ASSESSMENT OF THE CONSERVATION STATUS OF THE FUEGIAN STEAMER DUCK *TACHYERES PTENERES* IN CHILE

GONZALO MEDINA-VOGEL[1]*, GABRIELA MOLINA-MALDONADO[2], CARLOS CALVO-MAC[1], NICOLE DELGADO-PARADA[2], VALERIA GÓMEZ-SILVA[3,4], ELKE SCHÜTTLER[3,4], BENJAMÍN SANTIBÁÑEZ-BÓRQUEZ[5], JAIME R. RAU[6], & JAIME A. CURSACH[6]

[1]*Instituto One Health, Universidad Andres Bello, República 440, Santiago, Chile *(gmedina@unab.cl)*
[2]*Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Av. Libertador Bernardo O'Higgins 340, Santiago, Chile*
[3]*Centro Universitario Cabo de Hornos, Universidad de Magallanes, O'Higgins 310, Puerto Williams, Chile*
[4]*Cape Horn International Center (CHIC), O'Higgins 310, Puerto Williams, Chile*
[5]*Escuela de Ciencias Ambientales y Sustentabilidad, Facultad de Ciencias de la Vida, Universidad Andres Bello, República 440, Santiago, Chile*
[6]*Laboratorio de Ecología, Departamento de Ciencias Biológicas y Biodiversidad, Universidad de Los Lagos, Casilla 933, Osorno, Chile*

Received 29 April 2025, accepted 29 July 2025

ABSTRACT

Medina-Vogel, G., Molina-Maldonado, G., Calvo-Mac, C., Delgado-Parada, N., Gómez-Silva, V., Schüttler, E., Santibáñez-Bórquez, B., Rau, J. R., & Cursach, J. A. (2025). Assessment of the conservation status of the Fuegian Steamer Duck *Tachyeres pteneres* in Chile. *Marine Ornithology*, *53*(2), 401–408. http://doi.org/

The Fuegian Steamer Duck *Tachyeres pteneres* is endemic to the southern cone of South America. Though classified as Least Concern by the International Union for Conservation of Nature (IUCN) Red List, it is categorized as Near Threatened by the Chilean Ministry of Environment. However, few studies have been conducted on this species, and large portions of its distribution remain unsurveyed. This lack of information hinders a full appreciation of the species' conservation status under the IUCN criteria. We therefore conducted extensive surveys along the southern coast of Chile. Between March 2021 and April 2023, we carried out visual censuses at 40 sites (bays, channels, isles, and islets) covering 889 km of coast between Valdivia (40°S) and Caleta Tortel (48°S). Additionally, we surveyed two sites on Navarino Island (Cape Horn archipelago, 54°S) between November 2021 and January 2022. Finally, we compared populations in bays with and without off-bottom bivalve aquaculture in the Chiloé archipelago (43°S). We found variable abundances of Fuegian Steamer Ducks along the Chilean coast, ranging from 0.02 to 2.4 ducks/km, while in 15 sites out of 40 we did not record any individuals. Fuegian Steamer Ducks also occurred significantly more frequently in bays without aquaculture (2.6 ducks/km) than bays with aquaculture (1.8 ducks/km). Our findings represent a marked decline in the species' distribution along archipelagos and continental areas when comparing our results with published data collected more than 10 years ago.

Key words: census, ground-nesting waterbirds, Patagonia, quetru no-volador, threatened

INTRODUCTION

The Fuegian Steamer Duck *Tachyeres pteneres,* or Quetru no volador in Spanish, is endemic to seashore habitats and is found along fjords and marine channels of Patagonia, in southern South America. Its distribution ranges from Valdivia (40°S) to Cape Horn (55°S) (Medrano & Cursach, 2018). Belonging to the genus *Tachyeres*, the Fuegian Steamer Duck is the only member of this genus adapted to feed on bivalves. The other species of this genus are *T. patachonicus*, *T. brachypterus*, and *T. leucocephalus* (Martínez-Piña & González-Cifuentes, 2017). In southern Chile, the Fuegian Steamer Duck is associated with sheltered nearshore intertidal and shallow subtidal habitats (Medrano & Cursach, 2018). It is typically found in pairs or flocks, occupying relatively shallow inshore waters near freshwater inputs, such as streams and rivers (Medina-Vogel et al., 2019; Medrano & Cursach, 2018).

The species faces a variety of threats, including the rapid expansion of the aquaculture industry in southern Chile (Medina-Vogel et al., 2019; Outeiro et al., 2022) and increasing predation by invasive species such as the American mink *Neogale vison* and unconfined domestic dogs *Canis familiaris* (Fasola et al., 2021; Gómez-Silva et al., 2024; Schüttler et al., 2009). Of special conservation concern is the American mink, which is expanding its range towards the southernmost islands of Chile (Schüttler et al. 2019), where apparently Fuegian Steamer Ducks have been unable to effectively adapt their nesting strategy to this new predator species (Gómez-Silva et al., 2025). This is also the case for the northern distribution of mink, which is currently being extended (e.g., Suárez-Villota et al., 2023).

Despite these recognized threats, there are no coordinated conservation actions specifically targeting the Fuegian Steamer Duck, and existing management efforts cover only portions of the species' range (BirdLife International, 2018). Although Chile has introduced recovery, conservation, and management plans for wildlife species recently (Ministry of Environment, 2024), such efforts require systematic, species-specific monitoring grounded in robust scientific data, a goal that remains largely unmet in Patagonia (Martínez-Harms et al., 2022). The aim of this study was to assess the population trend of Fuegian Steamer Ducks along their known distributional range in Chile by comparing our direct observations with published accounts. The results of our study will contribute to improving informed decision-making for the conservation of the world's largest marine duck.

