



BIOLOGICAL AND ECOLOGICAL ASPECTS OF THE SPECTACLED BEAR (*Tremarctos ornatus*, Ursidae) IN THE ECUADOREAN ANDEAN ZONE AND CONSERVATION PERSPECTIVES UNDER THE LANDSCAPE SPECIES APPROACH

ASPECTOS BIOLÓGICOS Y ECOLÓGICOS DEL OSO DE ANTEOJOS (*Tremarctos ornatus*, Ursidae) EN LA ZONA ANDINA DE ECUADOR Y PERSPECTIVAS PARA SU CONSERVACIÓN BAJO EL ENFOQUE DE ESPECIES PAISAJE

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Resumen

El oso andino u oso de anteojos (*Tremarctos ornatus*) ha habitado Sudamérica por más de cinco millones de años, y es el único representante viviente de los osos de nariz corta, un grupo que habitó solamente en el continente americano. Dentro de Ecuador es considerado en peligro de extinción, principalmente debido a la fragmentación y pérdida de hábitats naturales en la región andina, causada por actividades antrópicas productivas (ganadería y agricultura) y de extracción de recursos naturales. Este oso es un mamífero que necesita de grandes extensiones para poder alimentarse y buscar pareja. El oso andino es importante para las zonas que habita, principalmente el bosque andino y el páramo, debido a su eficiente rol como dispersor de semillas. En el presente trabajo se analizan aspectos de esta especie en Ecuador, utilizando el enfoque teórico de 'especies paisaje' para proponer actividades en pro de la conservación de este mamífero y de los hábitats en los que se desarrolla. Este enfoque permite evaluar de forma sistemática la calidad del paisaje en términos de los requerimientos biológicos de una especie de interés (en este caso, *Tremarctos ornatus*) y de los usos humanos del paisaje; de igual forma considera características del área de conservación como su variación. **Palabras clave:** Conservación biológica, *Tremarctos Ornatus*, Andes ecuatorianos, especies.

Abstract

The Andean bear (*Tremarctos ornatus*) has inhabited South America for more than five million years, and he is the only living representative of the short-nosed bears, a group that only lived on the American continent. In Ecuador he is considered an endangered species, mainly because the loss of natural habitats in the Andes, due to the pressure of productive anthropic activities (mainly, livestock and agriculture) and extraction of natural resources. This bear is a mammal that needs large areas to eat and find a mate. The Andean bear is important for cloud forests and paramos due to his efficient role as seed scatter. In this work, the 'landscape species' theoretical approach is applied in order to propose activities to conserve the Andean bear and the places that inhabits. This approach also allows to evaluate in a systematic way the quality of the landscape in terms of biological requirements of the species (here, *Tremarctos ornatus*) and the landscape human uses; likewise, it also considers the size and limits of the conservation area and its internal variation.

Keywords: Biological conservation, *Tremarctos Ornatus*, Ecuadorian Andes, Landscape Species.

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1 Introduction

Several regions in Latin America have been proposed as 'hotspots' (areas with special concentration of biodiversity), 'threatspots' (areas with such diversity, but with clear threats on it) or as 'countries with high numbers of threatened species' (Cole et al., 1994; Ceballos and Brown, 1995; IUCN, 1996). In this context, it is worth mentioning that mammals and birds, as well-known and more studied groups, are often seen as emblematic animal organisms, around which are planned activities and execution of conservation of habitats and natural ecosystems.

The richness of species, biodiversity values and mammalian endemism ranges for each country have been used as measures to characterize habitat loss and human population growth, as well as to identify global anthropic threats on the biological diversity (Sisk et al., 1994). Despite this, there are still some gaps in the knowledge of this group of vertebrates in neotropical regions. Among the emblematic mammals of Andean areas, the Andean bear (*Tremarctos ornatus*) is known as a vulnerable species (VU) within the Red List of the International Union for the Conservation of the Nature (IUCN, 2018) and endangered in Ecuador (Cuesta et al., 2001).

