

SHORT NOTE

Incidental distribution and activity of the flightless Campbell Island teal (*Anas nesiotis*) on Campbell Island/Motu Ihupuku, New Zealand

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The Campbell Island teal (*Anas nesiotis*) is a small, flightless duck native to Campbell Island/Motu Ihupuku (52° 32' S 169° 9' E) in the New Zealand/ Aotearoa subantarctic (Williams 2013). The species was thought extinct following the introduction of Norway rats (*Rattus norvegicus*) and feral cats (*Felis catus*) to the island during the mid-1800s. An ornithological survey of Dent Island was undertaken in 1975, discovering a single bird on the small islet c. 1 km off main Campbell islands western coast (Robertson 1976). The extant population at the time was suggested to be as low as 25 pairs (Gummer & Williams 1999). Following successful breeding in captivity, in 1999–2000 an insurance population

of 24 teal was established on the predator-free Whenua Hou/Codfish Island, allowing researchers to perform the first detailed ecological investigation of the species in the wild (Gummer & Williams 1999; McClelland 2002).

In 2001, Campbell Island/Motu Ihupuku was aerially treated with 120 tonnes of poison bait in the form of brodifacoum-laced cereal pellets at 6 kg/ha (McClelland & Tyree 2002) in a concerted, and successful effort to eradicate the mammalian invaders. Removal of rats and the previous extinction of feral cats (Moore 1997; Gillies & Fitzgerald 2005), paved the way for reintroduction of teal to the safety of the much larger main island, decreasing their immediate risk of extinction.

In captivity, Campbell Island teal are semi-nocturnal, being active on clear nights with peak activity at dusk. Post-release monitoring on Whenua Hou/Codfish Island

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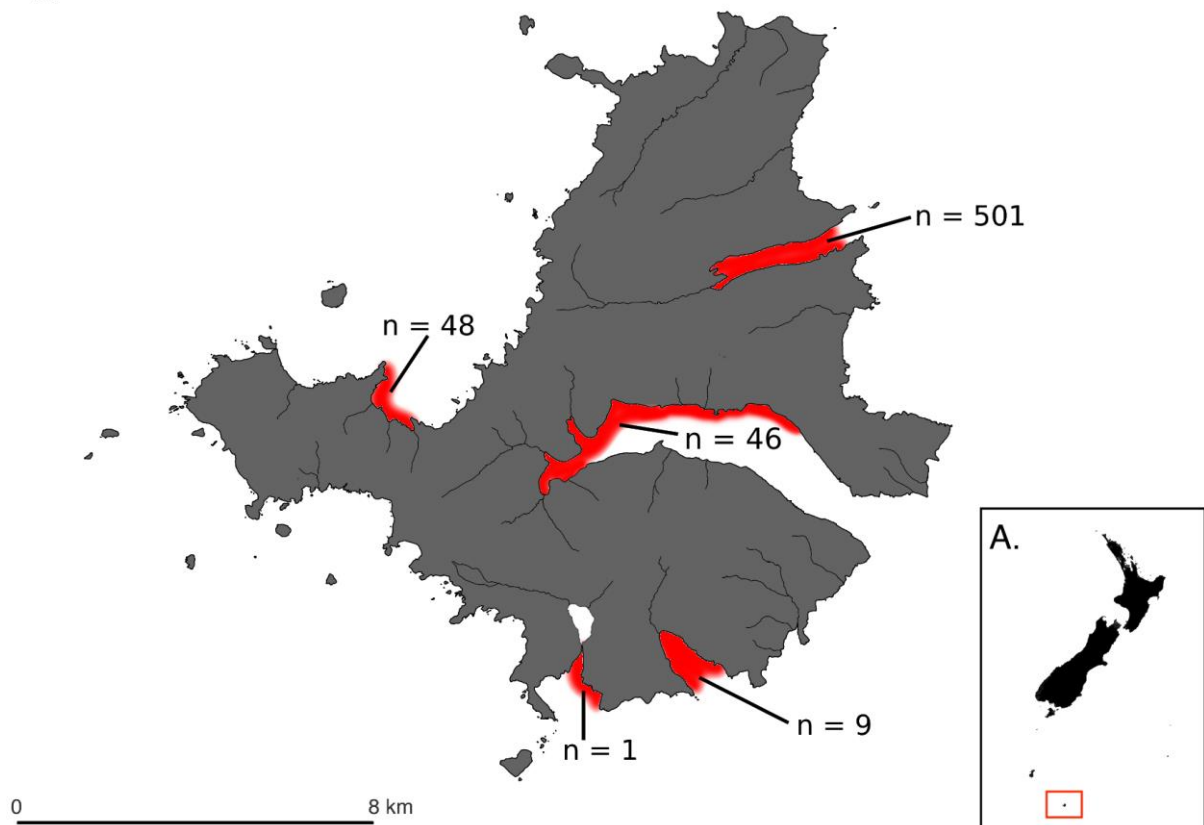


