Latin American Journal of Aquatic Research, 47(1): 122-128, 2019
DOI: 10.3856/vol47-issue1-fulltext-13

Research Article

Impact of human activities in habitat use and activity patterns of the marine otter (*Lontra felina*) in central Chile

Laura Gutiérrez[1,2], Fernanda Vargas[1,3], Pía Pinto[1,4], Walter Troncoso[1]
Macarena Santos-Carvallo[2] & Maritza Sepúlveda[2,5]
[1]Facultad de Ciencias del Mar y de Recursos Naturales, Universidad de Valparaíso, Reñaca, Chile
[2]Centro de Investigación y Gestión de Recursos Naturales (CIGREN), Instituto de Biología
Facultad de Ciencias, Universidad de Valparaíso, Valparaíso, Chile
[3]Centro de Investigación Marina Quintay, Facultad Ciencias de la Vida
Universidad Andres Bello, Viña del Mar, Chile
[4]Dirección General del Territorio Marítimo y de Marina Mercante (DIRECTEMAR), Valparaíso, Chile
[5]Núcleo Milenio INVASAL, Concepción, Chile
Corresponding author: Laura Gutiérrez (laura.11.gc@gmail.com)

ABSTRACT. The marine otter (*Lontra felina*) inhabits almost the entire coast of Chile. Its population density and its response to several anthropic threats are almost unknown. The objective of this study was to analyze and compare the patterns of habitat use, the frequency of sightings, and behavior of the marine otter in two coastal areas of the Valparaíso Region: Cachagua and Quintay. Twenty simultaneous visits to these localities were made, 10 in summer and 10 in fall. The observation area of each locality was divided into quadrants parallel to the coast to evaluate the marine otter habitat use. We evaluated the number of sightings, the type of behavior (displacement, diving, or feeding) and the duration. The number of sightings was significantly higher in Quintay. There was significantly more displacement in Quintay than in Cachagua during the summer. However, the time spent by the otters in the three behaviors was similar between seasons in Quintay. Moreover, the displacement and diving were less frequent in Cachagua during summer. The results suggest that the marine otter can adapt to changes in the conditions of its surroundings caused by humans.

Keywords: *Lontra felina*; marine otter; habitat; endangered species; anthropic impacts; Chile

INTRODUCTION

Due to the increase of use of coastal areas by humans, the probability of adverse impacts on the fragile coastal ecosystems and the species that inhabit them has increased considerably (Kirkwood *et al*., 2003; Valqui, 2004; Medina-Vogel *et al*., 2008). Notably, for birds and coastal marine mammals, perturbations such as construction, the presence of boats and tourists on the coast may alter the natural behavior of the animals. In many cases they have been driven away from essential habitat areas, interrupting their feeding and breeding cycles, which could produce a decrease in their abundance and reproductive success (*e.g.*, Kovacs & Innes, 1990; Yorio & Boersma, 1992; Cassini, 2001; Stockin *et al*., 2008). Several studies have shown that habitat degradation and fragmentation in coastal areas has accelerated in recent decades (Medina-Vogel *et al*., 2008; Vianna *et al*., 2010; Valqui, 2012). For birds, this has produced an alteration in their feeding and nesting areas (Rodgers & Schwikert, 2002; Davenport & Davenport, 2006), and for marine mammals, it has changed their habitat use (Harwood, 2001; Seuront & Cribb, 2011).

The sea otter *Enhydra lutris* in California, and the marine otter or 'chungungo' *Lontra felina* (Kreuder *et al*., 2003; Medina-Vogel *et al*., 2007) in Chile are among the most vulnerable species to human activites. These two species use rocky tidal shores as habitat with areas for feeding, grooming and establishing dens (Estes *et al*., 1978; Rozzi & Torres-Murra, 1990). Ebensperger & Castilla (1992) indicated that *L. felina*

Corresponding editor: Jorge Urbán

uses the Chilean rocky intertidal zone, which has natural crevices used as dens and feeding areas. The availability of dens appears to be a critical factor in habitat selection and the presence of this species in given sectors (Castilla & Bahamondes, 1979; Castilla, 1982; Cabello, 1983).

