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Short Note

Assessment of the Distribution and Coexistence of Two Sympatric Otter Species in the Chiloé Archipelago, Chile, Using Photo-Identification

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The southern river otter (*Lontra provocax*) and the marine otter (*Lontra felina*) are endangered species (Duplaix & Savage, 2018). Southern river otters inhabit rivers, streams, lakes, and fjords. Current populations in rivers and lakes have been confirmed only in a few isolated areas between 39º and 44º S (Medina, 1996). However, their distribution along the Chiloé Archipelago, marine fjords, and channels remains poorly understood (Medina, 1996; Sielfeld & Castilla, 1999; Medina-Vogel et al., 2013). The marine otter lives along the Pacific Ocean coast from 6º S in northern Peru to 56º S near Cape Horn, Chile (Valqui, 2012). Their habitat is primarily described as rocky and exposed to the wind and sea waves of the Pacific Ocean (Valqui, 2012). From Tacna in southern Peru to the border with Chile and Chiloé Island, the shoreline alternates between rocky patches and discontinuous sandy beaches (Medina-Vogel et al., 2008; Valqui, 2012). Geographically, rocky shoreline patches become increasingly separated from northern to central-southern Chile, with otter occupancy significantly influenced by human presence along the exposed coastline (Medina-Vogel et al., 2008). Notably, higher marine otter occupancy was observed only along the largest rocky shoreline patches, spanning approximately 412 km (Medina-Vogel et al., 2008). Recent anecdotal observations by Medina-Vogel et al. (2023) report marine otter presence at Johnson Island (44º 20' S), Rowlett Island (44º 47' S), and the Ninualac Sea Channel (45º 02' S) in the Aysén Region, Chile. Additionally, anecdotal reports mention marine otter populations at Islotes Las Hermanas, Isla Refugio, and the Palena River estuary area (43º 47' S, 73º 1' W; Medina-Vogel et al., 2023).

Chiloé Island represents the southernmost region where southern river otters inhabit freshwater ecosystems, while they occupy marine habitats to the south (Medina, 1996; Sielfeld & Castilla, 1999; Medina-Vogel et al., 2013). Both otter species inhabit marine areas associated with the continent, where they coexist along the same seashores, making studies challenging due to the difficulty of distinguishing between the two species without molecular analysis or extensive field observations (Sanino & Meza, 2016). In fact, marine and southern river otters are easily confused. Some published photos of southern river otters in nature books are likely marine otters (e.g., see Hucke-Gaete & Ruiz Troemel, 2010). Furthermore, to date, no studies have combined photo-identification and molecular evidence to assess the sympatric relationships between these two species. Identification difficulties arise from collected scats or clear observations due to the similarity in rhinarium morphology (Sanino & Meza, 2016). The marine otter exhibits a bare rhinarium and a straight dorsal border, contrasting with the biconcave edge of the southern river otter. Additionally, adult marine otters typically measure less than 1 m in body length, while adult southern river otters can reach up to 1.5 m (Lariviere, 1998, 1999; Sepúlveda et al., 2007; Medina-Vogel et al., 2024). To accurately assess the ecology of otter coexistence, it is crucial to avoid misidentification of species' field signs as well as confusion with American mink (*Neogale vison*) (Medina-Vogel et al., 2023). Therefore, in this study, through the use of photo-identification, our objectives were (1) to demonstrate the feasibility of studying the ecological relationship between marine and southern river otters by analyzing rhinarium photos and (2) to update the distribution and habitat use of both otter species in the Chiloé Archipelago.

The study area extends along the east and west coasts of the Chiloé Archipelago (41º 47.5' S, 73º