METHODS

Study area

The study was located in Chile along the southwestern coast of South America, covering 889 km of coast between Valdivia (40°S) and Caleta Tortel (i.e., Tortel Port Bay) (48°S), and 50 km at two sites on Navarino Island, Cape Horn archipelago (54°S). The study area was divided into four subareas based on the logistics of data collection: (i) the northern continental area from Valdivia to Chiloé Island, (ii) the insular area from northeast to southeast Chiloé, (iii) the southern continental area from Tic Toc Bay to Caleta Tortel, and (iv) Navarino Island (Fig. 1). South of Chiloé Island, the region encompasses the largest system of estuaries and fjords in the southern hemisphere and represents one of the most significant land-sea interfaces globally. It spans a total area of 452,204 km², including both marine and terrestrial landscapes (Martínez-Harms et al., 2022). The area between Caleta Tortel and Navarino Island could not be surveyed in this study due to the almost complete absence of infrastructure (Fig. 1).

Census methodology

All surveys were based on the assumption that Fuegian Steamer Ducks are diurnal, and thus, the fieldwork was conducted exclusively during daylight hours (Medina-Vogel et al., 2019; Vilugrón-Torres et al., 2016).

In Subareas i, ii, and iii, four observers conducted surveys in bays and peninsulas from an anchored 14-m sailboat between 13 July 2022 and 13 February 2023. Estaquilla Point and Mari Mari Harbor were surveyed from land on 15 March 2021 and 28 November 2021, respectively. In Subareas ii and iii, we also conducted continuous surveys from the same vessel, navigating at speeds between 3 and 5 knots, maintaining a distance of 30 to 500 m from the shore. We used binoculars (10×50, 15×50) and a spotting scope (20×50) (Fig. 2). On average, we spent 8 hr/day for two days to survey each of the 24 sites. Time spent surveying the 14 channels, fiords, coves, and sea passes varied depending on weather conditions but ranged from a couple of hours to 14 h. The geographic coordinates for each site as well as the survey distance were recorded using onboard nautical charts (Navionics+ Chile, Argentina, and Easter Island digital chart) (Table 1). Following the water-based survey, we conducted additional land-based surveys using 10×50 binoculars along the shores of Exploradores Bay, and Tortel Bay including the Montalva Channel (Subarea iii, Fig. 1, Table 1).

In Subarea iv (Navarino Island), we randomly established 500-m transects (N = 80) that were spaced more than 200 m apart, along 50 km of the northern coastline of the island. Distance was calculated using a GPS. Additionally, we surveyed 10 small islets (located < 300 m from the main coast) using kayaks. On these islets, 11 additional transects were established following the same spacing and length (500 m) as on the main island. These land-based surveys were conducted from November 2021 to January 2022, with one repetition per transect. During each transect survey, we recorded the number of individuals, pairs, or chicks. For all study subareas and sites, the comparable result was the maximum number of Fuegian Steamer Ducks (adults plus chicks) counted per survey along with the distance (length) in one observational period (day) (Table 1). If we saw a single bird, we did not assume it was paired with the mate being on the nest (following Medina-Vogel et al., 2019). The final result was the total number of birds (adults and chicks) observed and counted. In parallel, we opportunistically recorded observations of potential predatory mammals like South American sea lions *Otaria flavescens*, invasive American mink, native marine otters *Lontra felina*, native southern river otters *L. provocax*, and free-ranging domestic dogs (quantitative mink records from camera traps in Gómez-Silva et al. 2024).

In addition to our general survey of Subarea ii, we selected four bays without off-bottom bivalve aquaculture (Chacao, Ten-Ten, Chonchi, Aituy) and four bays with off-bottom bivalve aquaculture (Tenaún, Quemchi, Rauco, Yaldad). Monitoring took place during November and December 2021 (Fig. 1). Surveys in these bays were conducted monthly, from 08h00 to 15h00, using kayaks, following a modified protocol adapted from Medina-Vogel et al. (2019). Ducks were observed along the bay's contour as we maintained a distance of no more than 100 m from the shore and proceeded at a low speed (< 3 knots). The observations were made using binoculars (10×25) by a team consisting of a kayak driver and an observer, who also served as a data recorder. To minimize disturbance, we kept a distance of at least 50 m from the birds, which is greater than the flushing distance of Fuegian Steamer Ducks (Vilugrón-Torres et al., 2016). The surveyed distances in each bay were as follows: Chacao (10.4 km), Ten-Ten (13.1 km), Chonchi (9.8 km), Aituy (12.6 km), Quemchi (8.3 km), Tenaún (11.1 km), Rauco (8.3 km), and Yaldad (16.7 km). The distance was calculated using a GPS. In each bay, one pair of ducks was followed for 10 min to record its activity, i.e., feeding (diving, probing the substrate, ingesting prey, and feeding near seaweed banks), resting, and interacting. We recorded this behavior at 2-min intervals for 11 to 13 hr/day. Feeding activity was measured as the proportion of time spent foraging relative to the total observation time (Medina-Vogel et al., 2019). To compare data between bays with and without off-bottom bivalve aquaculture, the total proportional time of ducks observed in relation to the total time of observation was compared using chi-square and t-tests for independent samples. The statistical tests were performed in the R statistical computing environment (R version 4.1.1, Core Team 2024).

RESULTS

Observations of Fuegian Steamer Ducks

We observed a total of 530 Fuegian Steamer Ducks (adults plus chicks) across 40 survey sites in Subareas i, ii, iii, and iv, with site counts ranging from 0 to 65 and averaging 12.3 individuals per site (standard deviation [SD] = 16.9) (Tables 1 and 2). In the northern continental study area, encompassing only Mari Mari Bay, we observed three ducks, at a density of 0.12 ducks/km along 24.1 km (Fig. 1, Table 1). We did not find any Fuegian Steamer Ducks at 15 (38%) of the 40 survey sites, including the northern study sites of Niebla, Corral, and Mansa Bays. In the Chiloé archipelago, between Chacao Bay and Calliruca Point, we counted 443 individuals, averaging 24.6 ducks per site (SD = 17.8) at a density of 2.4 ducks/km along 185.8 km of coastline.