Threats to marine otter populations have increased in recent years in Chile, which in turn has increased their isolation (Medina-Vogel *et al*., 2008; Vianna *et al*., 2010; Valqui, 2012). When humans are present, marine otters remain away from their dens during the day; they are observed near fissures and places difficult to access by humans and away from the coast (Badilla & George-Nascimento, 2009). The marine otter, currently classified as endangered by the International Union for the Conservation of Nature (IUCN) (Valqui & Rheingantz, 2015), and the information about this species is still insufficient in Chile. Therefore, it is critical to evaluate how this species is impacted by and how it responds to the continual increase in the use of the coast in Chile.

The Valparaíso Region in the central part of Chile is an important distribution area for *L. felina*. It is also a region with heavy use of the coast, due both to the construction of houses and industries and to the massive influx of tourists, especially in summer months. This impact may be reflected in a) decreased presence of the marine otter (a lower number of sightings), b) changes in its behavior, spending more time in displacement and doing less feeding, and c) differences in habitat use, spending more time away from the coast. In contrast, in areas with less anthropic intervention and/or outside of the summer season more animals are expected to be observed along the coast, with more time dedicated to feeding in sectors near the coast.

The objective of this study is to analyze and compare the patterns of habitat use, sightings and behavior of the marine otter in two coastal areas of the Valparaíso Region, Cachagua and Quintay, which have different characteristics of anthropic activity. We predict, that: 1) the impact of human activities on the coast will negatively affect the presence of marine otters; 2) they will dedicate more time to displacement and less time to feeding in the Cachagua sector (high human presence), especially in summer months; and 3) in Quintay (low human presence) there will not be temporal changes in the number of sightings and/or in the time marine otters allocate to different behaviors.

MATERIAL AND METHODS

Study zone

This study was performed in two localities of the Valparaíso Region: Cachagua (32°35'S, 71°27'W) and Quintay (33°11'S, 71°42'W) (Fig. 1). We made a total of 20 simultaneous visits to these two localities, 10 in summer (January and February 2015) and 10 in fall (May and June 2015). The observation site in Cachagua was situated north of the town, in a rocky area next to a coastal walking road with high tourist flow in summer months, but low tourist flow in fall months. The observation point for Quintay was north of the fishing village; it is a semi-protected rocky zone away from human activities during the entire year (Fig. 1).

Data collection

In each visit, direct observations were made by two researchers separated by a distance of approximately 150 m. Observations took place from 09:00 to 18:00 h. Every five minutes each observer scanned the study area for one minute, using the methodology proposed by Medina-Voguel *et al.* (2006). The observation area was divided into unequal quadrants parallel to the coast (Fig. 1) extending 100 m into the ocean, with a visual cover of approximately 350 m. These quadrants were georeferenced, and we counted the number of sightings in each of them. With this information the habitat use of *L. felina* was evaluated, representing the data using Google Earth satellite images and using the QGIS (version 2.18) program to graph this variable.

A sighting event was recorded every time an animal or a group of animals was seen (Badilla & George-Nascimento, 2009). The time and the quadrant in which the individual or group was located, as well as the behavior and its duration were recorded for each sighting. Different behaviors from a same individual were registered separately. Observed behaviors were assigned to a) feeding, b) diving, and c) displacement, following the criteria used in previous studies (Castilla & Bahamondes, 1979; Badilla & George-Nascimento, 2009; González-Pérez & Cubero-Pardo, 2010) and field experience (Table 1).

Statistical analysis

The variables number of sightings and time in each behavior were analyzed. The number of sightings was analyzed independently for localities and seasons, using 2×2 contingency tables. The three behaviors were analyzed independently for localities and seasons, using factorial ANOVA or the Kruskal-Wallis test, depending upon whether the data did or did not fulfill the parametric assumptions of normality and homoscedasticity (Zar, 1996). The duration of each behavior was standardized using the number of sightings in each locality. Statistical analyses were performed with Statistica 7 (StatSoft, Inc., 2004), considering $P < 0.05$ as significant.

