Supplementary Material

Could *Lontra longicaudis* be considered a flagship species of the southern Yucatan Peninsula? Perspectives on its distribution, ecology, and conservation

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Table S1. Communities and natural protected areas of the study area.

Country, waterbody	Community/ Protected area	Code	Area
Mexico (MX) Río Hondo (RH)	Subteniente López	SL	Lower area
	Huay Pix	HP	Middle area
	Juan Sarabia	JS	Middle area
	Ucum	UC	Middle area
	Sacxán	SX	Middle area
	Palmar	PM	Middle area
	Ramonal	RM	Middle area
	Pucté	PT	Middle area
	Allende	AL	Middle area
	Sabidos	SA	Middle area

	Obregón Viejo	OV	Middle area
	Cacao	CC	Middle area
	Cocoyol	CY	Middle area
	San Francisco Botes	SB	Middle area
	Revolución	RV	Middle area
	Calderón	CA	Middle area
	La Unión	LU	Upper area
	Pioneros	PI	Upper area
	Justo Sierra Méndez	JSM	Upper area
	Arroyo Negro	AN	Upper area
Guatemala (GT) Río Hondo (RH)	Mirador Río Azul National Park	MRANP	Upper area
	Biotopo Protegido Naachtún Dos Lagunas	BPNDL	Upper area
Mexico (MX) Laguna Bacalar (LB)	Xul-Ha	XH	South Zone
	Bacalar	BA	Central Zone
	La Península	LP	North Zone
	Buenavista	BV	North Zone
	Pedro Antonio Santos	PAS	North Zone

Mexico (MX) Laguna Guerrero (LG)	Laguna Guerrero	LG	Lagoon
	Raudales	RA	Lagoon
	Luis Echeverría	LE	Savannah

Table S2. Category of variables corresponding to the characteristics of the interviewees. Asterisks (*) indicate variables used in statistical analyses.

Variables	Categories
Age (class)	C1: 18-39 years
	C2: 40-61 years
	C3: 61-81 years
Schooling level*	None
	Elementary
	Middle School
	High School
	College
	Postgraduate
Livelihoods	Sugarcane harvester
	Tourism services
	Technician
	Park ranger
	Boaters
	Fishers

	Housewife
	Others
Activity in the water body*	Fishing
	Tourism services
	Technical activities
	Control and surveillance
	Cattle raising
	Recreation

Table S3. Glossary of terms for Neotropical otter behaviors, threats, and human-otter interactions perceived by the interviewees.

Behavior	Description
Swimming	Locomotion behavior, the individual can be observed totally submerged into the water or diving, in places with transparent waters. When diving, the otter puts its head in the water first and propels itself with its hind legs to fully submerge. It can also be observed superficially submerged in shallow water, that is, with the body and tail submerged and the head slightly out of the water (Medina-Barrios and Morales-Betancourt, 2019).
Hunting	The individual swims totally or superficially in the water chasing its prey, generally fishes. During this behavior, the individual may dive for intervals and return to the surface to breathe.
Feeding/Eating	Maintenance activity, the otter handles and holds its prey (e. g. fishes, crustaceans, mollusks) with the forelegs superficially in the water or on land. The otter tears its prey by biting with its canines, then chews with its molars before swallowing.
Taking refuge/Hiding	It is considered a posture and behavior of terrestrial locomotion. The individual hides among the grasses on the shore. Also, among the roots of mangroves that are submerged in shallow waters.

Resting	Comfort activity that consists of the individual lying on his side with the limbs flexed, the ventral surface and the tail resting on the ground, rock, trunk, or dock.