In Subarea ii, Fuegian Steamer Ducks were more likely to occur in bays without aquaculture than bays with aquaculture: $\chi^2(df = 7, n = 193) = 194.3, p < .001$. We counted 80 birds (41%) in bays with aquaculture and 113 (59%) in bays without aquaculture (Table 2), which is, respectively, 1.8 ducks/km compared to 2.6 ducks/km. The total observation time at non-aquaculture sites amounted to 36h07m, during which ducks were observed feeding for 17h08m,

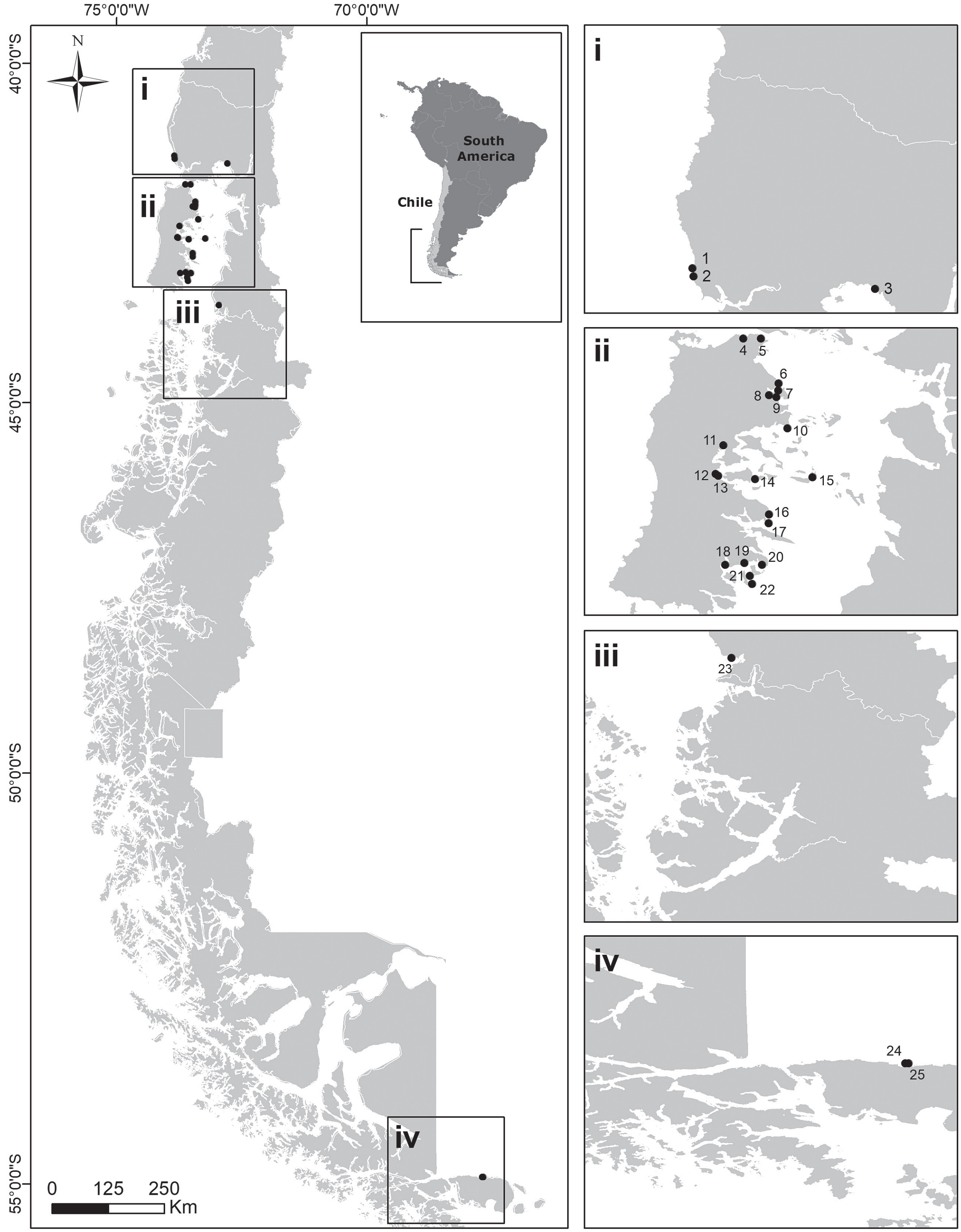

Fig. 1. Study area to monitor Fuegian Steamer Ducks along the southwestern margin of South America, Chile, divided into four subareas: (i) the northern continental area (Valdivia to Chiloé Island); (ii) the insular area (northeast to southeast Chiloé); (iii) the southern continental area (Tic Toc Bay to Caleta Tortel); and (iv) Navarino Island, Cape Horn. Survey sites with positive observations: 1. Estaquilla Point, 2. Mari Mari Harbor, 3. Piedra Azul Cove, 4. Caulin Bay, 5. Chacao Bay, 6. Aituy Bay, 7. Quemchi Bay, 8. Queniao Point, 9. Caucahué Channel North, 10. Caucahué Channel South, 11. Tenaún Bay, 12. Rauco Bay, 13. Chonchi Bay, 14. Quehui Island Channel, 15. Huechapiao Point, 16. Ten-Ten Bay and Aitui Bay, 17. Queilen Point, 18. Yaldad Bay, 19. Quellón Port Bay, 20. Pilcomayo Channel, 21. Cailin Point, 22. Calliruca Point, 23. Tic Toc Port, 24. Navarino Island, 25. Navarino islets.

Fig. 2. Observation of Fuegian Steamer Duck families (A) and pairs (B) along the Chiloé archipelago (Subareas i and ii) and from a sailboat (C) near Aysén, Chile (Subarea iii). Photo credits: Gonzalo Medina-Vogel

corresponding to 47% of the time. At aquaculture sites, the total observation time was 36h15m, with ducks feeding for 10h45m (30% of the time). On average, duck pairs at aquaculture sites spent between 27% and 32% of their time feeding, whereas at non-aquaculture sites they fed between 43% and 55% of the time. This difference between sites was significant ($t[x] = 4.1$, $p = .015$) and indicates that ducks spent significantly less time feeding in areas with off-bottom bivalve aquaculture.