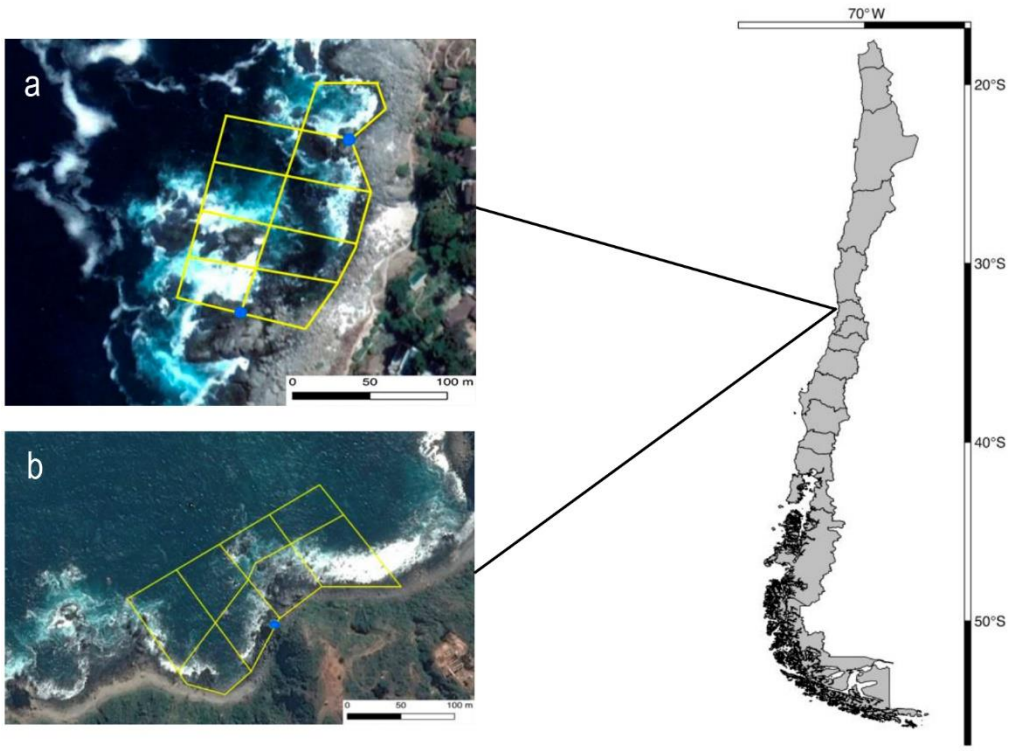

Figure 1. Geographic location of a) Cachagua and b) Quintay study sites in the Valparaíso Region, central zone of Chile. Yellow lines indicate the quadrants, and the blue circles the observation points.

Table 1. Description of the behaviors of *Lontra felina* observed in the field.

Behavior	Description
Displacement	The animal maintains a constant direction to move from one place to another on land or in the water, with constant immersions.
Diving	Prolonged immersions that begin after the animal lifts its tail to the surface.
Feeding	Animal ingests different organisms such as crustaceans, fish and mollusks, both on the ocean surface and on rocky shore.

RESULTS

A total of 471 sightings, 164 in Cachagua and 307 in Quintay were registered. The number of sightings was significantly higher in Quintay ($\chi^2 = 86.8$, $P < 0.0001$). Contrary to expectation, the number of sightings was significantly higher in fall for Quintay ($\chi^2 = 18.3$, $P < 0.0001$), and in summer for Cachagua ($\chi^2 = 35.6$, $P < 0.0001$) (Fig. 2).

There were significant differences in behavior for each locality. There was significantly more displacement in Quintay during summer but this difference was not significantly during fall, and significantly more diving in Quintay in both seasons (Tables 2).

No significant differences were found in feeding behavior between seasons or localities (Table 2). The time spent by the animals in these three behaviors was

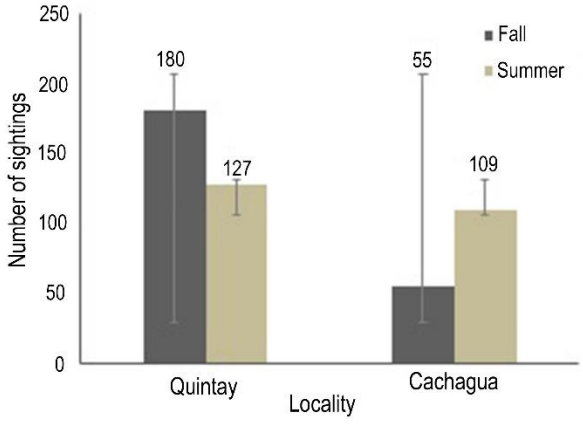

Figure 2. Number of sightings of *Lontra felina* during summer and fall in Cachagua and Quintay, Valparaíso Region, central zone of Chile. Bars indicate standard deviations.

