others in the South Island is unknown.

Here we present the findings of a literature review, observational records, protected species dog-assisted surveys (Hufton 2017; Hufton 2023), and genetic analyses of who from the Makarora catchment and highlight the population as a significant remnant that contains a distinct haplotype that warrants inclusion in the national management of who.

In the 1980s, the late Peter Child reported who as relatively rare on both sides of the Main Divide (Southern Alps/Kā Tiritiri o te Moana), in the Makarora and tributaries, with pairs noted at the head of the Makarora, Siberia Stream, the Blue River, Newland Stream, and Cameron's Creek (Child 1981). During his survey, he recorded 22 adults in approximately 2,500 km² of Mt Aspiring National Park, noting at the time, "the population was disappointing and probably declining" (Child 1981). Historical landowner records (NZ Archive 1978) include a who pair located on the true right, of the Makarora River delta at the head of Lake Wānaka. The habitat here has since changed and is no longer suitable for who. The Blue Duck Liaison Group (Williams 1989) reported: "one pair recorded

on the Young and the Blue Rivers. Previously birds had been seen on the Siberia. Local people commented that blue ducks were always found at the same place on the Blue River. The balance of the Blue River appears to have good blue duck habitat but no birds. This raises questions about dispersal and recruitment of who in South Island valleys." Further monitoring was disregarded given the apparent lack of birds and the remoteness of those few remaining pairs (Williams 1989).

Since the establishment of Aspiring Biodiversity Trust (2017), specialised protected species dog-assisted surveys have been undertaken for who within the Makarora catchment (Hufton 2023). Sites (Fig 1; Table 1) include; the upper Makarora (originally known by Ngāi Tahu as Wharemanu/ House of the Birds) (Ngāi Tahu Atlas 2021), Siberia Valley (the Siberia River combined with the Crucible and Gillespie streams drains the Southern Alps Kā Tiritiri o te Moana within Mt Aspiring National Park and joins the Ōtānenui/Wilkin River at Kerin Forks, a tributary of the Makarore/Makarora River), upper Wilkin, Wonderland Stream, Newland Stream, the Tiel Creek, Camerons Creek, Blue River, and the Mueller River (west of the main divide). The Young River was surveyed with the aid of a protected species dog during 2017, a survey commissioned by Forest & Bird (van Klink 2017). Environmental DNA (eDNA) freshwater sampling has also been undertaken for several riparian locations (Hufton 2023). Additionally, observational and incidental who records (2018–2022 seasons) have been compiled (Table 1) to help develop a better understanding of the current who population status and distribution within the Makarora catchment, to guide best use of resources to optimise species recovery where birds are still naturally residing. Furthermore, several who feather samples were retrieved from the field (Siberia, Newland; Aspiring Biodiversity Trust [ABT] surveys 2023) for DNA sequence analysis.

Based on the results of the survey work, ABT observations and recent verified who records (Fig. 1; Table 1), there are currently at least 25 adult who (comprising 11 pairs) within the Makarora catchment: three pairs in the upper/mid Wilkin; four pairs in the Siberia/Gillespie Stream; one pair in the Tiel, single males in the Cameron and Newland; up to three adults (1 pair) in the Blue; three adults (1 pair) in the Young (with a probable male bias), and a pair in the Levin. With three birds in catchments immediately west of the main divide (Fig. 1) proximal to the Siberia basin east of the main divide. This is promising as Child (1981) identified only 22 adults and up to two young birds from within the entire Mt Aspiring National Park. The Makarora catchment area alone extends to c. 800 km².