Threats	**Description**
Predation	Otters are potential prey for jaguars, crocodiles, and large snakes (Duplaix, 1978; Larivière, 1999).
Habitat perturbation	Changes in land use around waterbodies and the manipulation of water flows due to the construction of reservoirs or to irrigate extensive crops. These activities can cause soil erosion on the banks, a decrease in the level and water quality, which can affect the presence of otters and other species of the aquatic ecosystem (Gallo-Reynoso and Meiners, 2018).
Water pollution	The presence of heavy metals derived from industrial waste contaminates the water bodies where otters are present. Heavy metals in the water are associated with the mortality of the Neotropical otter (Gallo-Reynoso, 1997).
Hunting	In Mexico, otters were intensively hunted for their fur trade between 1530 and 1821. In other countries, intensive hunting of otters occurred between 1940-1970, until it became occasional. Hunting was internationally prohibited in 1975, since the species was included in CITES Appendix I. Currently, the species is protected, according to national and international laws (Gallo-Reynoso, 1997; Larivière, 1999; GOB, 2000; DCA, 2021).

Killing due to competition/ Competition	The illegal hunting of otters is also motivated by the conflicts it has caused with fishers, due to the supposed competition for fishing resources and the damage that otters cause to fishing gear (Rheingantz et al. 2017).
Killing due to fear/Fear	In this study we define it as the injuries or death that people cause to otters out of caution or fear of being attacked by them.
Presence of fishing nets	It refers to the incidental death of otters when they become entangled in fishing nets (Rheingantz et al. 2017).

Interactions	**Description**
Human-otter interactions	Direct or indirect interactions that otters have with humans when they coincide in the same place. Some examples of interactions are mentioned below: “It [the otter] snatches the fish from my hook when I’m fishing.” (INT02-MX-CC). “The otter steals the fish from my nets, but it also has the right to eat.” (INT04-MX-CC).

“Otters break my nets when stealing my fish, but the crocodile does it too.” (INT01-MX-OV).

“Once I found the fish bitten in my nets, but I didn’t know if it was the otter or the crocodile.” (INT02-MX-PT).

“The otter has stolen one or two fish from me, but it doesn’t affect me because these events are rare. I find it kind of funny.” (INT01-MX-SX).

“People have complained that otters steal fish in El Remate [a town near the Petén Itzá Lake]. They have even killed them there for that.” (INT-01-GT-PNMRA).

“A neighbor of San Miguel [a town near the Petén Itzá Lake] complained because the otter ate his chickens.” (INT-06-GT-PNMRA).

Table S4. Code book on perceived values for the species. Values terms were modified from De Alba y Reyes (1998).

Values	Description	Example
Direct use value – non-extractive		
Economic	In this case it is attributed to ecotourism activities. People perceive an economic incentive to offer a tourism service taking advantage of the aquatic ecosystem and the appreciation of the species.	"They [the otters] are an attraction for tourism, it is curious to see them." (INT01-MX-RH-HP)
Indirect use value – Functional benefits		
Ecological	It is attributed to the environmental services that people receive through the ecosystem or the function of the species.	"The otters eat the fish that are sick, they clean the population." (INT05-MX-BL-BA)
Non-use value		
Inheritance	Also called legacy value. Corresponds to the value of inherits the benefits of some resource to the descendants. This value implies a sense of belonging.	“It [the otter] is important that it be preserved for the new generations.” (INT02-MX-BL-PAS)

Existence	Corresponds to the value that is given to an environmental good because it exists. Generally, it has aesthetic, cultural, and religious implications. This value does not imply possession or direct or indirect use of the environmental good.	“They [the otters] are living beings, they are from the water, and they must live in the water” (INT01-MX-RH-SB)