Table 2. Comparison of the time recorded for the three behaviors in Cachagua and Quintay of *Lontra felina* in different seasons.

Behavior	Summer		Fall	
	χ^2	*P*	χ^2	*P*
Displacement	13.33	0.0003	0.44	0.50
Diving	4.86	0.02	5.93	0.01
Feeding	0.03	0.85	0.76	0.38

Table 3. Duration of the behaviors of *Lontra felina* in the studied localities and seasons.

Locality	Season	Displacement (s)	Diving (s)	Feeding (s)
Quintay	Summer	9,711	1,810	1,330
	Fall	13,035	7,339	2,337
Cachagua	Summer	2,772	777	1,732
	Fall	5,778	1,041	577

similar between seasons in Quintay, while in Cachagua they dedicated significantly more time to displacement and diving in fall (Table 3).

Marine otters did not use all the quadrants equally. In Cachagua, more marine otters were seen in quadrant G in summer (17%), and in quadrant E in fall (16.4%) (Fig. 3), while in Quintay there were more sightings in quadrant F both in summer (31.5%) and fall (48.9%) (Fig. 4).

DISCUSSION

This study provides new information on the relative abundance and behavior of *L. felina* in the central area of Chile. Its relevance resides in the fact that the marine otter is one of the marine mammals with the greatest conservation problems both in Chile and in the world (Valqui & Rheingantz, 2015). This study is an addition to other Chilean studies on the distribution and abundance of this species (Cabello, 1983; Rozzi & Torres-Mura, 1990; Sielfeld & Castilla, 1999), particularly in a region poorly evaluated. It also adds to studies of the marine otter's characteristics and habitat selection (Sielfeld, 1990; Ebensperger & Castilla, 1992; Medina-Vogel *et al*., 2006, 2007), and behavior and diet (Castilla & Bahamondes, 1979; Castilla, 1982; Ostfeld *et al*., 1989; Sielfeld, 1990; Ebensperger & Castilla, 1992; Medina, 1995; Villegas *et al*., 2007; Badilla & George-Nascimento, 2009; Córdova *et al*., 2009; Mangel *et al*., 2011; Córdova & Rau, 2016).

As expected, the results showed a significantly higher number of sightings in Quintay. *Lontra. felina* uses areas with strong wave exposure (Sielfeld, 1990; Sielfeld & Castilla, 1999), such as in Cachagua. However, its distribution does not appear to be exclusively restricted to exposed zones. They can also use more restricted areas (Delgado-Rodríguez *et al*., 2006) such as Quintay, which has beneficial conditions for chungungo permanence.

Contrary to our prediction, there were differences in the number of sightings between seasons in Quintay, with the number of sightings increasing during fall. Based on field observations, this may be related to the presence of offspring in the area, who are in a learning process and leave the dens more frequently in this season, which in turn increases the number of sightings. It is important to note that other environmental and/or anthropogenic factors may affect marine otter populations, such as the size of waves and the number of tourists (Barbosa *et al*., 2001). However these factors were not considered in this study.

Also contrary to our expectation, the number of sightings between seasons was different in Cachagua, with more sightings in summer. *Lontra. felina* spends more than 80% of the day hidden in caves, preferably within or near its burrow. Thus the number of individuals may be underestimated (Medina-Voguel *et al*., 2006, 2007). However, one consequence of the increase in the number of tourists is the presence of domestic animals, including rats, that may disturb their dens (Apaza *et al*., 2003; Medina-Vogel *et al*., 2008; Vianna *et al*., 2010; Mangel *et al*., 2011), making the otters more visible when they leave their hiding places. It should be mentioned that the study area is in front of Cachagua Island National Monument (between Bahía de Quintero and Cachagua), which has the highest density of chungungos in the area (Figueroa *et al*., 2016). This island is administered by the National Forestry Corporation (CONAF), which prohibits the presence of people on the island. Along with its topography, this makes it an ideal place for the animals to stay when animals are bothered by the tourists, a condition that may account for the increased number of sightings (CONAF, 2017).