In the southern continental area (Subarea iii), between Tic Toc Port Bay and Tortel Port Bay, only eight Fuegian Steamer Ducks were recorded, which is 0.02 ducks/km over 357.8 km (Fig. 1, Table 1). Tic Toc Port was also the only continental site (Subarea iii) where Fuegian Steamer Ducks were observed.

In the Cape Horn archipelago, a total of 60 ducks (30 pairs) were observed on Navarino Island across 80 km of surveyed coastline, yielding an average density of 0.75 ducks/km, including one group of three chicks. On nearby islets along the northern coast, 10 ducks were recorded over 5.5 km (1.81 ducks/km), though no chicks were observed.

Presence of predatory mammals

Mammalian species were observed across multiple subareas. American mink were seen at Niebla and Corral Bays, Mansa Bay, Estaquilla Point, and Mari Mari Bay (Subarea i); at Piti Palena Fjord and Escondido Port (Subarea iii); and on Navarino Island (Subarea iv). Free-ranging domestic dogs were present throughout the Chiloé archipelago and between Valdivia and Chacao Channel (Subarea ii). In the continental region, dogs were observed specifically in Escondido Port, Cisnes Bay, and Palena Bay Island (Subarea iii), as well as on Navarino Island (Subarea iv) (Fig. 1, Table 1). Marine otters were observed exclusively at Cailin Point (Subarea ii, Chiloé archipelago), while southern river otters were recorded at the southern end of the continental Refugio Channel (Subarea iii; Table 1). Sea lions were consistently present across the surveyed areas, with the exception of Piti Palena Fjord (Subarea iii; Table 1).

DISCUSSION

Overall, we found a high variability of relative abundance of Fuegian Steamer Ducks along the Chilean coast, ranging from 0.02 ducks/km Subarea iii) to 2.4 ducks/km (Subarea i), while in 15 sites out of 40 we recorded zero individuals. Our observations indicate a marked reduction in numbers of Fuegian Steamer Ducks compared to previously published accounts. For comparison, Medina-Vogel et al. (2019) conducted 10 censuses in the southern area of Chiloé Island during one nesting season (March 1988–February 1989). They documented a relative abundance of 3.3 ducks/km (55.3 ± 16.6 individuals) in Yaldad Bay and 6.6 ducks/km (68.6 ± 43.5 individuals) at Mauchil Island. In contrast, we recorded 0.02 ducks/km in the southeastern continental area, 0.12 ducks/km in the northwestern continental area, and 2.4 ducks/km on Chiloé Island, including Yaldad Bay, where we found 1.6 ducks/km (Table 1). Although chicks were documented in both studies between December and February, our observations revealed their presence in only 35% of the formerly studied bays ($n = 40$). Notably, Fuegian Steamer Ducks (adults only) were detected at a single site in the southeastern continental area (Subarea iii), Tic Toc port. Unfortunately, there are no reports of previous duck surveys in this subarea.

TABLE 1
Total counts of Fuegian Steamer Ducks *Tachyeres pteneres* observed from March 2021 to April 2023 across survey sites and sub areas in southern Chile

Site name	Sub area	Geographic location	Date	Survey distance (km)	Ducks counted (adults and chicks)[a]
Niebla and Corral Bays	i	39°53.3′S, 073°24.2′W	24 January 2023	30.9	0
Mansa Bay		40°35.0′S, 073°44.3′W	13 July 2022	3.3	0
Estaquilla Point		41°23.7′S, 073°50.4′W	28 November 2021	3.6	2
Mari Mari Harbor		41°26.5′S, 073°50.1′W	15 March 2021	10.4	3(+)
Piedra Azul Cove	ii	41°30.9′S, 072°46.8′W	20 March 2023	1.5	2
Caulín Bay		41°49.5′S, 073°37.4′W	28 June 2022	1.9	2
Chacao Bay		41°49.5′S, 073°31.2′W	14 November 2021	10.4	32
Quemchi Bay		42°09.2′S, 073°28.4′W	21 November 2021	8.3	13
Queniao Point		42°05.2′S, 073°25.1′W	26 January 2023	10.4	53(+)
Caucahue Channel North		42°07.6′S, 073°25.2′W	31 January 2023	10.4	26(+)
Caucahue Channel South		42°09.9′S, 073°25.8′W	02 February 2023	10.4	12
Tenaún Bay		42°20.7′S, 073°22.0′W	21 December 2021	11.1	27
Rauco Bay		42°36.6′S, 073°46.9′W	02 February 2023	8.3	13
Chonchi Bay		42°37.2′S, 073°46.1′W	24 November 2021	9.8	10
Huechapiao Point		42°37.7′S, 073°13.3′W	15 December 2021	2.8	24(+)
Quehui Island Channel		42°38.4′S, 073°33.3′W	18 February 2023	17.2	24
Ten-Ten Bay		42°49.6′S, 073°44.3′W	5 November 2021	13.1	6
Aitui Bay		42°50.7′S, 073°28.4′W	02 December 2021	12.6	65
Queilen Point		42°53.7′S, 073°28.5′W	03 February 2023	10.4	24
Yaldad Bay		43°08.1′S, 073°43.6′W	27 December 2021	16.7	27
Pilcomayo Channel		43°08.2′S, 073°30.8′W	03 February 2023	20.4	58(+)
Quellón Port Bay		43°07.5′S, 073°37.0′W	04 February 2023	1.3	6(+)
Cailin Point		43°12.0′S, 073°35.1′W	06 February 2023	3.3	17(+)
Calliruca Point		43°14.8′S, 073°34.3′W	07 February 2023	8.9	6
Tic Toc Port	iii	43°36.0′S, 072°57.1′W	17 February 2023	3.3	8
Escondido Port Bay		43°36.9′S, 072°53.2′W	16 February 2023	13.7	0
Piti Palena Fiord		43°46.7′S, 072°54.4′W	15 February 2023	48.2	0
Santo Domingo Port Bay		43°57.7′S, 073°06.5′W	14 February 2023	4.4	0
Refugio Channel		43°58.4′S, 073°07.6′W	07 February 2023	25.9	0
Melimoyu Fiord		44°04.4′S, 073°07.5′W	08 February 2023	20.4	0
Gala Fiord		44°12.4′S, 073°10.7′W	09 February 2023	57.4	0
Gemmel Fiord		44°20.2′S, 072°55.9′W	09 February 2023	65.2	0
Sibbald Pass		44°26.9′S, 072°45.5′W	10 February 2023	9.6	0
Puyuhuapi Channel (east seashore)		44°35.0′S, 072°43.2′W	11 February 2023	32.6	0
Magdalena Fiord		44°38.1′S, 072°54.5′W	11 February 2023	44.6	0
Cisnes Port Bay		44°44.0′S, 072°41.6′W	13 February 2023	6.9	0
Exploradores Bay		46°17.8′S, 073°30.3′W	10 April 2023	8.3	0
Tortel Port Bay and Montalva Channel		47°48.6′S, 073°32.3′W	08 April 2023	17.2	0
Navarino Island	iv	54°55.3′S, 067°39.9′W	02 November 2021–01 January 2022	80	60(+)
Navarino Islets		54°55.3′S, 067°41.0′W	08 November 2021–17 December 2021	5.5	10
Total				629.2	530