Figure 1. Location of study site. A. New Zealand region; B. Campbell Island/Motu Ihupuku, New Zealand. Waterway centre lines are plotted in black. Numbers indicate the sum of Campbell Island teal detected at each site. Teal were mainly detected at Northeast Harbour (501 observations), Northwest Bay (48), and Perseverance Harbour (46).

found teal utilised low-altitude forested streams, wetland areas, and rocky coastal habitats (McClelland 2002). Tracked birds were found less than 100 m from any water source (usually the coastline), although typically less than 50 m (McClelland 2002). Teal travelled up to 1.5 km inland using waterways to navigate, occasionally travelling across forested areas to access inland ponds (McClelland 2002). On Dent Island, teal were found to be more numerous below the 100 m contour, and in moister areas (i.e., creeks and seepage channels) providing opportunities for foraging, and under mega herb stands through which they can easily navigate without being observed by avian predators such as subantarctic skua (*Stercorarius antarcticus*; Williams & Robertson 1996).

During 2004–06, three successive translocations returned 154 teal to Campbell Island/Motu Ihupuku across four major sites: Perseverance Harbour ($n = 71$), Northwest Bay ($n = 50$), Northeast Harbour ($n = 20$), and Six Foot Lake ($n = 13$; McClelland & Gummer 2006; Gummer & Berry 2007). A survey in 2008 estimated the known extant wild population to be a minimum of 200 mature individuals across main Campbell Island/Motu Ihupuku, 100–200 mature individuals at Whenua Hou/Codfish Island, and a remnant satellite population at Dent Island of c. 30 individuals (Williams 2013). Despite their successful return to their endemic range and subsequent, though infrequent population estimates, little is known of preferred activity periods in their endemic range.

In conjunction with ongoing hoiho/yellow-eyed penguin (*Megadyptes antipodes*) research, we collected

observations of wild Campbell Island teal in their endemic habitat opportunistically between 5 Dec 2023 and 8 Feb 2024 using a combination of trail cameras and direct visual surveys. Seventeen trail cameras (Bushnell E3 Trophy Cam) were deployed along exposed coastlines at 500 m intervals and at strategic coastal and at strategic points surrounding human encampments; capturing time-lapse images every minute between 0400 h and 2400 h NZDT. Camera deployment ranged from 1 to 60 days. To investigate the relationship between observations of teal, tide height, and time of day, we calculated Pearson's correlation coefficient (Benesty *et al.* 2009) between the frequency of observations and tide height at time of observation sourced from the New Zealand National Institute of Water and Atmospheric Research (NIWA) database. We separated tide height into bins of 0.1 m height difference and temporal bins of 1 hour increments. Permutation analysis was performed to investigate the statistical significance of the observed coefficient. Tide height and temporal data were each permuted 10,000 times with replacement from raw time associated-tide height data at Motu Ihupuku sourced from CliFlo (www.cliflo.niwa.co.nz) to generated null distributions of against which the observed coefficients could be plotted to determine statistical significance. Statistical analyses were performed using RStudio (Version 3.0.386, Posit Team 2024).

