

New records of the Endangered southern river otter *Lontra provocax*, with notes on its diet, in threatened wetlands of southern Chile

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Abstract The wetlands inhabited by the southern river otter *Lontra provocax* in Chile are subject to anthropogenic disturbances. As a result of the modification and destruction of its habitat, caused by loss of riparian vegetation, and other threats, the species is categorized as Endangered on the IUCN Red List. We monitored the river otter and its diet during September 2020–January 2021 in a swamp forest fragment in southern Chile. We obtained evidence of river otter presence from the upper part of the wetland to the confluence with the Bueno River, suggesting inter-population connectivity of the species in an extensive hydrographic basin. Faeces and food remains showed a predominance of native macrocrustaceans, with introduced fish present at lower levels. The detection of the southern river otter in a fragment of threatened swamp forest suggests a low abundance in environmentally degraded freshwater environments. The identification of subpopulations such as the one reported here provides valuable data to support the conservation of the species in threatened wetlands.

Keywords Carnivore conservation, Chile, diet, freshwater habitat, Huillín, *Lontra provocax*, southern river otter, swamp forest

The Huillín or southern river otter *Lontra provocax* is a species distributed in Chile and Argentina and is categorized as Endangered on the IUCN Red List (Sepúlveda et al., 2021). In Chile, one part of the population is distributed in rivers, lakes and wetlands in the south-central area of the country (39–44°S), and another part in estuarine wetlands and austral fjords (44–56°S; Medina-Vogel, 1996). The water systems occupied by the south-central populations have been altered by the establishment and expansion of aquaculture, forestry, agriculture including livestock farming, and hydroelectric industries. These economic activities have increased the transport of sediments and organic matter to surface waters and wetlands, altering the

amount and specific contributions of nutrients (Leiva et al., 2019), affecting riparian vegetation and leading to the fragmentation of river otter populations.

The pitrantos are freshwater swamp forests characterized by the evergreen vegetation association Blepharocalyo-Myrceugenietum, where the dominant species are the temú *Blepharocalyx cruckshanksii* and pitra *Myrceugenia exsucca* trees (González et al., 2003). They are also the primary habitat for the river otter, other species of aquatic mammals, and birds, which find refuge, feeding and breeding sites in these wetlands. In Chile, these wetlands are one of the ecological communities most affected by climate change, intensive logging for firewood and draining of soil for agricultural use (Peña-Cortés et al., 2006). They are also threatened by the expansion of introduced macrophytes (e.g. waterweed *Egeria densa*), which have progressively increased their distribution range in Chile, competing with and displacing native species (Hauenstein, 2006). The temú is a highly hygrophilous species, fundamental in the structuring of the aquatic galleries used by the river otter; it is categorized as Near Threatened on the IUCN Red List (González, 1998).

We examined swamp forest fragments in Trinidad Lagoon and Pucopio Stream, near the Coastal Mountain range hotspot, southern Chile, for signs of river otter presence. This 235-ha wetland is not officially recognized as an area of high conservation value (e.g. as a national park, wildlife reserve, Ramsar wetland or biosphere reserve). It is affected by anthropogenic pressures such as forestry and agricultural activity that drive slow but progressive habitat degeneration, pollution, drainage and sedimentation of water bodies (Fuentes et al., 2021). During a 5-month period (September 2020–January 2021) we collected information on the river otter along 10 transects of 200 m length each, distributed between the upper part of the wetland and the confluence of Pucopio Stream with the Bueno River, covering 9 km of riverside (Fig. 1). On a monthly basis we surveyed each transect for signs of otter presence, based on the authors' experience in identifying footprints and faeces of otters and other aquatic and terrestrial mammals occurring in southern Chile. We recorded the geographical locations of otter faeces, food remains, footprints, burrows and direct sightings. We collected faeces and food remains, washed and dried them, observed invertebrate and fish remains with a stereoscopic lens and identified them by comparison with specimens held in the zoological collection