There was more displacement in Quintay than in Cachagua during summer. This could be related to the location of the feeding areas in both sectors. Field observations indicated that most displacements in Quintay appeared to be in quadrants away from the coast in search of food (Fig. 4, quadrant C-D), whereas the feeding zones in Cachagua are closer to the coast (Fig. 4, quadrant E-G). There were frequent observations of adults returning to their burrows from feeding zones with prey in their mouths, which is coincident with the fact that adults were recorded together with their offspring in both seasons in Quintay.

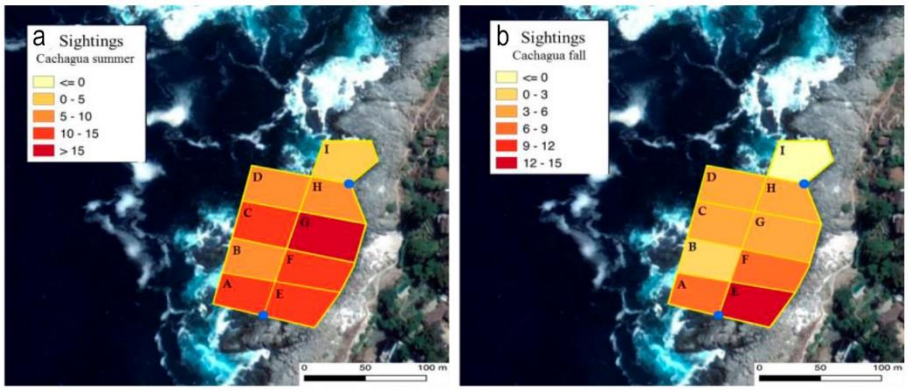

Figure 3. Proportion of sightings of *Lontra felina* in the different quadrants of observation in Cachagua. The colors indicate the spaces most used by the animals in a) summer and b) fall.

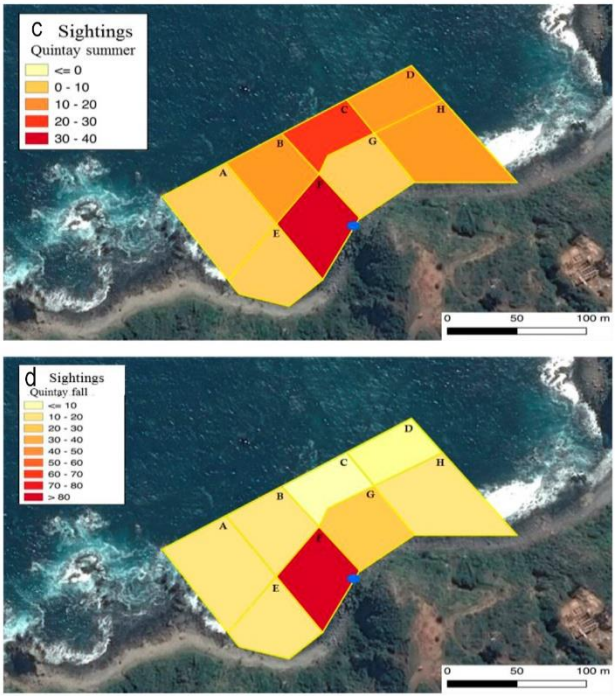

Figure 4. Proportion of sightings of *Lontra felina* in the different quadrants of observation in Quintay. The colors indicate the spaces most used by the otters in c) summer and d) fall.

More time spent of diving was recorded in Quintay than in Cachagua, in both seasons. The lesser time devoted to diving in Cachagua is consistent with the report of Villegas *et al*. (2007) who observed that, in an exposed environment, the duration of the dives was smaller compared to areas with greater protection, as is the case of Quintay. The explanation is that the energy cost of searching for food may be lower, which would allow the animals to spend more time submerged (Houston & Carbone, 1992). In Cachagua, differences in the duration of displacement and diving between seasons were recorded, both being shorter during summer. As mentioned above, this may be due to the vicinity of the Cachagua Island, which may be a feeding and refuge area for the chungungos, especially during summer when there are many people in the coastal areas of the mainland.