[a] Counts marked with (+) indicate both adults and chicks were observed; otherwise, only adults were observed.

TABLE 2
Comparative counts of Fuegian Steamer Ducks *Tachyeres pteneres* observed at sites with and without bivalve aquaculture farms at Chiloé Island (Subarea ii), southern Chile

Sites	Total ducks counted		Total observed time (*h*:*min*)	Total feeding time (*h*:*min*)
	With aquaculture	Without aquaculture		
Chacao Bay	–	32	NA	NA
Ten-Ten Bay	–	6	11:15	04:51
Chonchi Bay	–	10	12:18	06:49
Aituy Bay	–	65	05:28	05:28
Quemchi Bay	13	–	11:45	03:27
Rauco Bay	13	–	NA	NA
Tenaún Bay	27	–	12:30	04:03
Yaldad Bay	27	–	12:00	03:15
Mean (± SD)	20.0 ± 8.1	28.3 ± 27.0	–	–

Interestingly, Tic Toc port was also the only site in the continental section of the study that yielded observations of Ashy-headed Geese *Chloephaga poliocephala* (*n* = 9). Several additional avian species were also opportunistically recorded in the Chiloé archipelago (Subarea ii), including the Black-necked Swan *Cygnus melancoryphus*, Yellow-billed Pintail *Anas georgica*, and Bronze-winged Duck *Speculanas specularis*. Other species of the Anatidae family were notably absent from the remaining sites of Subarea iii (Tic Toc Port Bay to Tortel Port Bay and Montalva Channel, Table 1). On Navarino Island, Upland Geese *Chloephaga picta*, Ashy-Headed Geese, Kelp Geese *Chloephaga hybrida*, Crested Ducks *Lophonetta specularioides*, and Flying Steamer Ducks were recorded. Thus, study sites without Fuegian Steamer Ducks also were poor in other aquatic birds.

In 1989, Medina observed 82 ducks (November 1988) and 141 ducks (February 1989 [summer]) at Yaldad Bay and Mauchil Island, respectively (Medina-Vogel et al., 2019)—versus our record of 27 ducks (December 2021) in Yaldad Bay, 17 ducks (February 2021) at Cailin Point, and six ducks (February 2021) at Calliruca Point (8–9 km from Mauchil Island). This qualitative comparison underscores the extent of decline over the past 34 years. Indeed, these numbers are even less than Medina's winter (June–August) count in 1989 in Yaldad Bay (28 individuals), and 14 additional censuses recorded between 28 and 141 ducks, averaging 61 ducks per survey. Therefore, our results highlight a substantial reduction in the populations of Fuegian Steamer Ducks in Yaldad Bay area and nearly no occurrences at 13 (93%) of 14 study sites along the continental coastline. The decrease is apparent, as well, in previous studies along continental zones, such as in Lenca Bay (41°36.3′S, 072°41.3′W) during 2006–2007, when an average of 14 ducks were reported, with seasonal variations ranging from four (spring) to 27 (autumn), yielding a density of 0.2 ducks/km (Cursach & Rau, 2009). In the nearby Caicura Islands, in 2015 only a single pair of Fuegian Steamer Ducks was observed (Cursach et al., 2022). On Navarino Island, Schüttler et al. (2009) documented 0.5 to 13.75 ducks/km per transect (4 km), yielding a relative abundance of 1.75 ducks/km along 48 km of coastline, versus our estimate of 0.75 ducks/km along 80 km of coastline. This decreasing trend was also observed in the local nest abundance of Fuegian Steamer Ducks, i.e., 0.33–0.39 nests/km versus 0.22 nests/km (Gómez-Silva et al., 2025).

Contrary to other studies on ducks and marine aquaculture, we found Fuegian Steamer Ducks less common in bays with aquaculture, and those ducks spent less time feeding compared to non-aquaculture sites. Previous studies indicate that bivalve aquaculture structures (rafts and longlines) can enhance prey density for marine ducks by providing habitat for bivalves and other invertebrates, such as crustaceans (Cursach et al., 2011; Varennes et al., 2013; Žydelis et al., 2009). These findings contrast with our observations, where bivalves constitute only 2.6% of the diet of Fuegian Steamer Ducks, with gastropods, crustaceans, and chitons contributing > 80% (Tobar et al., 2011). In Caulín Bay of the Chiloé archipelago, Cancridae and Majidae crabs dominate the diets of Fuegian Steamer Ducks (Araneda et al., 2017), and in Argentina, the diet of the Chubut Steamer Duck *T. leucocephalus* consists primarily of *Cyrtograpsus* spp., Nereididae spp., and Mytilidae spp., though not surpassing 14% of its diet (Agüero et al., 2014). Thus, while mussel farms may offer shelter or alternative prey, they are not a primary food source for Fuegian Steamer Ducks (Medina-Vogel et al., 2019).

