

Massive sea lion and fur seal hunting in the Patagonian coasts is altering Southern Atlantic Ocean ecosystems

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Sea lions and fur seals are now apex predators, that is, superpredators. Credit: Massimiliano Drago, UB-IRBio

Sea lion hunting by the Europeans at the Atlantic coasts of South America started in the 19th Century and continued up to the second half



of the 20th century in Argentina and Uruguay. The practice changed nutrition guidelines of these pinnipeds as well as the structure of the coastal trophic network, according to the studies by the team co-directed by Lluís Cardona from the University of Barcelona (IRBio), and Enrique Crespo from the Patagonian National Center and the National University of Patagonia (Argentina).

The results of this study are published in two articles in the scientific journals *Oecologia* and *Paleobiology*, by co-authors Fabiana Saporiti and Lisette Zenteno (UB-IRBio), and Damian G. Vales (Patagonian National Center), among others.

This research is one of the results of the project "Effects of human exploitation on apex predators and structure of the trophic network in the Argentinian sea over the last 6000 years."

A megafauna exploited by humans in all oceans

Hunting and fishing usually create a reduction in the abundance of bigger species. Therefore, megafauna are considered among the most threatened. Marine mammals are an essential element of megafauna in all oceans and they have been over-exploited by humans. However, knowing about the effects of this exploitation on the functioning of food networks in marine ecosystems, a high complex structural framework, is still a challenge for the scientists due to the difficulty of performing manipulative experiments.

In the new studies, the scientific team shows the ecological effects of marine resource exploitation in the southern coasts of South America over the last 6000 years, focusing on two species hunted by both aboriginal hunter-gatherers and European colonizers—the South American <u>sea lion</u> (Otaria flavescens) and the South American fur seal (Arctocephalus australis).



Sea lions, abundant predators in South American waters

The South American sea lion (Otaria flavescens) is a marine mammal with a robust physique and a short and flatter snout. The species is present in the coasts of South America from Peru to Cape Horn and Brazilian coasts. With a similar geographical distribution, the South American fur seal (Arctocephalus australis) is half its size, with a longer snout, and eats mainly pelagic fish, having a lower position in the food pyramid of the marine ecosystem compared to the other species.

Six-thousand years ago, hunter-gatherers in Tierra del Fuego started exploiting both species, an activity that later spread up to the northern Patagonia. "The Otaria flavescens and Arctocephalus australis species are the most abundant marine mammals in the area at this moment, and they had been historically extremely exploited by the aboriginal huntergatherers, who based a great part of their resources on these species" says Professor Lluís Cardona (UB-IRBio), member of the Research Group of Large Marine Vertebrates of the UB.

When massive sea lion hunts affect natural habitats

Applying analytical techniques of C and D stable isotope ratios in an innovative way to sea lion and fur seal bones from archaeological sites in Patagonia and Tierra del Fuego, the experts rebuilt the pinnipeds' diets in different time periods of the second half of the Holocene and compared them to the current ones.

"Everything suggests that aboriginal exploitation didn't affect their diets or the structure of the trophic network, although it was common to eat sea lions and fur seals as well as some marine fish and birds. Therefore, over the years, the trophic network did not change in a relevant way



despite the changes in the main productivity of the ocean, and sea lions and fur seals had a lower trophic level compared to the current one, which is similar to the one of the hake," says Cardona.

New superpredators in the marine ecosystem

With the arrival of the Europeans in the 16th century, and especially the phase of massive marine resource exploitation that started in the late 19th century, the diets of sea lions and fur seals changed. Human pressure eradicated both species, which altered the food pyramid and the ecological role of these marine large vertebrates at the south of the continent, according to the authors. "Sea lions and fur seals now have a higher trophic level compared to the times of the Europeans' arrival. They are now apex predators, that is, super-predators," says Cardona.

"This surprising result can be understood since the population of sea lions is now lower, and therefore, there is more food for each animal, despite the development of the fishing activity. Regarding A. australis, which has a smaller mouth, the change in diet hasn't been that shocking, because it has a physical limitation to get big fish and therefore, a lower trophic plasticity. However, O. flavescens changed from eating anchovies to eat hakes and octopuses."

Is it possible to bring back those ecosystems altered by human activity? The effects of the marine ecosystem exploitation alter the length of the trophic network. According to the authors, if the apex predators are extinguished, the trophic network gets shorter. However, if they are only less present, the trophic network of the ecosystem can grow due the decrease in intraspecific competition.

New researchers on historical ecology in the southern regions of the American continent can shape new scenarios on the ecosystems altered by human action. "These works show that the ecological niche we now



see in wild species can differ from what they had in natural conditions. They now live in a new ecosystem which has been shaped by humans. This means that restoring natural ecological systems can be a difficult objective, if possible," says Cardona.

More information: Damián G. Vales et al. Holocene changes in the trophic ecology of an apex marine predator in the South Atlantic Ocean, *Oecologia* (2016). DOI: 10.1007/s00442-016-3781-4

Shifting niches of marine predators due to human exploitation: The diet of the South American sea lion (Otaria flavescens) since the late Holocene as a case study. *Paleobiology*. DOI: 10.1017/pab.2015.9

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