Habitat use by *L. felina* was selective. The quadrants most used by chungungos in Cachagua were G in summer and E in fall. Both quadrants are shallow areas near the coast, mostly used to search for food and to move to the crevices in the adjacent rocky areas. The change in habitat use between seasons may be related to food availability in the two quadrants, described as a factor that modifies habitat use (Lodé, 1994). Also, quadrant G is hard for people to access, which prevents it from being disturbed by human presence. The quadrant F was the most used by the chungungos in both seasons in Quintay. Offspring were observed there during the entire study, which would explain the preferential use of this sector by adults.

Although further study is required, the results reported here suggest that the chungungo can adapt to changes in its habitat (Valqui, 2012). While recognizing that indirect and cumulative impacts, caused by humans, are probably affecting this species (Delgado-Rodríguez *et al*., 2006; Medina-Vogel, *et al*. 2007), this study suggests that *L. felina* can maintain its behaviors because it is able to change its efforts as a response to disturbances (Cursach *et al*., 2012; Briones-Salas *et al*., 2013), despite the constant pressure made by humans in the areas where sea otters live (Medina-Vogel, *et al*., 2004, 2007, 2008).

ACKNOWLEDGMENTS

We thank Andrea Colilef, Melissa Rebolledo, Valentina Bernal, Vania Carrera, Constanza Páez,

Jaime Sepúlveda and Karina Zúñiga for their help in collecting field data. This study was part of the project entitled “Evaluation of the impact of tourist activity in populations of the chungungo (*Lontra felina*) in the central area of Chile," financed by the fund “Los Estudiantes Primero: Hacia una mayor eficacia y eficiencia curricular del pregrado en la UV, UVA1315”. M. Sepúlveda acknowledges Núcleo Milenio INVASAL, funded by Iniciativa Científica Milenio from Chile's Ministerio de Economía, Fomento y Turismo. We would also like to give special thanks to our families for their continuous support during this study.

REFERENCES

Apaza, M., Valqui, J. & Castañeda, C. 2003. Estado de conservación de *Spheniscus humboldtii* y *Lontra felina* en la costa norte del Perú. Instituto Nacional de Recursos Naturales (INRENA), Lima, 24 pp.

Badilla, M. & George-Nascimento, M. 2009. Conducta diurna del chungungo *Lontra felina* (Molina, 1782) en dos localidades de la costa de Talcahuano, Chile: ¿Efectos de la exposición al oleaje y de las actividades humanas? Revista de Biología Marina y Oceanografía, 44(2): 409-415.

Barbosa, A.M., Real, R., Márquez, A.L. & Ángel Rendon, M.A. 2001. Spatial, environmental and human influences on the distribution of otter (*Lutra lutra*) in the Spanish provinces. Diversity and Distributions, 7: 137-144.

Briones-Salas, M., Peralta-Pérez, M. & Arellanes, E. 2013. Análisis temporal de los hábitos alimentarios de la nutria neotropical (*Lontra longicaudis*) en el rio Zimatán en la costa de Oaxaca, México. Therya, 4(2): 13-138.

Cabello, C. 1983. La nutria de mar en la Isla de Chiloé. Corporación Nacional Forestal (CONAF), Boletín Técnico, 6: 1-37.

Cassini, M. 2001. Behavioral responses of South American fur seals to approach by tourists - a brief report. Applied Animal Behaviour Science, 71: 341-346.

Castilla, J. 1982. Nuevas observaciones sobre conducta, ecología y densidad de *Lutra felina* (Molina, 1782) (Carnivora, Mustelidae) en Chile. Museo Nacional de Historia Natural, Publicación Ocasional, 38: 197-206.

Castilla, J.C. & Bahamondes, I. 1979. Observaciones conductuales y ecológicas sobre *Lutra felina* (Molina, 1782) (Carnivora, Mustelidae) en la zona central y centro-norte de Chile. Archivos de Biología y Medicina Experimentales, 112: 119-132.

Corporación Nacional Forestal (CONAF). 2017. Monumento Natural Isla de Cachagua. [http://www.conaf.cl/parques/monumento-natural-isla-cachagua/]. Reviewed: 20 May 2018.