The low abundance of Fuegian Steamer Ducks along the continental coastline may be related to increases in nest predators, particularly invasive mink. Mink are confirmed nest predators of Fuegian Steamer Ducks in Patagonia (Liljesthröm et al., 2014; Schüttler et al., 2009). Indeed, Fuegian Steamer Ducks exhibit low nest survival rates, largely due to mink predation (e.g., 43.5% of 23 nests; Schüttler et al., 2009). They were not able to adapt their nesting strategy towards nesting in less-dense shrubland as observed, for example, in Upland Geese when comparing nesting habits after 15 years (Gómez-Silva et al. 2025). However, as Gómez-Silva et al. (2025) state, Fuegian Steamer Ducks might be responding to mink predation by selecting predator-free islets for breeding—possibly an ineffective adaptation strategy, as mink can reach islets as far as 300 m from the main coast (Gómez-Silva et al., 2024). Accordingly, mink were observed at several sites where we lacked records of Fuegian Steamer Ducks in Subareas i, iii, and iv. This is also true for other populations of Patagonian waterfowl, which have been strongly impacted by mink predation. For example, among 25 species studied in Lanin National Park, Argentina, 12 were less abundant in areas with mink presence (Peris et al., 2009). Mink predation also has been documented for the globally endangered Hooded Grebe *Podiceps gallardoi* in Argentinean Patagonia (Roesler et al., 2012). Scientists therefore argue for mink control for conserving vulnerable species (e.g., Fasola & Roesler, 2016). Indeed, starting effective mink control programs is an urgent task (e.g., Medina-Vogel et al., 2023) as the mink population expands across Chile, now ranging into northern (Fasola et al., 2021; Mora et al., 2018; Suárez-Villota et al., 2023) and southern fjords (Crego et al., 2015; Schüttler et al., 2019; Vergara & Valenzuela, 2015).

Concurrent with mink invasion, the Chilean aquaculture industry has expanded rapidly since the late 1980s, driven primarily by farmed salmon production (Outeiro et al., 2022). Early life stages of salmon occur in farms from central to southern Chile, with marine fattening taking place farther south in Patagonian fjords and channels (Outeiro et al., 2022; Quiñones et al., 2019). Medina (1989) highlighted the potential risks for Fuegian Steamer Ducks arising from boats powered by outboard motors. Therefore, habitat disturbance from aquaculture infrastructure, such as high-speed boat traffic, could negatively affect Fuegian Steamer Ducks, although this interaction remains undocumented (Jiménez et al., 2013; Quiñones et al., 2019).

CONCLUSIONS

This study provides an overview of abundances of Fuegian Steamer Ducks over a large portion of its distributional range in Chile. These findings allow as to evaluate the conservation status of and threats to Fuegian Steamer Ducks, as they indicate a notable reduction in both population size and distribution. Our results suggest a 204-km southward contraction of the northern limit of the distribution of Fuegian Steamer Ducks along the Chilean coastline from Valdivia (40°S) to Maullín harbor (Fig. 1). Additionally, the distribution of Fuegian Steamer Ducks now appears highly fragmented between Tic Toc Bay and Caleta Tortel, being dependent upon the availability of safe islets for breeding. Therefore, we strongly recommend a large-scale census across the southern Chilean archipelagos and comparisons between areas with and without American mink presence to identify and protect critical refuges for Fuegian Steamer Duck subpopulations. In Chile, the Ministry of Environment has classified the Fuegian Steamer Duck as Near Threatened (Ministry of Environment, 2015). However, systematic data on the species' spatial ecology, its habitat preferences, and the extent of threats as described in our study have been lacking. Previous studies on the Fuegian Steamer Duck have focused on specific sites, such as Chiloé (43°S; Araneda et al., 2017; Medina-Vogel et al., 2019) and Navarino Island (54°S; Gómez-Silva et al., 2024, 2025; Schüttler et al., 2009), leaving most of its known distribution unsurveyed (Medina-Vogel et al., 2019). This knowledge gap hampers accurate assessments of the species' conservation status under IUCN Criterion B, which relates to geographic range and population fragmentation (Bouchet et al., 2021). We therefore hope that our study contributes to a reassessment of the IUCN classification of the Fuegian Steamer Duck from Least Concern to Vulnerable (VU) and advocate closing knowledge gaps through further systematic research that will contribute to the conservation of the world's largest marine duck.

ACKNOWLEDGEMENTS

We extend our gratitude to the Universidad Andrés Bello (UNAB) for making this study possible. We also thank the crew of the sailboat *Beluga*—Catalina Quiros, Diego Medina, Jeronimo Niño, and Patricio Tausch—for their essential collaboration during the field surveys. The maritime authority of Chile (DIRECTEMAR, its acronym in Spanish) issued the maritime authorizations and high-seas sport sailing license to GM-V. Data acquisition on Navarino Island was supported by the Chilean National Agency for Research and Development through grants ANID PIA/BASAL FB0002, ANID/BASAL FB210018, and ANID master grant No. 22220927. Finally, we wish to thank Bruce Dugger and the editor of this journal for comments that greatly improved our manuscript.

AUTHOR CONTRIBUTIONS

GM-V conceived the study, participated in its design and coordination, participated in data acquisition, commanded the sailboat, and wrote draft and final versions of the manuscript. GM-M, CC-M, and ND-P participated in data acquisition and manuscript writing. VG-S participated in the field work on Navarino Island and adjacent islets, wrote the respective paragraphs in the manuscript, and commented on an earlier version of the manuscript and the final draft. ES supervised field work on Navarino Island, wrote the respective paragraphs in the manuscript, and commented on an earlier version and the final draft of the manuscript. BS-B participated in the acquisition of data to compare populations in bays with and without off-bottom bivalve aquaculture and record feeding times in the Chiloé archipelago. JRR and JAC provided references and critically read earlier drafts and the final version of the manuscript.