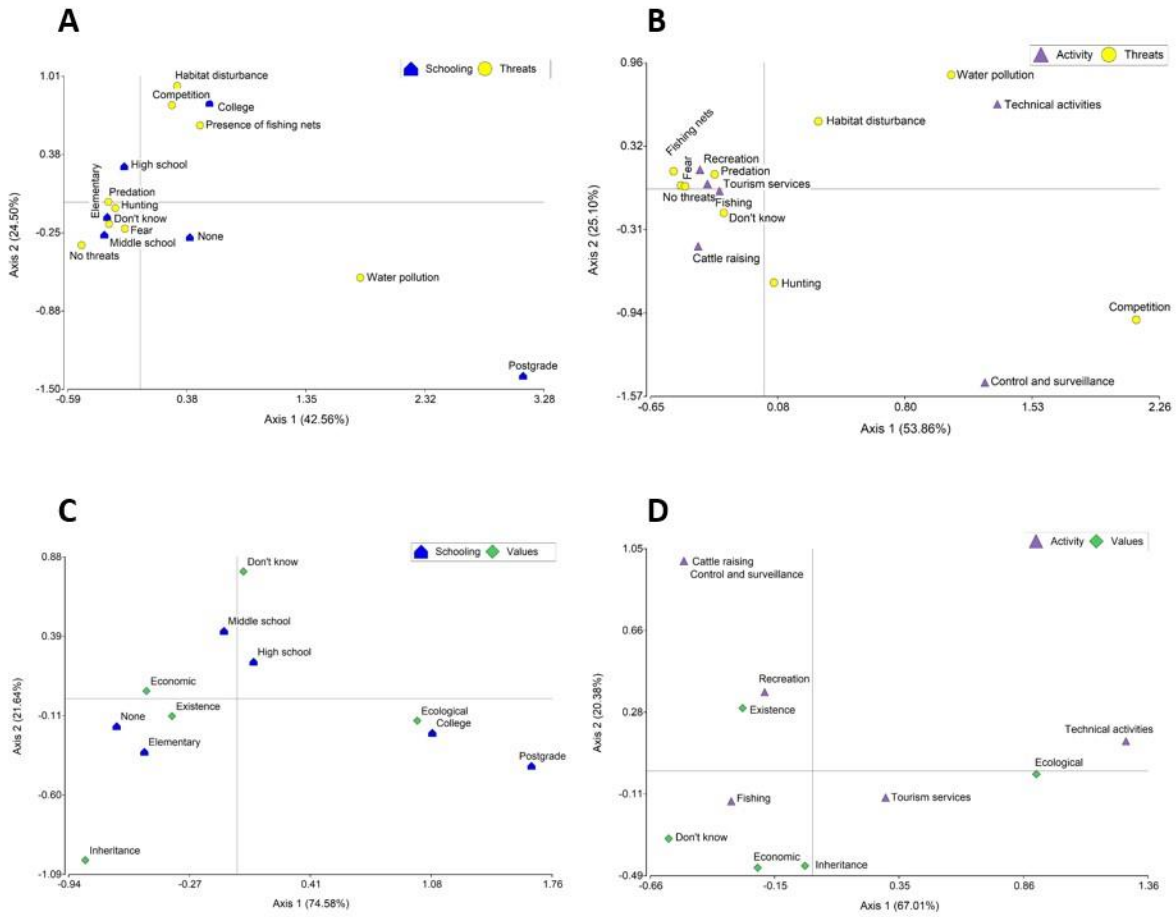

Fig. S1. Correspondence analysis of the threat and value of otter related with the schooling level and the activities of the interviewees. A) Threats and the schooling level, B) Activity of the interviewees and the schooling level, C) Values of the species and the schooling level, and D) Activity and the water body.

Table S5. Presence of fish species and other groups of fauna and flora mentioned by interviewees in the study area. Species name with an asterisk are part of the Neotropical otter's diet in the water bodies, and double asterisks mean that the species is part of the Neotropical otter's diet in the Maya Biosphere Reserve according to the interviewees. Number in parentheses corresponds to the number of times mentioned. MRANP = Mirador Río Azul National Park; BPNDL = Biotopo Protegido Naachtún-Dos Lagunas. ? = Unidentified species.