34.2' W to 43º 16.4' S, 73º 34.5' W), and the adjacent continental region of Chile, extending from TiToc Port Bay (43º 36.0' S, 72º 57.1' W) to Melimoyu Fiord (44º 04.4' S, 73º 07.5' W) (Figure 1). Otter species identification was conducted through direct observation and photo-identification of the otter's rhinarium (i.e., the moist and furless skin around the nostrils), both in water and on land (Santibañez et al., 2024). Photographs were captured using a Nikon® D3300 with AF-S Nikkor® 18-200 mm 1:3.5-5.6 GED from aboard an anchored sailboat, and a Canon® EOS Rebel T7 lens Tamaron® EF 150-600 mm f/5-6.3 di VC USD G2 and Canon® EF 75-300 mm f/4-4.6 III from a stationary rowboat and a kayak. Observation effort between December 2019 and March 2024 along the seashore environment comprised continuous observation during daylight hours for 2 d from the anchored sailboat at each study site, and it comprised continuous observation of 4 to 6 h a day for 2 d from a stationary rowboat or kayak along rivers and lakeshores. Walking surveys along seashores, rivers, and lakeshores complemented observations whenever feasible because of too dense riparian vegetation or too steep rocky shoreline. Sea observations were conducted from a 14-m-long sailboat by four observers, maintaining 50 to 100 m from shore, utilizing binoculars (10x50, 15x50 resolution) and a spotting telescope (20x50 resolution). Site names and geographical locations were determined using onboard nautical charts (Navionics+® Chile, Argentina, and Easter Island nautical digital chart). Observations from stationary rowboats involved four to five individuals, while observations from kayaks were performed by a single person, with an observation radius ranging from 10 to 50 m. When an animal was observed from either platform, the camera lens was used to confirm identity as an otter or American mink, and then to photograph the latter species for identification.

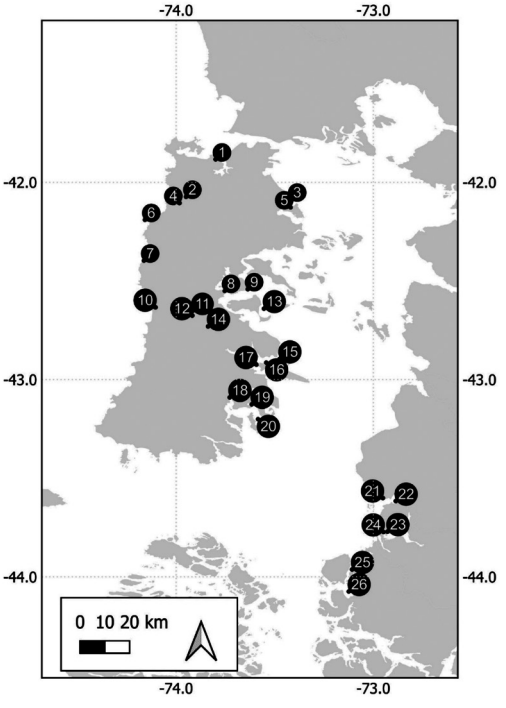

Figure 1. Study area and study sites: Ancud Port Bay (1), Coluco River (2), Queniao Tip (3), Huentru River (4), Caucahue Sea Channel North (5), Metalqui Island (6), Ñango River (7), Castro Sea Channel (8), Rilan Peninsula (9), Cucao River (10), Notue River (11), Huillinco Lake (12), Quehui Island Channel (13), Tarahuin River (14), Queilen Tip (15), Tranqui Tip (16), Chequelen Tip (17), Yaldad River (18), Quellón Port Bay (19), Cailin Tip (20), TiToc Port Bay (21), Escondido Port Bay (22), Piti Palena Fiord (23), Raul Marin Balmaceda Port Sea Channel (24), Santo Domingo Port Bay (25), and Melimoyu Fiord (26).

A total of 26 study sites were surveyed, with otters observed on 20 occasions at 13 study sites (50%). Out of these, clear photos for successful identification were obtained on 17 of 20 occasions (85%) (Table 1). An American mink was also observed on one occasion in the same study site as a southern river otter (Coluco River; Figure 2a; Table 1). On two other occasions where minks were observed, no signs of otters (such as resting areas, dens, or scats) were recorded, despite a thorough examination along the seashore.