La riqueza de especies, valores de biodiversidad y rangos de endemismo de mamíferos para cada país han sido utilizados de manera conjunta como medidas de caracterización de la pérdida de hábitat y crecimiento poblacional humano, así como para identificar las amenazas antrópicas globales sobre la diversidad biológica (Sisk et al., 1994). A pesar de ello, todavía existen algunos vacíos en el conocimiento de este grupo de vertebrados en regiones neotropicales. Entre los mamíferos emblemáticos de zonas andinas, el oso andino (*Tremarctos ornatus*) se encuentra catalogado como especie vulnerable (VU) dentro de la Lista Roja de la Unión Internacional para la Conservación de la Naturaleza (IUCN, 2018) y en peligro de extinción en Ecuador (Cuesta et al., 2001).

One of the most challenging problems in the biodiversity conservation in Ecuador's Andean area is to protect

large species, such as the spectacled bear (Castellanos, 2010) or the mountain tapir (Álvarez and Yáñez, 2017), and at the same time to meet the needs of people who share spaces with them. Large carnivores, for example, are particularly difficult to conserve because they compete directly or indirectly with humans for space and resources (Treves et al., 2006), carnivores have direct effects on the abundance of herbivores, scavengers, and indirect effects on the vegetation and food nets through trophic waterfalls (McFarland, 2009), making their conservation important and complex.

The conservation of the spectacled bear in Andean countries, where protected areas and wildlife habitats are embedded in a matrix of heterogeneous uses, usually with rapid changes in land use and/or tenure, is particularly difficult (Peyton et al., 1998; Ferraro, 2002; Himley, 2009).

1.1 The Andean region of Ecuador and neighboring countries as a natural habitat of the spectacled bear

The habitat is considered as all the resources and characteristics of a place, which allow the presence of an organism (Begon et al., 1999); therefore, an animal can use a habitat in different ways, according to the access, its availability, as well as its particular requirements (Cuesta et al., 2001). The availability and access to such habitat may vary over the time, depending on environmental factors such as the climate and biological factors of the species, as well as the communities that structure the local system (Begon et al., 1999).

In South American, the spectacled bear inhabits cloud forest and mooring environments in six countries: Colombia, Venezuela, Ecuador, Peru, Bolivia and northwestern Argentina (Castellanos, 2010). The presence of this species in its southernmost area, the northwestern of Argentina, is based on the encounter of DNA fragments, extracted from hair and feces (Teta et al., 2018).

In Ecuador, the presence of the bear is reported mainly in cloud forests and Andean moors, usually within protected areas, but possibly also outside them (Cuesta, 2000; Goldstein and Cancino, 2001; Bioweb, 2018) (Figure 1).

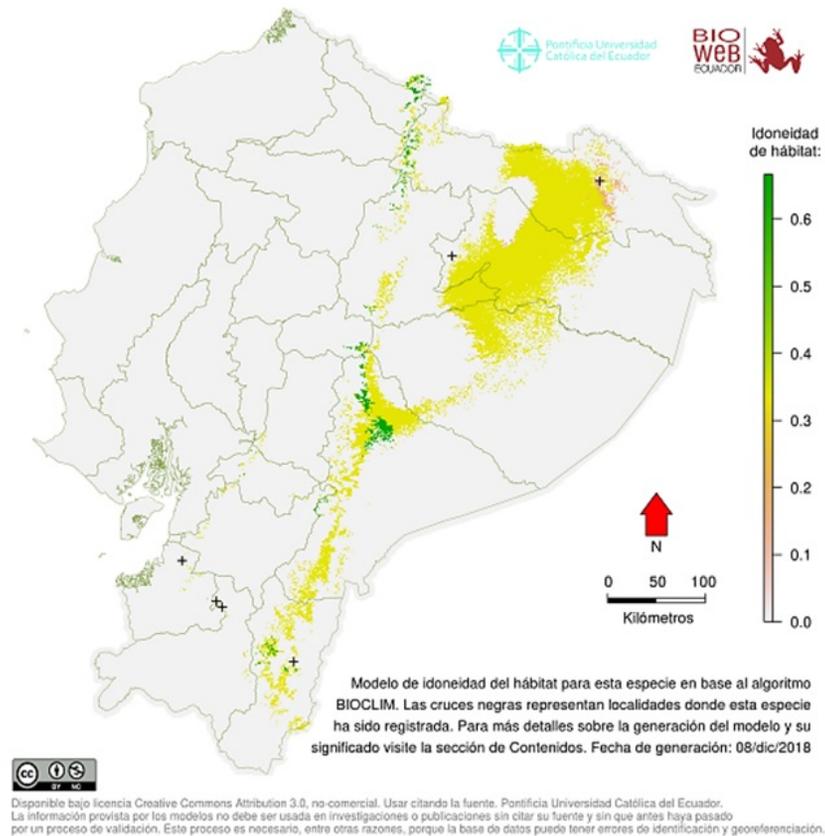


Figure 1. Potential distribution of the spectacled bear Source:Bioweb (2018).