Common name (in Spanish)	Scientific name	Río Hondo	Laguna Bacalar	Laguna Guerrero	MRA NP	BPN DL
	Order / Family					
	Perciformes					
	Cichlidae					
Bocona, blanco, Petén espléndido, tenguayaca*	*Petenia splendida*	X (38)	X (7)	X (4)	X	X (9)
Tilapia*	*Oreochromis niloticus*	X (24)	X (4)	X	X	X (3)
Tilapia*	*O. mossambicus*	X (24)	X (4)	X		
Mojarra colorada, rayada, bull*	*Mayaheros urophthalmus*	X (19)	X (8)	X (4)		X
Mojarra chetumaleña*	*Cryptoheros chetumalensis*	X (22)	X (10)	X (2)	X	X (7)

Mojarra tigre, guapote*	*Parachromis multifasciatus*	X	X		X	X (3)
Mojarra negra, mojarra paleta, mojarra cueruda, mojarra copetona*	*Vieja melanurus*	X (2)	X	X (3)	X	X
Gerreidae						
Mojarra blanca, guacha*	*Diapterus auratus*	X (2)	X	X		X
Mojarra bandera*	*Eucinostomus melanopterus*	X (2)	X	X		
Mojarra española*	*Eucinostomus gula*		X (2)	X		
Chihua, chabelita*	*Eugerres plumieri*	X (11)		X (4)		
Eleotridae						
Dormilón, naca	*Dormitator maculatus*	X (6)	X (3)			
Guavina	*Gobiomorus dormitor*	X (4)			X	
Haemulidae						

Chac chi	*Haemulon plumierii*			X (2)	X
	Lutjanidae				
Pargo mulato	*Lutjanus griseus*	X		X (3)	
	Carangidae				
Jurel	*Caranx latus, C. hippos*	X (21)	X	X (5)	
	Centropomidae				
Robalo	*Centropomus undecimalis*	X (13)	X		
	Sphyraenidae				
Barracuda	*Sphyraena barracuda*	X	X	X	
	Siluriformes				
	Ictaluridae				
Vaca, bagre azul del sureste*	*Ictalurus meridionalis*	X (13)			X

Ariidae						
Banderudo	*Bagre marinus*	X (2)	X	X		
Heptapteridae						
Filín, juil, jolote, bagre, pez gato*	*Rhamdia guatemalensis*	X (3)			X	X (4)
Loricariidae						
Pez diablo*	*Pterygoplichthys pardalis*	X (3)			X	
Scombriformes						
Scombridae						
Sierra	*Scomberomorus maculatus, S. regalis*			X (3)		
Elopiformes						
Megalopidae						

Sábalo	*Megalops atlanticus*	X (16)	X (7)	X (4)		
Cyprinodontiformes						
Poeciliidae						
Pez topo	*Phallichthys fairweatheri*	X				
Picudito, pija de padre	*Belonesox belizanus*	X	X	X (4)	X	
Aletón	*Poecilia petenensis*				X	X
Topote lacandón	*Poecilia kykesis*	X	X			
Bute, pupo, topote del Atlántico	*Poecilia mexicana*	X	X		X	X (2)
Clupeiformes						
Engraulidae						
Boquerón, anchoa	*Anchoa parva*		X	X		
Clupeidae						

Sardina maya*	*Dorosoma petenense*	X (4)	X (3)	X	X	X
Albuliformes						
Albulidae						
Macabi	*Albula vulpes*			X		
Atheriniformes						
Atherinopsidae						
Charal, plateadito	*Atherinella* sp.	X	X			
Atherinidae						
Tinícalo cabezón	*Atherinomorus stipes*		X	X		
Beloniformes						
Belonidae						
Pez aguja	*Strongylura notata*	X (2)	X (3)			

Synbranchiformes						
Synbranchidae						
Anguila de lodo*	*Ophisternon aenigmaticum*	X	X (2)		X	
Lepisosteiformes						
Lepisosteidae						
Pejelagarto	*Atractosteus tropicus*				X	X (3)
Characiformes						
Characidae						
Pepesca	*Astyanax aeneus*					X
Sardinita de Bacalar*	*Astyanax bacalarensis*	X	X			
Myliobatiformes						
Dasyatidae						

Raya	*Hypanus guttatus*			X
Raya	?		X	
	Decapoda			
	Portunidae			
Jaiba*	*Callinectes sapidus*	X (2)	X	X
	Architaenioglossa			
	Ampullariidae			
Chivita*	*Pomacea flagellata*	X (5)	X (2)	
	Testudines			
	Dermatemydidae			
Tortuga blanca*, **	*Dermatemys mawii*	X		
	Crocodylia			