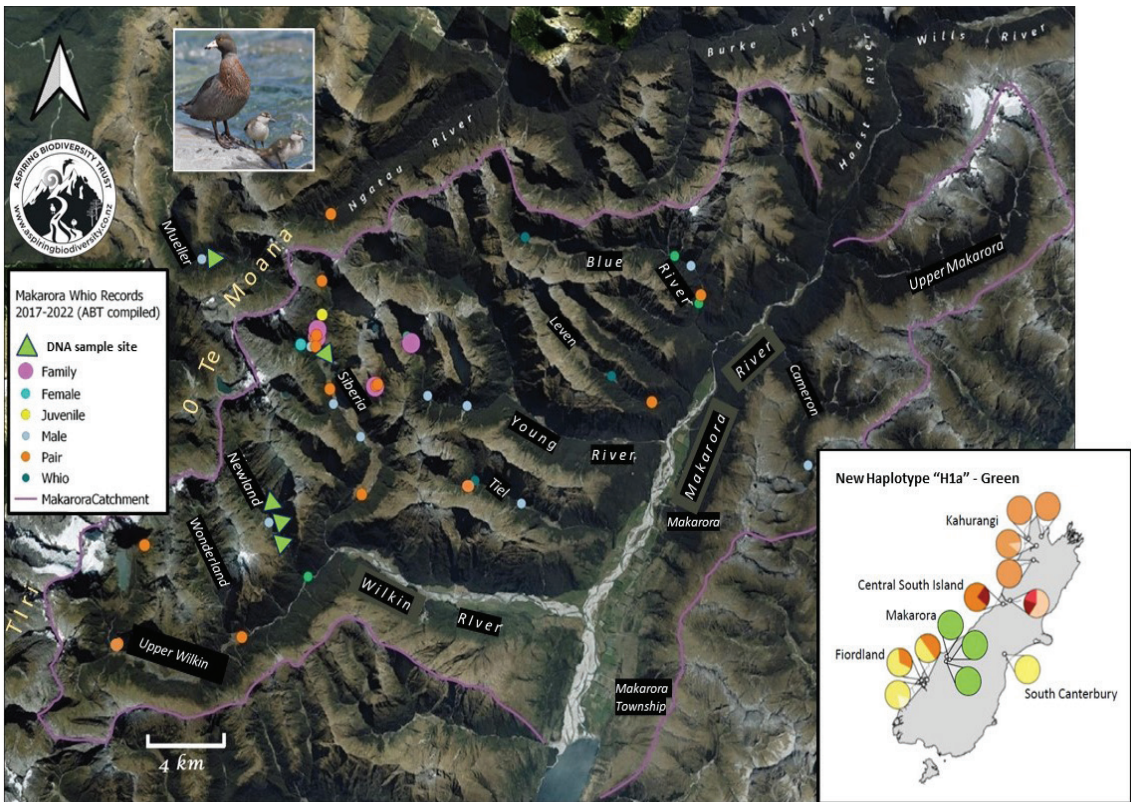


Figure 1. Aspiring Biodiversity Trust (ABT) overview plan of who (blue duck, *Hymenolaimus malacorhynchos*) records during surveys combined with observations and verified incidental records (individuals, pairs, family 2+ birds) for the Makarora Catchment 2017–2022 (Table 1). Located at the head of Lake Wānaka, in Ōtākou/Otago region of the South Island of New Zealand (44°14'S, 169°14'E). Insert showing distribution of who mitochondrial control region haplotypes present on South Island of New Zealand (colours represent haplotypes) including the new haplotype H1a (green) detected in four who samples from the Makarora catchment (Siberia & Newland), and one who sample from South Westland (Mueller River). This new haplotype is one base pair different from haplotype H1 (yellow colour), which is the most common Fiordland haplotype (Robertson *et al.* 2007; Grosser *et al.* 2017). Modified from Grosser *et al.* (2017). Inset photograph: who adult with Class 2 ducklings (WRG 2004), Siberia Valley, Makarora (Nick Beckwith; ABT work programme, October 2019).

The Siberia Valley and associated streams are deemed to be high priority for who recovery in the Makarora catchment as breeding has been confirmed over three consecutive seasons, with up to four ducklings recorded and sensitive moult locations and commuting routes identified (Table 1). Additionally, a who pair has been recorded for Tiel Creek (a first record for this valley; connecting to the Siberia). Also, who have been recorded at the head of the Ngatau River (INaturalist 2022) and the Mueller River immediately adjacent to the head of the Siberia basin (Fig. 1). Conjointly, the upper/mid Wilkin Valley is high priority as who pairs have been confirmed in suitable habitat (Hufton 2023) as similar to that described by Collier *et al.* (1993), Godfrey *et al.* (2003), and Ballie & Glaser (2005), and therefore breeding is possible.

Mitochondrial control region sequences (DNA sequencing following Robertson *et al.* 2007; Grosser *et al.* 2017) from four feather samples collected during ABT surveys of the Makarora catchment (Newland and Siberia) revealed a new haplotype H1a, indicating a previously undetected maternal lineage of who in the catchment. This new haplotype is one base pair different from haplotype H1 (Fig. 1), which is the most common Fiordland haplotype (Robertson *et al.* 2007; Grosser *et al.* 2017). Previous genetic studies of who did not include birds from South Westland (Robertson *et al.* 2007; Grosser *et al.* 2017). Genetic analysis of a who feather sample from the Mueller River (South Westland; ABT survey March 2023) detected the same new haplotype as found in the Makarora who (Fig 1).