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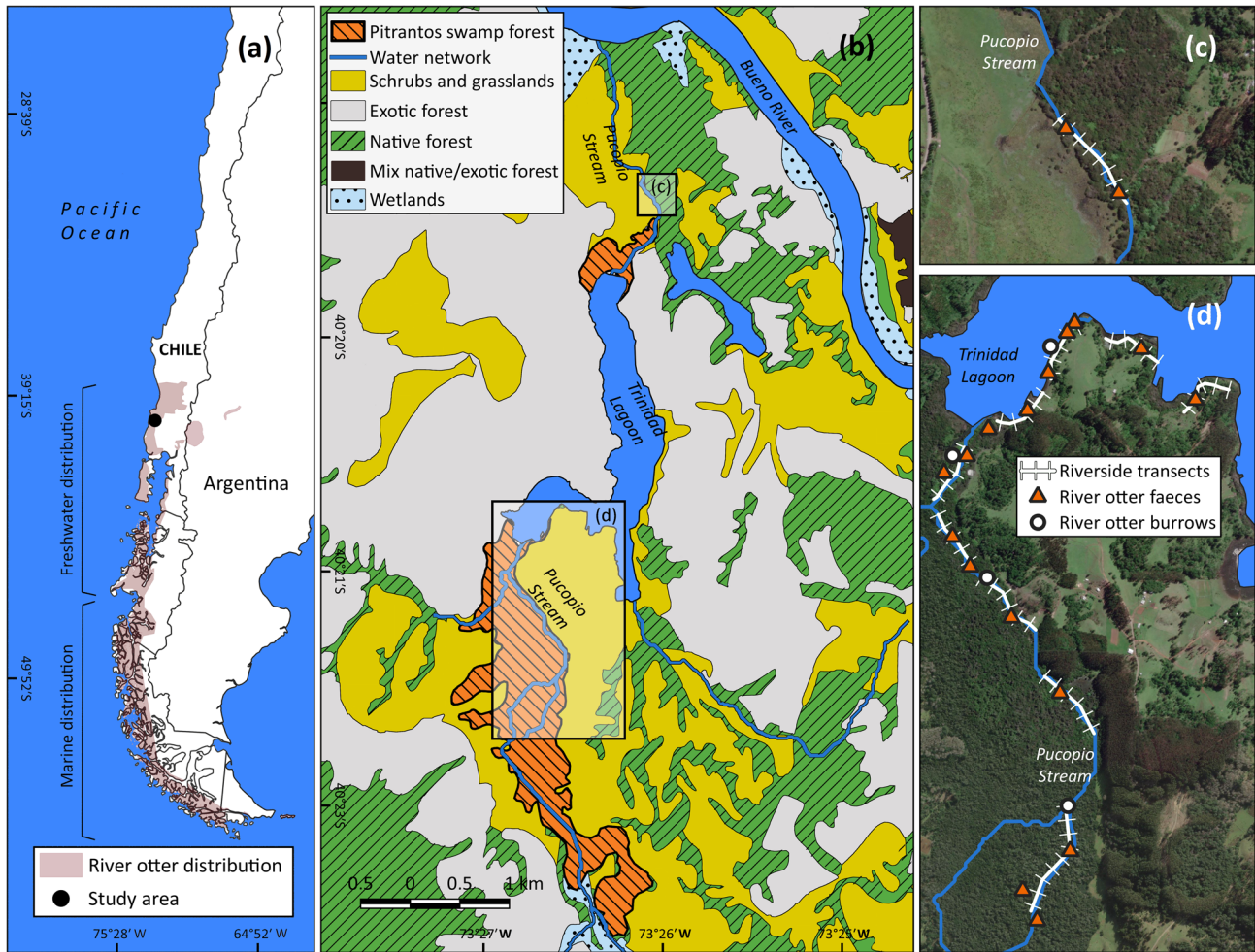


FIG. 1 (a) Geographical distribution of the river otter *Lontra provocax* according to the IUCN Red List (Sepúlveda et al., 2021). (b) Details of land cover in the vicinity of the swamp forest or pitranto, and in the sub-basin of Pucopio Stream and Trinidad Lagoon. (c, d) Location of survey transects and records of river otter burrows and faeces in Pucopio Stream and Trinidad Lagoon.

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We found evidence of the river otter from the upper part of the wetland to the confluence of Pucopio Stream and Bueno River (Fig. 1), in all transects and on all sampling occasions. Faeces were the most common records ($n = 40$), followed by food remains (26), footprints (15), burrows (4) and one direct sighting (Table 1, Plate 1). The faeces and food remains showed a predominance of macro-crustaceans of the genera *Samastacus* and *Aegla*, which is consistent with previous studies that report high consumption of these prey in rivers with abundant riparian vegetation and low slopes (Medina-Vogel et al., 2003; González & Medina-Vogel, 2006). Scales of the introduced carp *Cyprinus carpio* and brown trout *Salmo trutta* were also observed, taxa that were previously identified in the diet of otters in rivers of southern Chile (Franco et al., 2013). Non-native carp and salmonids have successfully adapted to their new environment in Chile, with a range of ecological impacts such as

predation of and competition with native fish species (Figuroa et al., 2010; Arismendi et al., 2014). However, their effect on modifying trophic chains involving native aquatic predators is unknown. Native predators such as the river otter can act to regulate native and invasive species, so the examination of this interaction offers opportunities to improve our knowledge on the selection and contemporary evolution of the adaptive traits of native predators (Carlsson et al., 2009).