New observations and identification of marine otters were confirmed on the southeast seashore of the Chiloé Archipelago, starting with an observation at Cailin Tip. Cailin Tip is a small sandy/grass cape located on Cailin Island, facing Laitec Island, whose seashore is predominantly rocky. This area is partially exposed to southerly winds and sea waves from the Corcovado Gulf, with a depth of 14 m. The marine otter was observed swimming ~800 m from the nearest rocky seashore, where abundant kelp forests grow. A second observation of a single marine otter occurred east of Tranqui Tip (Tranqui Island), swimming from west to east at about 100 to 150 m from shore (Figure 2b). A subsequent 4-km walking survey of the seashore revealed no dens, resting sites, or otter scats. The shoreline consists of a combination of pebble and sandy beaches, with vegetation extending beyond 10 m from the sea at high tide. This protected seashore experiences minimal wind and sea wave exposure, with a rocky seashore ~5 km away and a depth of 13 m, featuring only a few scattered kelp forests. On the opposite northwest seashore of the archipelago, several marine otters were observed at Metalqui Island and Ancud Port Bay

Table 1. Study sites and observed otter species (southern river otter [*Lontra felina*] and marine otter [*Lontra provocax*]) and alien-introduced American mink (*Neogale vison*) from December 2019 to March 2024 along the Chiloé Archipelago, south of Chile

#	Site name	Geographic location	Date (d/mo/y)	Otter species	Photo identification
1	Ancud Port Bay	41°53.0' S, 73°48.0' W	21/1/2024	*Lontra felina*	Yes
2	Coluco River	42°04.2' S, 73°57.0' W	26/3/2022	*Lontra provocax*	Yes
2	Coluco River	42°04.2' S, 73°57.0' W	26/6/2022	*L. provocax*	Yes
2	Coluco River	42°04.4' S, 73°57.0' W	25/9/2023	*Neogale vison*	Yes
2	Coluco River	42°04.4' S, 73°57.0' W	25/3/2021	*L. provocax*	Yes
3	Queniao Tip	42º05.2' S, 73º25.1' W	26/1/2023	None	
4	Huentru River	42°06.3' S, 73º59.0' W	10/2/2023	None	
5	Caucahue Sea Channel North	42º07.6' S, 73º25.2' W	31/1/2023	None	
6	Metalqui Island	42°11.4' S, 74°09.5' W	8/12/2023	*L. felina*	Yes
6	Metalqui Island	42°11.4' S, 74°09.5' W	2/12/2022	*L. felina*	Yes
7	Ñango River	42°23.8' S, 74°09.8' W	8/12/2023	None	
8	Castro Sea Channel	42°33.0' S, 73º45.2' W	15/1/2023	*L. provocax*	No
9	Rilan Peninsula	42°32.5' S, 73°38.2' W	19/2/2024	None	
10	Cucao River	42°38.0' S, 74°06.3' W	13/2/2023	*L. provocax*	Yes
10	Cucao River	42°38.0' S, 74°06.3' W	4/1/2022	*L. provocax*	Yes
10	Cucao River	42°38.0' S, 74°06.3' W	2/3/2023	*L. provocax*	Yes
11	Notue River	42°38.4' S, 73°55.0' W	17/12/2019	*L. provocax*	Yes
11	Notue River	42°38.4' S, 73°55.0' W	16/5/2021	*L. provocax*	Yes
11	Notue River	42°39.1' S, 73°55.0' W	25/1/2023	*L. provocax*	Yes
11	Notue River	42°39.1' S, 73°55.0' W	13/11/2022	*L. provocax*	Yes
11	Notue River	42°39.1' S, 73°55.0' W	11/3/2021	*L. provocax*	Yes
12	Huillinco Lake	42°40.5' S, 73°55.1' W	9/4/2023	*L. provocax*	Yes
13	Quehui Island Channel	42°38.4' S, 73º33.3' W	18/2/2023	None	
14	Tarahuin River	42°43.8' S, 73º50.3' W	3/102022	None	
15	Queilen Tip	42º53.7' S, 73º28.5' W	3/2/2023	None	
16	Tranqui Tip	42°54.8' S, 73°32.6' W	17/2/2024	*L. felina*	Yes
17	Chequelen Tip	42°55.4' S, 73°35.6' W	18/2/2024	None	
18	Yaldad River	43°05.4' S, 73°43.7' W	13/2/2024	*L. provocax*	Yes
19	Quellón Port Bay	43°07.5' S, 73°37.0' W	4/2/2023	None	
20	Cailin Tip	43°12.0' S, 73°35.1' W	6/2/2023	*L. felina*	No
21	TiToc Port Bay	43°36.0' S, 72°57.1' W	21/2/2023	None	
22	Escondido Port Bay	43°36.9' S, 72°53.2' W	19/2/2023	*N. vison*	No
23	Piti Palena Fiord	43°46.2' S, 72°55.7' W	17/2/2023	*N. vison*	No
24	Raul Marin Balmaceda Port Sea Channel	43°46.3' S, 72°56.9' W	15/2/2023	None	
25	Santo Domingo Port Bay	43º57.7' S, 73º06.5' W	14/2/2023	None	
26	Melimoyu Fiord	44°04.4' S, 73°07.5' W	8/2/2023	*L. provocax*	No