Crocodylidae		
Cocodrilo (hatchlings)**	*Crocodylus moreletii*	
Suliformes		
Phalacrocoracidae		
Cormorán**	*Phalacrocorax brasilianus*	
Anseriformes		
Anatidae		
Pato doméstico*, **	*Cairina moschata domestica*	X
Galliformes		
Phasianidae		
Gallina doméstica**	*Gallus gallus domesticus*	
Rodentia		

Cuniculidae						
Paca, tepezcuintle**	*Cuniculus paca*					
Crassiclitellata						
Lumbricidae						
Lombriz*	*Lumbricus terrestris*	X				
Malpighiales						
Rhizophoraceae						
Mangle*	*Rhizophora mangle*	X (2)				
Poales						
Cyperaceae						
Cortadera, zacate*	*Cladium jamaicense*		X			
Total species mentioned		**36**	**30**	**24**	**15**	**14**

Table S6. Statements on human-otter interaction and potential conflicts used for the Likert weighting method (n = number of answers). Likert weight: 1 = Completely disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Totally agree. Modified from Dias (2016).

Statements	1	2	3	4	5
1. The Neotropical otter is an animal that has brought problems to the inhabitants of the area	n = 82	n = 2	n = 5	n = 1	n = 0
2. The Neotropical otter must be conserved here because it is part of the area	n = 0	n = 0	n = 3	n = 3	n = 84
3. People should not treat the otter badly, as it is a characteristic animal of the area	n = 1	n = 0	n = 4	n = 2	n = 83
4. The Neotropical otter is an attractive animal for people	n = 3	n = 1	n = 21	n = 14	n = 51
5. The Neotropical otter must be protected by the government or municipality to prevent it from disappearing	n = 0	n = 1	n = 4	n = 5	n = 80
6. Although if otters bother people, otters should not be mistreated	n = 0	n = 0	n = 5	n = 7	n = 78
7. People don’t like otters	n = 38	n = 5	n = 34	n = 11	n = 2

References

Alba, E., Reyes, M.E., 1998. Valoración económica de los recursos biológicos del país, in: Conabio, (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad) (Eds.), La diversidad biológica de México: Estudio de País, 1998. Conabio, pp. 212-234.

DCA, (Diario de Centro América), 2021. Consejo Nacional de Áreas Protegidas. Resolución 04-09-2021 sobre la Actualización de la Lista de Especies Amenazadas en Guatemala.

Dias, A.S.V., 2016. The Neotropical otter in southeast Brazil: a socioecological approach. Universidade de Lisboa.

Duplaix, N., 1980. Observations on the ecology and behavior of the giant river otter *Pteronura brasiliensis* in Suriname. Rev. d'Ecologie, Terre Vie 34, 495–620.

Gallo-Reynoso, J.P., 1997. Situación y distribución de las nutrias en México, con énfasis en *Lontra longicaudis annectens* Major, 1897. Rev Mex Mastozoología 2, 10–32.

Gallo-Reynoso, J.P., Meiners, M., 2018. Las nutrias de río de México. Biodiversitas 2–7.

GOB, (Government of Belize), 2000. Wildlife Protection Act. Chapter 220. Belmopan, Belize, 15 p.

Larivière, S., 1999. *Lontra longicaudis*. Mamm. Species 1–5.

Medina-Barrios, O., Morales-Betancourt, D., 2019. Notes on the behaviour of Neotropical river otter (*Lontra longicaudis*) in Palomino River (La Guajira, Colombia). IUCN Otter Spec. Group Bull. 36(1): 34-47.

Rheingantz, M., Santiago-Plata, V.M., Trinca, C.S., 2017. The Neotropical otter *Lontra longicaudis*: a comprehensive update on the current knowledge and conservation status of this semiaquatic carnivore. Mamm. Rev. 47, 291–305.