Córdova, O., Rau, J.R., Suazo, C.G. & Arriagada, A. 2009. Estudio comparativo de la ecología alimentaria del depredador de alto nivel trófico *Lontra felina* (Molina, 1782) (Carnivora: Mustelidae) en Chile. Revista de Biología Marina y Oceanografía, 44: 429-438.

Córdova, O. & Rau, J. 2016. Interacción entre la pesca artesanal y el depredador de alto nivel trófico *Lontra felina* en Chile. Revista de Biología Marina y Oceanografía, 51(3): 621-627.

Cursach, J., Rau, J., Ther, F., Vilugrón, J. & Tobar, C. 2012. Sinantropía y conservación marina: el caso del chungungo *Lontra felina* en el sur de Chile. Revista de Biología Marina y Oceanografía, 47(3): 593-597.

Davenport, J. & Davenport, J.L. 2006. The impact of tourism and personal leisure transport on coastal environments: a review. Estuarine, Coastal and Shelf Science, 67: 280-292.

Delgado-Rodríguez, C., Álvarez, R. & Pfeifer, A.M. 2006. Assessment of the population density and conservation status of sea cat (*Lontra felina*) in the 10th region of southern Chile. [http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=9F15FD5C53012084C51F950BE3-B8247A?doi=10.1.1.475.2513&rep=rep1&type=pdf]. Reviewed: 10 March 2018.

Ebensperger, L. & Castilla, J.C. 1992. Selección de hábitat en tierra por la nutria marina, *Lutra felina*, en Isla Pan de Azúcar, Chile. Revista Chilena de Historia Natural, 65: 429-434.

Estes, J.A., Smith, N.S. & Palmisano, J.F. 1978. Sea otter predation and community organization in the western Aleutian Islands, Alaska. Ecology, 59(4): 822-833.

González-Pérez, F. & Cuber-Pardo, P. 2010. Efecto de actividades turísticas sobre el comportamiento de fauna representativa de las Islas Galápagos, Ecuador. Latin American Journal of Aquatic Research, 38(3): 493-500.

Harwood, J. 2001. Marine mammals and their environment in the twenty-first century. Journal of Mammalogy, 82: 630-640.

Houston, A.I. & Carbone, C. 1992. The optimal allocation of time during the diving cycle. Behavioral Ecology, 3: 255-265.

Figueroa, L., Oliva, D. & Durán, R. 2016. Monitoreo de mamíferos marinos y aves. En: Instituto de Fomento Pesquero (IFOP) (Ed.). Determinación de los impactos en los recursos hidrobiológicos y en los ecosistemas marinos presentes en el área de influencia del derrame de hidrocarburo de Bahía Quintero, V Región Valparaíso, pp. 339-420.

Kirkwood, T., Boys, R., Gillespie, C., Proctor, C., Shanley, D. & Wilkinson, D. 2003. Towards an e-

biology of aging: integrating theory and data. Nature Reviews Molecular Cell Biology, 4: 243-249.

Kovacs, K. & Innes, S. 1990. The impact of tourism on harp seals (*Phoca groenlandica*) in the Gulf of St. Lawrence, Canada. Applied Animal Behaviour Science, 26: 15-26.

Kreuder, C., Miller, M.A., Jessup, D.A., Lowenstine, L.J., Harris, M.D., Ames, J.A., Carpenter, T.E., Conrad, P.A., & Mazet, J.A. 2003. Patterns of mortality in southern sea otters (*Enhydra lutris nereis*) from 1998-2001. Journal of Wildlife Diseases, 39(3): 495-509.

Lodé, T. 1994. Environmental factors influencing habitat exploitation by the polecat *Mustela putorius* in western France. Journal of Zoology, 234: 75-88.

Mangel, J, Whitty, T., Medina-Vogel, G., Alfaro-Shigueto, J., Cáceres, C. & Godley, B. 2011. Latitudinal variation in diet and patterns of human interaction in the marine otter. Marine Mammal Science, 27(2): 14-25.

Medina, G. 1995. Feeding habits of marine otter (*Lutra felina*) in southern Chile. Proceedings of the International Otter Colloquium, 6: 65-68.