A total of 614 observations of Campbell Island teal were made, comprising 510 (83.0%) observations from trail cameras ($n = 283,749$ total images) and 114 (17.0%) from direct visual sightings (Table 1). Observations were

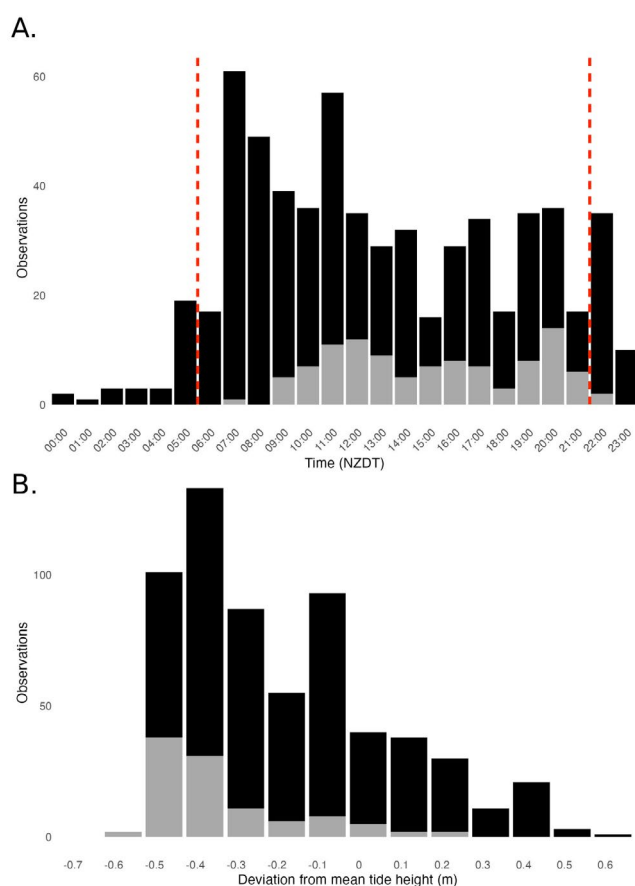


Figure 2. A. Height of tide at time of observation; B. deviation from mean tide height at time of observation of Campbell Island teal on Campbell Island/Motu Ihupuku, New Zealand; black = trail camera, grey = visual observations; dashed lines indicate dawn and dusk.

distributed across five main locations: Northeast Harbour (84.0%), Northwest Bay (7.9%), Perseverance Harbour (6.4%), Southeast Harbour (1.5%), and Monument Harbour (0.2%; Fig. 1; Table 1). No teal were observed in Smoothwater Bay or at Shag Point. Activity patterns showed no significant correlation with time of day ($p = 0.49$), indicating that foraging behaviour along coastlines was primarily influenced by tidal periods rather than circadian rhythms. Teal were most frequently observed during daylight hours, particularly near dawn (0700 h NZDT), midday, and dusk (2200 h NZDT; Fig. 2A). Teal were most frequently observed at low tide, with 82.6% of sightings occurring below mean tide height (Fig. 2B). We identified a significant negative correlation between tide height and observation frequency ($r = -0.21$, $p < 0.001$).

Table 1. Location of Campbell Island teal observed across the study period (Dec 2023 – Feb 2024) on Campbell Island/Motu Ihupuku, New Zealand. FOO = frequency of observation, * = visual observations only.

Location	n images	observations	FOO%
Northeast Harbour	228,707	510	0.22%
Northwest Bay	16,347	48	0.29%
Perseverance Harbour	17,550	46	0.26%
Southeast Harbour	18,900	9	0.05%
Monument Harbour	*	1	NA
Shag Point	2,245	0	NA

At Northwest Bay, teal were easily observed, having dispersed from their initial release site of Capstan Cove, with adult birds sighted at Middle Bay, Whalers Point, Whalers Bay increasingly westward. This is consistent with post-release tracking of teal in 2005, which found adult teal at all Northwest Bay sites visited in this study (Lynn Adams 2005, second transfer of Campbell Island teal to the subantarctic in September 2005, unpubl. internal report DOC WGNCO-52053). The coastal environment of Northwest Bay contains relatively sheltered bays (such as Capstan Cove and Middle Bay), however much of the remaining coast experiences high wave action, providing fewer foraging opportunities for teal. Whalers Bay presents a sandy shoreline which accumulates windrowed seaweed and kelp and is comparable to Waikoropupu/Sealers Bay on Whenua Hou/Codfish Island where teal actively forage on similar kelp blows (McClelland 2002); however, few teal were observed foraging here during our observation period.