REFERENCES

Agüero, M. L., Borboroglu, P. G., & Esler, D. (2014). Trophic ecology of breeding White-headed Steamer-Duck (*Tachyeres leucocephalus*). *Waterbirds*, *37*(1), 88–93. http://doi.org/10.1675/063.037.0111

Araneda, R., Tobar, C. N., Rau, J. R., & Cursach, J. A. (2017). Dieta del pato quetru no volador *Tachyeres pteneres* en un humedal marino de Chiloé, sur de Chile [Diet of the Magellanic Flightless Steamer Duck *Tachyeres pteneres* in a marine wetland of Chiloé, southern Chile]. *Revista de Biología Marina y Oceanografía*, *52*(3), 631–634. http://dx.doi.org/10.4067/S0718-19572017000300019

BirdLife International. (2018). Tachyeres pteneres (e.T22680033A133081668). The IUCN Red List of Threatened Species 2018. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22680033A133081668.en

Bouchet, P. J., Thiele, D., Marley, S. A., Waples, K., Weisenberger, F., Balanggara Rangers, Bardi Jawi Rangers, Dambimangari Rangers, Nyamba Buru Yawuru Rangers, Nyul Nyul Rangers, Uunguu Rangers, & Raudino, H. (2021). Regional assessment of the conservation status of snubfin dolphins (*Orcaella heinsohni*) in the Kimberley Region, Western Australia. *Frontiers in Marine Science*, *7*, Article 614852. https://doi.org/10.3389/fmars.2020.614852

Crego, R. D., Jiménez J. E., & Rozzi, R. (2015). Expansión de la invasión del visón norteamericano (*Neovison vison*) en la Reserva de la Biosfera Cabo de Hornos, Chile [Invasive expansion of the American Mink (*Neovison vison*) in the Cape Horn Biosphere Reserve, Chile]. *Anales del Instituto de la Patagonia*, *43*(1), 157-162. http://dx.doi.org/10.4067/S0718-686X2015000100015

Cursach, J. A., & Rau, J. R. (2009). Abundancia y nidificación del pato quetru no volador *Tachyeres pteneres* en Bahía Lenca, Seno de Reloncaví, sur de Chile. *Boletín del Museo Nacional de Historia Natural (Chile)*, *58*, 97–100. https://doi.org/10.54830/bmnhn.v58.2009.238

Cursach, J. A., Suazo, C. G., Rau, J. R., Tobar, C. N., & Gantz, A. (2011). Ensamble de aves en una mitilicultura de Chiloé, sur de Chile [Assemblage of birds in a mussel farm on Chiloé Island, southern Chile]. *Revista de Biología Marina y Oceanografía*, *46*(2), 243–247. http://dx.doi.org/10.4067/S0718-19572011000200013

Cursach, J. A., Vilugrón, J., Rau, J. R., Tobar, C., & Oyarzún, C. (2022). Islas Caicura (41°S): Sitio importante para la reproducción de aves y mamíferos marinos del Seno de Reloncaví, sur de Chile [Caicura Islands (41°S): Important site for the reproduction of birds and marine mammals in Reloncaví Sound, southern Chile]. *Anales del Instituto de la Patagonia*, *50*, 1–13. https://doi.org/10.22352/AIP202250003

Fasola, L., & Roesler, I. (2016). Invasive predator control program in Austral Patagonia for endangered bird conservation. *European Journal of Wildlife Research*, *62*, 601–608. https://doi.org/10.1007/s10344-016-1032-y

Fasola, L., Zucolillo, P., Roesler, I., & Cabello, J. L. (2021). Foreign carnivore: The case of American mink (*Neovison vison*) in South America. In F. M. Jaksic & S. A. Castro (Eds.), *Biological invasions in the South American Anthropocene* (pp. 255–299). Springer. https://doi.org/10.1007/978-3-030-56379-0_12

Gómez-Silva, V., Crego, R. D., Jaksic, F. M., Flores-Benner, G., & Schüttler, E. (2024). Understanding ground-nesting habitat selection by waterbirds to prioritize invasive predator control on islands. *Basic and Applied Ecology*, *78*, 14-22. https://doi.org/10.1016/j.baae.2024.04.007

Gómez-Silva, V., Jaksic, F. M, Crego, R. D., Flores-Benner, G., & Schüttler, E. (2025). Adaptive response in waterbirds after mink introduction in subantarctic ecosystems. *Scientific Reports*, *15*, Article 15147. https://doi.org/10.1038/s41598-025-98920-1

Jiménez, J. E., Arriagada, A. M., Fontúrbel, F. E., Camus, P. A., & Ávila-Thieme, M. I. (2013). Effects of exotic fish farms on bird communities in lake and marine ecosystems. *Naturwissenschaften*, *100*, 779–787. https://doi.org/10.1007/s00114-013-1076-8

Liljeström, M., Fasola, L., Valenzuela, A., Raya Rey, A., & Schiavini, A. (2014). Nest predators of Flightless Steamer-Ducks (*Tachyeres pteneres*) and Flying Steamer-Ducks (*Tachyeres patachonicus*). *Waterbirds*, *37*(2), 210–214. http://doi.org/10.1675/063.037.0209

Martínez-Harms, M. J., Armesto, J. J., Castilla, J. C., Astorga, A., Aylwin, J., Buschmann, A. H., Castro, V., Daneri, G., Fernández, M., Fuentes-Castillo, T., Gelcich, S., Gonzalez, H. E., Hucke-Gaete, R., Marquet, P. A., Morello, F., Nahuelhual, L., Pliscoff, P., Reid, B., Rozzi, R., . . . Tecklin, D. (2022). A systematic evidence map of conservation knowledge in Chilean Patagonia. *Conservation Science and Practice*, *4*(1), Article e575. https://doi.org/10.1111/csp2.575

Martínez-Piña, D., & González-Cifuentes, G. (2017). *Las aves de Chile: Guía de campo y breve historia natural*. Ediciones del Naturalista.

