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THE WHITE-TAILED DEER, IN THE ARENILLAS ECOLOGICAL  
RESERVE**

# PROPOSAL

FOR THE CONSERVATION OF THE YELLOW GUAYACAN AND THE WHITE-TAILED DEER, IN THE ARENILLAS ECOLOGICAL RESERVE

## PROPUESTA DE CONSERVACIÓN DEL GUAYACÁN AMARILLO Y EL VENADO COLA BLANCA EN LA RESERVA ECOLÓGICA ARENILLAS

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### ABSTRACT

Conservation management plans for protected areas are designed to protect an area threatened by anthropogenic activities, but in this process several ecosystem factors are not considered. In this research, the objective was to build a conceptual model and design several strategies for the conservation of yellow guaiac and white-tailed deer in the Arenillas Ecological Reserve. We used the Open Standards for Conservation where we identified two conservation targets (yellow guaiac and white-tailed deer), the scope, conservation vision, contributing factors and threats to build a conceptual model of the current situation. Then the objectives for the conservation target were designed with their respective strategies and targets. The project highlights the importance of establishing restoration programmes and incentives for farmers so that the agricultural border does not continue to grow, as well as the need to establish protected areas to protect and restore key deer habitats. These actions will not only benefit the target species, but will also contribute to the overall conservation of the Arenillas Ecological Reserve and the promotion of a healthy natural balance in the communities near the reserve.

### Keywords:

Biodiversity, tropical dry forest, contributing factors, conservation plan.

### RESUMEN

Los planes de manejo para la conservación de espacios protegidos se construyen en función de proteger un área amenazada por las actividades antropogénicas, pero en este proceso no se considera varios factores del entorno ecosistémico. En la investigación, se planteó el objetivo de construir un modelo conceptual y diseñar varias estrategias para la conservación del guayacán amarillo y el venado cola blanca en la Reserva Ecológica Arenillas. Se utilizó los estándares abiertos para la conservación, donde se identificó dos objetos de conservación (guayacán amarillo y venado cola blanca), el alcance, la visión de la conservación, los factores contribuyentes y amenazas para construir un modelo conceptual de la situación actual. Luego se diseñó los objetivos para objeto de conservación, con sus respectivas estrategias y metas. La propuesta destaca la importancia de establecer programas de reforestación e incentivos a los agricultores para que no continúe creciendo la frontera agrícola, también establecer áreas de reserva para proteger y restaurar los hábitats clave del venado. Estas acciones no solo benefician a las especies objeto de la conservación, sino que también contribuyen a la conservación general de la reserva Ecológica Arenillas y la promoción de un equilibrio saludable en la naturaleza en las comunidades próximas a la reserva.

### Palabras clave:

Biodiversidad, bosque seco tropical, factores contribuyentes, plan de conservación.

## INTRODUCTION

Ecuador's National System of Protected Areas was established in 1976 with the main objective of conserving and protecting the biodiversity of the country's diverse ecosystems (Morcatty et al., 2013). One of these protected areas is the Arenillas Ecological Reserve (REA), located in the province of El Oro, in the coastal region of Ecuador. The REA is part of the Tumbesian Endemism Region, characterized by its tropical dry forest, mangroves, and rich fauna. However, despite its importance and its role as a refuge for diverse species, the conservation of the REA has been threatened by human activities that are detrimental to its ecological balance and perpetuity. Among the problems facing the REA are illegal logging, which has resulted in the loss of vegetation and natural habitats. Similarly, land use changes due to the expansion of the agricultural frontier and illegal hunting have also contributed to the degradation of the protected area (Freile & Santander, 2005; Briceño et al., 2016; Espinoza et al., 2016). The wildlife and biodiversity of the reserve are directly threatened by these activities.

Despite conservation efforts, the REA's potential as a tourist destination, as well as its role in the development of local economic activities such as agriculture and cattle ranching, jeopardize the long-term sustainability of its management plans. Previous studies in other protected areas indicate that recreational activities, as well as agriculture, can have significant negative impacts on fragile and sensitive ecosystems such as tropical dry forest, causing soil erosion and vegetation destruction, in addition to disturbing wildlife and altering their behavioral patterns (Smith et al., 2018).

On the other hand, conservation plans for protected areas do not take into account the complexity of food chains (Terborgh & Estes, 2013). Several such empirical studies support the theory of trophic degradation in ecosystems through impacts on processes as diverse as disease dynamics, natural wildfires, invasive species, and altered biogeochemical cycles (Soulé 2014). In addition, ecological theory predicts that changes in ecosystems can be attributed to changes in the abundance and distribution of consumers. Therefore, the design of conservation strategies is complex and should not be constructed from an anthropocentric spatial conservation approach.