Some records of its presence include cloud forest and moorland to adjoining subtropical forest regions. Its presence in these three ecosystems relates to records made in the provinces of Pastaza, Morona Santiago, Zamora Chinchipe, Sucumbíos, Napo, Chimborazo, Cañar, Azuay, Loja, Carchi, Imbabura, Pichincha, Cotopaxi, Bolívar, Tungurahua and El Oro (Tirira, 2007). Taking into a more standardized nomenclature of the natural regions, it can be mentioned that it is located in: Western Montane Forest, Moorland, Eastern Montane Forest (Castellanos and Boda, 2018).

1.2 Description of the species

The spectacled bear, also known as Andean bear, is a unique species of the Andes. It is large and robust in body, males are between 1.8-2.0 m tall, they weigh up to 175 kg, females are somewhat smaller (Tirira, 2007). Adult males and females have a muscular short neck, small ears and dark brown snout, their black fur is thick and abundant. They also have a combination of white or light brown spots around the eyes, which can extend to the jaw, throat and chest (Figure 2 and 3); the size, coloration and

shape of these spots are usually different in each individual and are characteristics that are often used for their identification (Castellanos, 2010; Tirira, 2007).

He is a mammal of daytime and nocturnal habits, terrestrial, partially arboreal and solitary; he is also an omnivorous animal (he eats fruits, plant matter and meat, and can eat carrion if necessary). Generally, his diet includes ripe fruits, bromeliad buds, tender parts of palms, orchid bulbs or even tree bark (Castellanos, 2005). However, his eating habits may change according to where he is and the availability of the resources (Peralvo et al., 2005), and if food is scarce, he may even go so far as to hunt deer, rodents and sometimes calves (Goldstein, 2002; Castellanos, 2005). He usually builds nests on both the ground and tall trees for resting and for uninterrupted feeding (Goldstein, 2002).

1.3 Objectives and methodological aspects

This document aims to share with the national and regional academic society information of interest for the knowledge and conservation of the spectacled bear. It was based on a critical review of specific literature (considering

technical and/or scientific publications published mainly in the last two decades around this species of mammal and his habitats), as well as authors' opinions on the ecological and conservation role, present and future of this species in Ecuador.

2 Reproductive biology



Figure 2. Physical appearance of a spectacled bear.
Source: Tirira (2007).

Much of the mating behavior of this species remains unstudied. Males and females gather to mate between April and June. The couple remained together for 1 to 2 weeks, copulating several times during this period (International Association for Bear Research and Management, 1999). Molecular genetics studies conducted by Ruiz-García (2003) in bear populations in five Andean countries show an alarming reality: the genetic variability of the Andean bear is relatively low. The populations of Ecuador have the least variability, possibly because the fragmentation of their habitats is greater in Ecuador, which generates populations of bears more isolated and most at risk of disappearing (Kattan et al., 2004).

3 Ecological importance in cultural tourism and nature

The spectacled bear is the only living representative in South America of the entire Ursidae family, giving him a particular right to exist and the academic community a great ethical obligation to facilitate his conservation. Human beings, as the main transformative agent of the environment, have the obligation and responsibility to conserve not only the Andean bear but also the rest of the wild species.

However, despite this ethical need, little is known about the ecology of this bear in Ecuador and his role in the ecosystems he inhabits. Studies in Bolivia have shown that he is an active seed dispersing agent and that the

passage of these through his digestive tract does not affect the viability (Rivadeneira, 2008).

Therefore, this mammal is very important for the areas he inhabits, mainly for some plant species of Andean forest and moorland, due to his effective role of depositing seeds with higher germination in suitable areas. Moreover, in most of the time the spectacled bear takes down complete trees to reach their fruits and eat (Troya, 2002). In this way, spaces open up within the forest where more sunlight enters and rainwater reaches directly into the ground. Thus, the bear helps to the renewal of the vegetation of the forest, since many plants need to have an open space above them (clear) to grow better. Their droppings also contribute to some extent to manure the forest floor. In addition, they feed many small organisms such as beetles, insect larvae, butterflies (Castellanos, 2003).