Medina, G. (1989). *Contribución a la ecología del pato quetru no volador (*Tachyeres pteneres*) y la relación de esta especie con la mitilicultura en Yaldad, Chiloé insular* [Unpublished master's thesis]. Universidad Austral de Chile.

Medina-Vogel, G., Calvo-Mac, C., Delgado-Parada, N., Molina-Maldonado, G., Johnson-Padilla, S., & Berland-Arias, P. (2023). Co-occurrence between salmon farming, alien American mink (*Neogale vison*), and endangered otters in Patagonia. *Aquatic Mammals*, *49*(6): 561–568. https://doi.org/10.1578/AM.49.6.2023.561

Medina-Vogel, G., Pons, D. J., & Schlatter, R. P. (2019). Relationships between off-bottom bivalve aquaculture and the Magellanic steamer duck *Tachyeres pteneres* in southern Chile. *Aquaculture Environment Interactions*, *11*, 321–330. https://doi.org/10.3354/aei00313

Medrano, F., & Cursach, J. A. (2018). Quetru no volador *Tachyeres pteneres*. In F. Medrano, R. Barros, H. V. Norambuena, R. Matus, & F. Schmitt (Eds.), *Atlas de las aves nidificantes de Chile* (p. 70). Red de Observadores de Aves y Vida Silvestre de Chile.

Ministry of Environment [Chile]. (2015). *Ficha de antecedentes de* Tachyeres pteneres, https://clasificacionespecies.mma.gob.cl/wp-content/uploads/2019/10/Tachyeres_pteneres_12RCE_FIN.pdf

Ministry of Environment [Chile]. (2024). *Recovery, Conservation, and Management Plans for Wildlife Species*. https://mma.gob.cl/biodiversidad/planes-de-recuperacion-conservacion-y-gestion-de-especies/

Mora, M., Medina-Vogel, G., Sepúlveda, M. A., Noll, D., Álvarez-Varas, R., & Vianna, J. A. (2018). Genetic structure of introduced American mink (*Neovison vison*) in Patagonia: Colonisation insights and implications for control and management strategies. *Wildlife Research*, *45*(4), 344–356. https://doi.org/10.1071/WR18026

Outeiro, L., Rau, J. R., & Ojeda, J. (2022). Historical-geographical colonization of salmon farming in Patagonia. *Interciencia*, *47*(4), 133–137.

Peris, S. J., Sanguinetti, J., & Pescador, M. (2009). Have Patagonian waterfowl been affected by the introduction of the American mink *Mustela vison*? *Oryx*, *43*(4), 648–654. https://doi.org/10.1017/S0030605309990184

Quiñones, R. A., Fuentes, M., Montes, R. M., Soto, D., & León-Muñoz, J. (2019). Environmental issues in Chilean salmon farming: A review. *Reviews in Aquaculture*, *11*(2), 375–402. https://doi.org/10.1111/raq.12337

R Core Team (2024). *R: A language and environment for statistical computing* (Version 4.1.1) [Computer software]. R Foundation for Statistical Computing. https://www.R-project.org/

Roesler, I., Imberti, S., Casañas, H., & Volpe, N. (2012). A new threat for the globally Endangered Hooded Grebe *Podiceps gallardoi*: The American mink *Neovison vison*. *Bird Conservation International*, *22*(4), 383–388. https://doi.org/10.1017/S0959270912000019

Schüttler, E., Crego, R. D., Saavedra-Aracena, L., Silva-Rodríguez, E. A., Rozzi, R., Soto, N., & Jiménez, J. E. (2019). New records of invasive mammals from the sub-Antarctic Cape Horn Archipelago. *Polar Biology*, *42*, 1093–1105. https://doi.org/10.1007/s00300-019-02497-1

Schüttler, E., Klenke, R., McGehee, S., Rozzi, R., & Jax, K. (2009). Vulnerability of ground-nesting waterbirds to predation by invasive American mink in the Cape Horn Biosphere Reserve, Chile. *Biological Conservation*, *142*(7), 1450–1460. https://doi.org/10.1016/j.biocon.2009.02.013

Suárez-Villota, E. Y., Quercia, C. A., Díaz Camacho, L. M., Valenzuela, J., & Nuñez, J. J. (2023). Mink invasion in Chiloé Island, Chile: Population genetics and *Leptospira* spp. detection in *Neovison vison*. *Mammal Research*, *68*, 521–531. https://doi.org/10.1007/s13364-023-00700-7

Tobar, C., Arriagada, A., Rau, J., Cursach, J., Suazo, C., & Márquez, R. (2011). Dieta del pato quetru no volador (*Tachyeres pteneres*) en isla Guapiquilán, Chiloé, sur de Chile [Diet of Flightless Steamer-duck (*Tachyeres pteneres*) at Guapiquilán Island, Chiloé, southern Chile]. *Boletín Chileno de Ornitología*, *17*(2), 103–108.

Varennes, E., Hanssen, S. A., Bonardelli, J., & Guillemette, M. (2013). Sea duck predation in mussel farms: The best nets for excluding common eiders safely and efficiently. *Aquaculture Environment Interactions*, *4*, 31–39. https://doi.org/10.3354/aei00072

Vergara, G., & Valenzuela, J. (2015). Presencia de visón americano (*Neovison vison*, Schreber 1777) en Chiloé, Chile: ¿Inicio de una invasión biológica? [Presence of American mink (*Neovison vison*, Schreber 1777) in Chiloé, Chile: Beginning of a biological invasion?] *Ecosistemas*, *24*(1), 29–31. https://doi.org/10.7818/ECOS.2015.24-1.05

Vilugrón Torres, J. C., Rau Acuña, J., & Encabo, M. E. (2016). *Comportamiento de aves y visitantes: Humedal de Caulín, Isla Grande de Chiloé – Chile*. EDUCO, Universidad Nacional del Comahue.

Žydelis, R., Esler, D., Kirk, M., & Boyd, W. S. (2009). Effect of off-bottom shellfish aquaculture on winter habitat use by molluscivorous sea ducks. *Aquatic Conservation*, *19*(1), 34–42. https://doi.org/10.1002/aqc.977