Figure 2. American mink at Coluco River (a); and marine otter observed at Tranqui Tip (b), Ancud Port Bay (c), and Metalqui Island (d). Notice bare rhinarium and a straight dorsal border in (c). (*Photo credits:* [a & d] Diego Navarro Vivar, [b] Gonzalo Medina-Vogel, and [c] Patricio Jonsson Valenzuela)

(Figure 2c & d). Metalqui Island is surrounded by extensive rocky seashores exposed to Pacific Ocean winds and waves.

The southern river otter was also identified in a marine habitat, with the first sighting at Melimoyu Fiord. The area was rocky with dense riparian vegetation, surrounded by two small bays. The otter was observed for about 15 min while it was swimming along the coast, moving towards the north and diving for several seconds in the same spot, coming up with prey, and moving and diving again, until we lost it behind a rocky tip. In the second sighting, footprints from an adult southern river otter and a pup were recorded at Castro Sea Channel (42º 33' S, 73º 45.2' W) on 15 January 2024 (Figure 3a). The adult footprints of southern river otters are double the size of marine otters (Medina, 1992; Lariviere, 1998, 1999). This observation represents the northernmost sighting of southern river otters using a marine habitat. The southern river otter was also identified in several of the rivers, lakes, and lagoons of Chiloé's main island (Figure 3b-f), whereas non-marine otters were observed and identified in freshwater habitats (e.g., rivers, streams, lakes, lagoons).

Thus, our research proved that the use of clear photos of the otter rhinarium are important field tools for otter identification to species, if not also in individual identification, in areas where two or more otter species coexist such as for Nearctic otters (*Lontra canadensis*) and Neotropical otters (*Lontra longicaudis*) in northern Mexico (Gallo-Reynoso et al., 2019), and for marine and southern river otters in the south of Chile (Sanino & Meza, 2016). Indeed, our study demonstrates the feasibility of using photography for otter species identification when photographs are taken from stationary observation points. Photos of marine and southern river otters' rhinarium confirm the presence and absence of coexistence for both species along a large territory in southern Chile.

We identified the occurrence of marine otters along the west and east coasts of the Chiloé Archipelago, whereas southern river otters were observed in the rivers, lakes, and lagoons of several Chiloé main island watersheds, as well as in protected marine habitats linked to the main island and continental region. Both sites where marine otters were observed along the southeast coast of the Chiloé Archipelago (Tranqui Tip and Cailin Tip) were areas with long pebble and sandy beaches, and soft bottoms.

The Tranqui Tip's closed rocky seashore patch was ~5 km from our observation point, and the observed marine otter was swimming more than 100 m from land. At Quelien Tip, the observed

Figure 3. (a) Southern river otter footprints at Castro Channel; and southern river otter observed at Notue River (b & c), Chepu River (d), and Coluco River (e & f). Notice biconcave edge rhinarium (b, c, d, e & f). (*Photo credits:* [a] Gonzalo Medina-Vogel, [b, d, e & f] Diego Navarro Vivar, and [c] Fernando Bórquez)