Table 1. Aspiring Biodiversity Trust (ABT) survey chronology, observational (during work programs) and incidental records (received and verified) for whio (blue duck, *Hymenolaimus malacorhynchos*) recorded in the Makarora Wilkin catchment (2017–2022 seasons) South Island, New Zealand. Record via, S = Survey (conservation dog assisted walkover or eDNA water sample), I = Incidental, O = Observational.

Date	Location	Observation	Record via
2017/2018	Young Valley SB	Single male x 2 above swing-bridge	S
	Upper Wilkin	Pair above Top Forks Hut on two occasions	I
	Siberia Basin	Pair and 1 x juvenile, plus possible concealed bird	S
2018/2019	Upper Wilkin	No birds, lots of field signs + feathers, habitat suitable	S
	Upper/Mid Wilkin	Pair, Wonderland/Wilkin Confluence	O
	Blue Valley	Single adult in Feb	I
	Levin Stream	Pair seen in Jan	I
2019/2020	Siberia Valley (upper)	Pair with x 3 ducklings (Oct)	O
	Siberia Valley (lower)	Pair below Siberia airstrip pools	O
	Ngatau Valley	Pair, head basin (adjacent to Siberia basin)	I
	Upper Wilkin	Pair at upper Lucidus/Castalia (1,000 m a.s.l.) in Feb	O
	Blue Valley	No birds, field signs/possible concealed bird	S
	Young Basin SB	Pair with ducklings in Jan	I
2020/2021	Siberia at dusk	Territorial male + female, Siberia head basin	O
	Young Valley NB	Single adult, Young head basin (Nov)	I
	Blue Valley	Single adult in Jan	I
	Siberia /Gellespie	Pair with 1 x duckling Gellespie Stream (Jan)	O
	Tiel Stream	Single adult male, good food availability	S
	Wonderland Valley	No whio or field-signs, habitat/food suitable	S
	Mid/Wilkin Valley	Single adult, Newland Confluence in Jan	I
2021/2022	Upper Siberia	Pair with x 4 ducklings in Oct	O
	Upper Siberia	Pair in Jan	O
	Blue Valley	Single adult in Oct	I
	Upper Makarora	No whio or signs with dog or eDNA, habitat & food good	S
	Siberia NB/Crucible Stream	Adult male and female, moult locations identified	S
	Siberia Valley	Adult male on Siberia after Crucible Stream	I
	Cameron Creek	No whio evidence in eDNA water samples (below hut)	S
	Levin Stream	Pair noted, previously noted in Jan 2019	I
	Mueller River	Pair, 3 Mar 2022 (adjacent to Siberia basin)	I
2022/2023	Siberia Valley	Five seen (pairs flying, guard male/dusk calls)	O
	Siberia Valley	Pair & field signs Gellespie Stream and lower Siberia	S
	Gellespie Stream	Pair seen on two separate occasions in Nov	I
	Blue Valley	Pair above Camp Flat and single male at basin	O
	Cameron	Single male high up in catchment above eDNA points	S
	Newland Valley	Single male in moult, further sign/concealed bird, food good	S
	Gellespie Stream	Single whio at recurring location on the flats (Jan-Mar)	O
	Mueller Valley SW	Single male and concealed bird; feather and faeces	S
	Tiel Valley	Positive eDNA result for north branch near forks, food good	S
	Tiel Valley	Pair, South branch above forks at dusk (Apr)	O
	Wilkin/Siberia/K-Forks	No evidence of whio in eDNA water samples	S

The detection of a new genetic maternal lineage in whio within the Makarora/South Westland area highlights the importance of this area for whio recovery (Fig. 1). Specifically, that whio in this area should be managed as a new recovery site in whio recovery planning, to retain this distinct genetic variation. Whio, however, do not currently feature in the Department of Conservation threatened species protection planning for the Makarora area. Our new understanding of the genetic relationship of the Makarora/South Westland whio to other areas (Fig. 1) should also inform future translocations. Previous studies have recommended that whio should be sourced locally (Robertson *et al.* 2007; Grosser *et al.* 2017), whether that is population to population translocations of wild whio or using Whio Nest Egg (WHIONE) (Whio Recovery Group 2004), where wild eggs are harvested, chicks raised in captivity and subsequently released (Grosser *et al.* 2017). Our findings also provide important insight into whio dispersal between the east and the west of the Main Divide (Southern Alps Kā Tiritiri o te Moana), as shown by haplotype sharing of the Makarora and South Westland whio (Fig. 1). Future studies should aim to resolve the haplotype distribution using additional South Westland feather samples.

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