He is a great climber and when he climbs trees to feed or sleep he builds platforms folding and breaking some branches. Many of these branches or sticks that were accumulated in the forest canopy fall to the ground to decompose and become organic fertilizer. In this way, the bear helps to prevent too much organic matter from accumulating in the upper part of the trees and generates spaces in the canopy or subdosel where sunlight reaches directly to the forest floor (Suárez, 1985).



Figure 3. Spectacled Bear (*Tremarctos ornatus*).
Source: Appleton (2017).

The Andean bear has also been an emblematic animal, involved in the development of many of the indigenous and peasant cultures in the Andean countries. For many he is sacred, for others he is the elder brother of the human being. In the oral traditions of people, the bear is found in legends, tales, songs and myths (Lameda and Del Moral, 2008).

The Andean bear appears in the common names of some plants, 'the bear's hand' (*Oreopanax bogotensis*) and 'bear grass' (*Xerophyllum tenax*). It is also very common to find

places named after the Andean bear: Alto del Oso (Colombia), La cueva del Oso (Ecuador), Quebrada El Oso (Colombia, Peru, Venezuela), Vereda del Oso (Colombia), among others. In this way, the Andean bear is part of the cultural heritage and worldview of the countries of the Andean region.

4 Aspects around the current care and conservation of the Andean bear under the landscape species approach

4.1 The landscape species-based conservation model

The spectacled bear conflict - cattle is an element worthy of being analyzed and addressed under the conceptual scheme for landscape species conservation planning (Sanderson et al., 2002), due to the particular characteristics of the conflict, which include ecological, social and economic components. Effective planning in conservation or conflict management must clearly define the elements that are biologically, economically and socially relevant to the species or the conflict, so that the conflicts can be planned on an appropriate scale (Poiani et al., 1998; Whited et al., 2000), preferably with an ecosystem approach and/or landscape ecology.

The landscape species approach focuses its efforts on an explicit spatial model that systematically evaluates the landscape in terms of the biological requirements of a species (in this case, *Tremarctos ornatus*) and the human uses of the landscape. This approach uses the requirements of the species to define the boundaries of the conservation area (the extent) and the variation within it (the point) (Sanderson et al., 2002). The conceptual model of conservation based on landscape species considers the identification of:

1. The biological landscape of the species.
2. The landscape of different human activities.
3. Spaces and moments in which human activities could endanger populations of the landscape species.
4. A potential focal landscape for the conservation of the species, based on the necessary local elements and the different interventions required for the conservation of the chosen biological population (Sanderson et al., 2002).

4.2 The choice of the species

Theoretically, any species could be considered as a candidate for landscape species, but in practice, considering many species as candidates would make the selection process very long. Therefore, organizations such as the WCS suggest that the initial group of candidate species for a given area consists of few species with a reasonable probability of being selected and that would meet one or more of the five following criteria (WCS: Wildlife Conservation Society, 2002):

- **Area:** the candidate species for landscape species should be widely distributed in natural habitats, so that if its life's area many other species of flora and fauna will be protected at the same time, this is known as the Umbrella Effect (Umbrella species (WCS: Wildlife Conservation Society, 2002)). In this sense the spectacled bear, for what has been mentioned above and for his distribution in Andean natural habitats of Colombia, Venezuela, Ecuador, Peru and northern Argentina, is a strong candidate for being considered landscape species.
- **Heterogeneity:** Some species require more than just large areas. In many cases, a wild species candidate for landscape species needs a variety of available natural habitats and different vegetation types for dispersion, fodder, reproduction and survival at favorable and unfavorable times (WCS: Wildlife Conservation Society, 2002). Again, the Andean bear meets these conditions.
- **Vulnerability:** another consideration in the selection of a landscape species is the number and severity of the threats that affect it. Threats can be classified according to the probability of their occurrence, how quickly they occur or may occur, their severity and the area they may affect in relation to the candidate species (WCS: Wildlife Conservation Society, 2002). The spectacled bear is currently listed as a vulnerable species by IUCN (2018), so his protection is necessary and urgent.
- **Ecological functionality:** some species have particularly strong effects on the structure and function of natural ecosystems: for example, beavers originate swampy areas by building dikes in rivers (WCS: Wildlife Conservation Society, 2002); tapirs and spectacled bears distribute seeds in the systems they visit and larger predators can control the abundance and composition of prey communities. Given these important effects on other species, maintaining healthy populations of landscape species and their habitats, such as the Andean bear, will help to conserve the ecosystems.
- **Socioeconomic importance:** the last criterion for the selection of a landscape species is its socioeconomic importance. Some examples show that the so-