The mean distance between neighbouring burrows was 640 m (range 482–872 m). Three of the four burrows were located on the riverside of Pucopio Stream, under the roots of living and fallen temú and pitra trees; the fourth was in an open, flood-free terrain adjacent to Trinidad Lagoon (Fig. 1). All burrows showed signs of otter activity, with fresh footprints, faeces and remains of prey near the entrances (Table 1, Plate 1). The relative density of new records in the monthly sampling events was 0.1–1.6 records/km (with the lowest recorded density in January 2021 and the highest

TABLE 1 Records of river otter *Lontra provocax* signs in the study area (Fig. 1). The number of records per month and the mean per linear transect km surveyed per month are shown.

Type of record	2020				2021
	September (n, mean/km)	October (n, mean/km)	November (n, mean/km)	December (n, mean/km)	January (n, mean/km)
Direct sightings			1 (0.1)		
Faeces	5 (0.6)	10 (1.1)	7 (0.8)	11 (1.2)	7 (0.8)
Food remains		6 (0.7)		14 (1.6)	6 (0.7)
Footprints		5 (0.6)	2 (0.2)	5 (0.6)	3 (0.3)
Burrows		1 (0.1)		2 (0.2)	1 (0.1)



PLATE 1 (a) River otter *Lontra provocax* photographed in Laguna Trinidad, southern Chile, and otter signs: (b) faeces, and (c, d) burrows.

in December 2020; Table 1), which is within the range described for the species in riparian environments of southern Chile (Sepúlveda et al., 2007). The feeding and burrowing activities observed in the lower part of the wetland suggest that this subpopulation is connected with that in the Bueno River (Magro et al., 2016). The Trinidad Lagoon sub-basin is part of the extensive water network of the Bueno River, which covers an area of 15,366 km² and is formed by tributary rivers and wetlands, facilitating otter population connectivity between forested wetland subsystems.

The ecological integrity of the swamp forest where we recorded the river otter is threatened by land-use change in the form of forest plantations with exotic species such as *Eucalyptus* sp. and *Pinus* sp. on the sloping shores around water bodies, and cutting of native forest for agricultural expansion, including livestock grazing (San Martín et al., 1988; Fuentes et al., 2021). The forest plantations and their harvest, together with the modifications in the channel of the Pucopio Stream, affect the natural vegetative succession of these swampy forests. Cutting of temú and pitra trees,

together with the drainage and gradual degradation of the wetland's edge, reduces the structural complexity that the river otter requires for shelter and reproduction (Medina-Vogel et al., 2003). Because the river otter is associated with well-preserved riparian vegetation, and is a high trophic level predator, it can be used as a sentinel and umbrella species (Chéhebar, 2006; Corpogujaira & Fundación Omacha, 2015). Monitoring of river otters can thus contribute to the preservation of the integrity and ecological function of these swamp forest fragments.

The detection of the river otter in a swamp forest exposed to various anthropogenic threats suggests low abundance of the species in freshwater environments affected by environmental degradation (Sepúlveda et al., 2021). Disruptions in the quality and quantity of riparian vegetation in the basin can isolate subpopulations, increasing the chance of local extirpation. The Chilean Ministry of the Environment is tackling this problem by planning and managing private and governmental efforts to strengthen the conservation of the species at the national, regional and local levels

(MMA, 2021). The identification and reporting of local subpopulations, together with future evaluations of their connectivity with larger geographical areas, provide valuable data to support the conservation of the species, especially in freshwater environments. Towards this goal, we continue to monitor the species in this wetland and others in the Bueno River basin.

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Author contributions Study design, fieldwork, data analysis and writing: both authors.

Conflicts of interest None.

Ethical standards This research abided by the *Oryx* guidelines on ethical standards and did not involve human subjects, experimentation with animals or collection of specimens.

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