Northeast Harbour had the highest number of teal observations across our study period. Teal were frequently observed by researchers traversing the coastline, with pairs observed foraging every 50–100 m; this is similar to the territory sizes estimated for tētē kākāriki | Auckland Island teal in areas of high food availability (40 – 100 m²; Williams 1995). The coastline of Northeast Harbour is primarily craggy rocks with a low shore gradient resulting in large areas of exposed rock, algae, and seaweed over which teal were conspicuously foraging and readily observed. This habitat remains relatively continuous along c. 90% of the southern shoreline, skirted by tussock and *Dracophyllum* spp. that provides potential nesting habitat. The shoreline is steeper and rockier along the eastern end of the north side of the harbour, providing a narrower coastal margin for foraging.

Teal were often observed at the western extremities of Perseverance Harbour near their original release sites. Although initially released at Camp Cove in 2004–05, no teal were observed at this site despite a considerable amount of observation time across our 10 weeks on the island at various tide heights. Coastal conditions at Camp Cove are substantially different to the neighbouring areas of Tucker and Garden Cove, with a steep coastal gradient forming bluffs providing little accessible foraging area, which may contribute to the absence of teal here. Despite this localised absence of teal, the presence of territorial males in nearby Lookout Bay and surrounding Beeman Point, paired with widely dispersed observations of adult teal near De la Vire Point, and Davis Point further east indicates that the habitat within Perseverance Harbour remains broadly suitable.

The presence of teal at Southeast Harbour was only confirmed through the deployment of trail cameras in *Dracophyllum* spp. peat bogs, with no teal observed during c. 30 h of visual observation, or on any trail cameras deployed along this coastline. Shag Point did not present suitable coastal habitat for Campbell Island teal. The foreshore at this site was primarily elevated basalt rock platforms with heavy wave action. The margin and tributaries of Six Foot Lake itself were not searched extensively, however prior observation of teal here in 2008 (James Fraser unpubl. records in Beeman Base hut book) and our observations of teal at nearby Monument Harbour and Southeast Harbour at the very least confirms the continued presence of teal in this area of the island.

Teal were most often observed along rocky shorelines at mid to low tide when large areas of the intertidal zone and neighbouring kelp beds were exposed. This is consistent with prior research which found Campbell Island teal rarely venture >100–150 m from water in which they can forage (McClelland 2002). All observed foraging microhabitats (sea lettuce *Ulva* spp., red seaweed *Stenogramme* spp., and

brown strap seaweed *Xiphophora* spp., potentially sourcing amphipods and other small invertebrates) were consistent with dietary notes of wild birds removed from Dent Island during the establishment of captive breeding programmes (Seddon & Maloney 2003). However, contrary to data presented by Preddey (1995) and McClelland & Tyree (2002), teal in their endemic range were not observed to be semi-nocturnal. Our permutation analyses revealed that teal foraging activity lacked the clear crepuscular circadian patterns associated with semi-nocturnality. Nocturnality is common in wildfowl and typically develops in species due to resource partitioning, resource scarcity, or to avoid diurnal predators (McNiel *et al.* 1992); pressures which are largely absent for teal on Campbell Island/Motu Ihupuku. It remains possible that teal were foraging in exposed areas at night; however, any such travel was not evident in our data. Activity observed over our observation period was more strongly driven by a negative correlation with tide height and the associated access to primary foraging areas.

Twenty years on from repatriation to their endemic subantarctic range, this flightless teal appears to be once again well established and widespread across their remote home. Activity periods and foraging behaviours, while considerably different to that observed in captivity and on Whenua Hou/Codfish Island, may better reflect typical behaviours within their endemic range. The nature and extent of teal living beyond the shoreline (e.g. in seepages, bogs, and adjacent concentrations of seabirds) require examination to fully appreciate how widely dispersed teal have become on Campbell Island/Motu Ihupuku.

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