cial environment in and around protected areas can drastically affect conservation outcomes. Since landscape species travel through large areas and find in this action a wide variety of habitats and types of land use, it is very likely that they will have contact with people and their activities (WCS: Wildlife Conservation Society, 2002). This is precisely what happens with the spectacled bear, in a negative sense for the human being, the bear can affect crops, annoy livestock, compete for space or resources; in a positive sense this bear has important benefits such as being a powerful cultural icon in Andean rurality by providing income, generating opportunities to local human communities through the development of ecotourism activities, such as those described for another species such as Andean tapir in similar studies (Álvarez et al., 2017).

4.3 Programs and plans for the conservation of the spectacled bear as an emblematic species in Ecuador

The Nature Foundation and the EcoScience Foundation in Ecuador have worked in recent decades (1980-2010) with the national government supporting the management of three protected areas where the spectacled bear is located (Podocarpus, Cotacachi-Cayapas, Cayambe-Coca). On the other hand, the Andean bear conservation program in the Northwestern Metropolitan District of Quito uses the bear as an umbrella species for the conservation of the environmental health of this region (Secretaría de Ambiente, 2014). The actions that are implemented to support the conservation of the bear support directly or indirectly the conservation and recovery of the remnants of natural vegetation. These conservation efforts must undoubtedly be expanded and supported by relevant management and research institutions.

5 Conclusions and recommendations

Since pre-Hispanic times, populations of Andean bear have been under a lot of pressure from humans. In Ecuador they were hunted out of fear, for sport, for obtaining products from their bodies or because they were eventually considered pests for crops and/or farm animals.

Currently, the main threats the bear faces are poaching and the destruction of his natural habitat, isolating the few remaining populations of spectacled bears in Ecuador. Additionally, the main habitat of the Andean bear is located in one of the areas of greatest growth and economic and social development in Ecuador: the An-

dean provinces.

Some measures must be considered to collaborate with the preservation of this species in its natural habitats; in addition, the spectacled bear must be taken into account officially as a landscape species for Ecuador and possibly also for the other Andean countries where he is located.

The relevant measure and action is to avoid the hunting of the bear; the law currently prohibits hunting and selling; however, it would need a little more control so that the norm would be fully complied with. It should be emphasized that these animals are shy and frightened; they try to avoid the presence of the human being and are not any threat to humans. If there were problems with an Andean bear in an area, the local environmental entity should be informed; they will indicate what to do. Hunting is not the solution and this practice only contributes to increase the risk of extinction of this species.

Do not cut down the Andean forest or the subtropical forest, nor modify the moors. In addition to being home to the Andean bear, these environments protect watersheds and ensure the supply of water in the region for the benefit of people. On the other hand, the forest and the moor are home to many other species of animals and plants beneficial to the ecosystem and for humans, some of them are not found in any other region of the planet. In this way, protecting the Andean bear's home also preserves the home of several plants and animals that share his habitat.

Campaigns to recover and protect Andean forests and moors are necessary. The deterioration of these systems implies the loss of water sources, indispensable for crops or human consumption. Attempts should be made to reforest areas where forest with native species once existed, as those that remain are discontinuously and fragmented. Forest restoration plans can be developed to connect those fragments to help the Andean bear have a wider area to live in.

Governments (national, provincial, municipal) must take effective control actions to illegal trafficking of spectacled bear. Consideration should also be given to applying stimuli for those who promote in some way the protection of this species and/or the habitats in which he is located or on which he depends. Non-governmental organizations interested in the conservation of this species must have the capacity, facilitated by the National Government, to channel national and international resources for the acquisition and/or management of land to ensure the conservation of the Andean bear's natural habitats.

Private and public Universities and research centers carrying out activities and programs in life and environmental sciences should be able to provide technical and scientific advice to rural communities and governmental and non-governmental entities for the conservation and recovery of Andean bear populations and the habitats they occupy.

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