marine otter was swimming 800 m from the closed rocky seashore of Laitec Island and farther than 100 m from the sandy seashore of Queilen Tip Cape. These two observations are both first time descriptions of marine otter swimming behavior between 1 to 5 km from any rocky refuge and more than 100 m from land. Instead, southern river otters have been observed crossing fjords and sea channels larger than 5 km wide south of the Chiloé Archipelago (Medina-Vogel et al., 2023, 2024). Indeed, several daylight observational studies stated that the long-distance swimming of marine otters is only between rocky patches, with sandy beaches eventually used for resting, for walking, or for running along, but no observation in the literature presented marine otters swimming more than 5 km away from rocky shore refuges (Valqui, 2012). In fact, the only available radio-tracking study described marine otter home ranges varying from 1,373 to 4,134 m, with core areas ranging from 49 to 495 m long and no significant differences between sexes (Medina-Vogel et al., 2007). Home ranges and the identified core areas followed the seashore contours. Core areas were caves or cavities between rocks or rock cracks used as dens or resting places on land. Marine otters were able to move (maximum distance) between 55 to 151% of their home range extension in less than 24 h (Medina-Vogel et al., 2007). Therefore, our observations demonstrate that there is much to discover about the ecology and behavior of these two otter species.

Hence, our documentation of long-distance swimming around Tranqui Tip and Cailin Island represents a novel observation for marine otters. Our observations of marine otters swimming in protected waters, away from sea waves and without nearby rocky seashore refuges in a region with abundant freshwater outlets, may be the outcome of an environment that encourages the species to spend longer periods in the sea. In fact, along their northern distribution, marine otters have been observed drinking freshwater from streams, including from house pipes along the coast; and in captivity, they frequently consume freshwater (Medina-Vogel et al., 2024). Indeed, it seems that calm waters also serve as habitat for marine otters. Villegas et al. (2007) investigated the daylight foraging behavior of marine otters, comparing activities between wave-protected and wave-exposed sites. They concluded that marine otters spent more time foraging in wave-protected areas than in wave-exposed habitats. Additionally, dives were 18% shorter in wave-exposed areas compared to wave-protected ones. Furthermore, they recorded dives 18% shorter in wave-exposed as compared with wave-protected habitat. Similarly, Gutiérrez et al. (2019) reported that otters spent a significantly greater time diving in Quintay (3° 11' S) (exposed) as compared to

the northern site, Cachagua (32° 35' S) (protected); the increased time spent diving in Quintay compared to Cachagua supports the notion that wave-protected habitats are more favorable for marine otters (Villegas et al., 2007). Nevertheless, previous observations indicate that marine otters spent the majority of their daytime hours out of the water, resting inside caves or rock cracks (Medina-Vogel et al., 2006, 2007). These authors suggest that the limited time spent in water may be an evolutionary adaptation or a behavioral response to a cold environment with abundant prey nearshore, where dives into the water are short and highly successful (Ostfeld et al., 1989; Medina, 1995; Medina-Vogel et al., 2004; Valqui, 2004).

South of Peru, marine otters inhabit river and lagoon habitats from sea level up to ~1,700 masl (Ugarte-Nuñez & Zanabria, 2024). However, it is unknown what environmental variables limit the occurrence of marine otter populations in freshwater habitats in the Chiloé Archipelago. Our study raises the possibility of active avoidance of marine otters when southern river otters are detected, similar to what has been observed between American minks and southern river otters (Medina-Vogel et al., 2013), which use both marine and freshwater habitats from the Chiloé Archipelago towards the south. Indeed, we recorded southern river otters in our study area in the sea's protected waters associated with the main Chiloé Island (Castro Channel), and, previously, the otters were described using marine habitats in Yaldad Bay, feeding on marine crayfish (Medina, 1989).

Along the continental study area, southern river otters were recorded on the east-oriented seashores (Medina-Vogel et al., 2013), even swimming across more than 5-km-wide fjords (Medina-Vogel et al., 2023). Southern river otters have been observed in waters protected from west and south winds, and from Pacific Ocean waves (Sielfeld & Castilla, 1999). Thus, our observations of one southern river otter at the Melimoyu Fiord and others at Castro Channel are not surprising.

Still, our observations underscore the necessity of conducting surveys, molecular analyses, and photo-identification studies to evaluate the ecology and coexistence of both otter species as well as potential threats and limiting environmental factors that might impact the distribution and conservation of both the marine and southern river otters along the Chiloé Archipelago in southern Chile (Medina-Vogel et al., 2023). Furthermore, our new findings regarding distance-from-shore otter swimming behaviors highlight the vulnerability of both species to predation by other marine mammals such as killer whales (*Orcinus orca*) and leopard seals (*Hydrurga leptonyx*) (Estes et al., 1998; Rogers, 2009).

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