Medina-Vogel, G., Rodriguez, C.D., Alvarez, R.E. & Bartheld, J.L. 2004. Feeding ecology of the marine otter (*Lutra felina*) in a rocky seashore of the south of Chile. Marine Mammal Science, 20(1): 134-144.

Medina-Vogel, G., Bartheld, J.L., Alvarez-Pacheco, R. & Delgado-Rodríguez, C. 2006. Population assessment and habitat use by marine otter *Lontra felina* in southern Chile. Wildlife Biology, 12: 191-199.

Medina-Vogel, G., Boher, F., Flores, G., Santibáñez, A. & Soto-Azat, C. 2007. Spacing behavior of marine otters (*Lontra felina*) in relation to land refuges and fishery waste in central Chile. Journal of Mammalogy, 88: 487-494.

Medina-Vogel, G., Merino, L., Monsalve, R. & Vianna, J. 2008. Coastal-marine discontinuities, critical patch size and isolation: implications for marine otter conservation. Animal Conservation, 11: 57-64.

Ostfeld, R.S., Ebensperger, L., Klosterman, L.L. & Castilla, J.C. 1989. Foraging, activity budget and social behaviour of the South American marine otter *Lutra felina* (Molina, 1782). National Geographic Research, 5(4): 422-438.

Rodgers, J. & Schiwikert, S. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology, 16: 216-224.

Rozzi, R. & Torres-Murra, J. 1990. Observaciones del chungungo (*Lutra felina*) al sur de la isla grande de Chiloé: antecedentes para su conservación. Medio Ambiente, 11: 24-28.

Sielfeld, W. 1990. Características del hábitat de *Lutra felina* (Molina) y *L. provocax* (Thomas) (Carnivora: Mustelidae) en Fuego-Patagonia. Revista de Investigaciones Científicas y Tecnológicas, Serie Ciencias del Mar, 1: 30-36.

Sielfeld, W. & Castilla, J.C. 1999. Estado de conservación y conocimiento de las nutrias en Chile. Estudios Oceanológicos, 18: 69-79.

Seuront, L. & Cribb, N. 2011. Fractal analysis reveals pernicious stress levels related to boat presence and type in the Indo-Pacific bottlenose dolphin, *Tursiops aduncus*. Physica A: Statistical Mechanics and its Applications, 390: 2333-2339.

StatSoft, Inc. 2004. Statistica (data analysis software system), version 7. [http://www.statsoft.com]. 15 January 2018.

Stockin, K., Lusseau, D., Binedell, V., Wiseman, N. & Orams, M. 2008. Tourism affects the behavioral budget of the common dolphin *Delphinus* sp. in the Hauraki Gulf, New Zealand. Marine Ecology Progress Series, 355: 287-295.

Valqui, J. 2004. Comportamiento de la nutria marina *Lontra felina* (Molina 1782) en un ambiente antrópico, la bahía de Pucusana, Lima, Perú. Tesis para optar el título de Biólogo, Universidad Nacional Agraria La Molina, Lima, 58 pp.

Valqui, J. 2012. The marine otter *Lontra felina* (Molina, 1782): A review of its present status and implications for future conservation. Mammalian Biology, 77(2): 75-83.

Valqui, J. & Rheingantz, M.L. 2015. *Lontra felina*. The IUCN Red List of Threatened Species 2015. [http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T12303A21937779.en]. Reviewed: 4 January 2018.

Vianna, J., Ayerdi, P., Medina-Vogel, G., Mangel, J., Zeballos, H., Apaza, M. & Faugeron, S. 2010. Phylogeography of the marine otter (*Lontra felina*): Historical and contemporary factors determining its distribution. Journal of Heredity, 101(6): 676-689.

Villegas, M.J., Aron, A. & Ebensperger, L.A. 2007. The influence of wave exposure on the foraging activity of marine otter, *Lontra felina* (Molina, 1782) (Carnivora: Mustelidae) in northern Chile. Journal of Ethology, 25: 281-286.

Yorio, P. & Boersma, P. 1992. The effects of human disturbance on Magellanic Penguin *Spheniscus magellanicus*. Bird Conservation International, 2: 161-173.

Zar, J. 1996. Biostatistical analysis. Prentice-Hall International, New York.

Received: 24 May 2018; Accepted: 29 August 2018