In this framework, the identification of species that play a fundamental role in the functioning and structure of an ecosystem and the design of specific conservation strategies based on key conservation objectives are of paramount importance. The tree *Handroanthus chrysanthus* (Székely, 2016), known as the yellow guaiac, and the ungulate mammal *Odocoileus virginianus* (Zimmermann, 1780), also known as the white-tailed deer, are representative species that play a crucial role in the biodiversity and functioning of the tropical dry forest of the REA. The yellow guaiac, for example, is not only a tourist attraction,

but also plays a fundamental role for pollinators, provides habitat for various bird species, and sequesters carbon. On the other hand, the white-tailed deer is considered a keystone species in several ecosystems due to its role in regulating shrub populations and seed dispersal (Terborgh & Estes, 2013). This mammal is also an indicator of habitat health and quality. As selective herbivores, they help control vegetation and maintain balance in the ecosystem. In addition, they act as seed dispersers by consuming fruits and excreting seeds in different areas, thus contributing to the regeneration of the flora.

The conservation of this species means protecting and restoring the habitat of key areas of the reserve for the feeding and reproduction of other species, as well as mitigating conflicts with human activities. By designing specific strategies based on a situational model and then projecting them into a chain of expected results. This implies that, in the long term, it increases the possibilities of conservation of this emblematic species and, with that, promotes the balance of ecosystems in the REA. The objective of this study was to construct a conceptual framework and design several strategies for the conservation of yellow guaiac and white-tailed deer in the Arenillas Ecological Reserve (REA), using a conceptual and management framework, steps indicated in the Open Standards for Conservation Practices.

## METHODOLOGY

### *Description of the Ecological Reserve of Arenillas*

The Arenillas Ecological Reserve is a 13170 ha protected area located in the southwest of the province of El Oro (Ecuador). It is home to several endemic species, including the yellow guayacan and white-tailed deer, which are listed as vulnerable by the IUCN. The landscape combines tropical dry forest, thorn scrub, and mangroves, creating a diverse ecosystem (Borchers & Urbina-Cardona, 2013). The climate is predominantly arid, with distinct rainy and dry seasons. Temperatures are warm, with average highs of 25-30°C and lows of 18-22°C. These climatic characteristics influence the adaptation of the reserve's flora and fauna, making it an ideal area for guaiacs and white-tailed deer (Angulo & Beltrán, 2012; Ortega & Carvajal, 2017).

The methodological framework of the conservation proposal is based on the bibliographic compilation and analysis of existing data for the identification of threats to yellow guaiac and white-tailed deer in the REA. For the construction of the proposal, the criteria Open Standards for Conservation Practices of the Conservation Measures Alliance, cited by Vázquez-Márquez et al. (2020), were used. The Open Standards are organized in a five-step cycle: 1) conceptualize, 2) manage, 3) implement and monitor, 4) analyze data, use results and adapt, and 5) capture and share learning. The standards adopted were conceptualization and management (Figure 1):

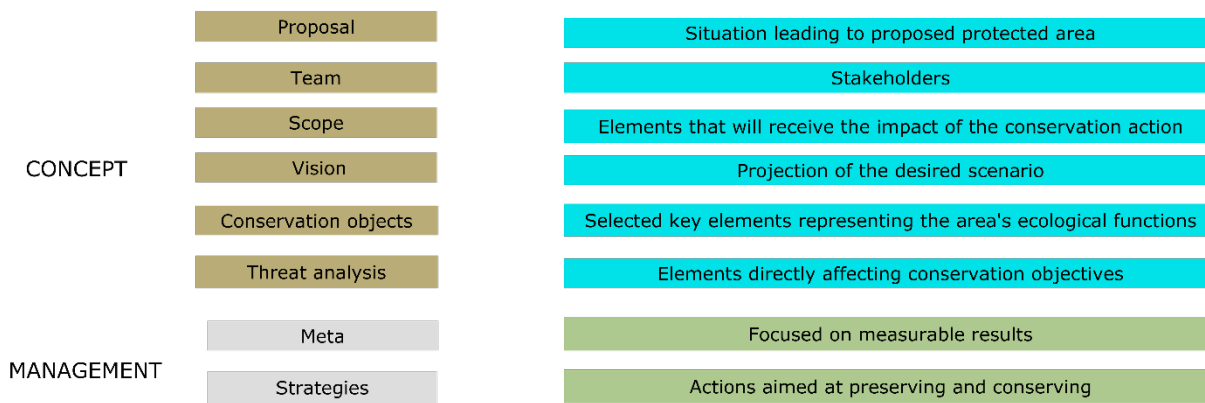


Figure 1. Schematic for developing a situational model based on the Open Conservation Standards.

The purpose and scope of the proposal were defined through a comprehensive review of the scientific literature, management reports, previous studies, and conservation strategies associated with the REA. This information was analyzed by the proposal design team, which consisted of three agronomists and one biologist. The vision was built with a horizon of effective, achievable and sustainable results.

The criteria for identifying the selected conservation targets were based on

**Ecological importance:** both species are important in the ecosystems they inhabit. The yellow guaiac can be a dominant species in the tropical dry forest, while the white-tailed deer can be a key herbivore in the regulation of vegetation.

**Conservation value:** Species that are endangered or facing significant threats are selected. If the yellow guaiac or white-tailed deer are endangered or their habitat is highly threatened, their conservation becomes a priority.

**Representativeness:** The species selected must be representative of the biodiversity and ecosystems found in the reserve. Yellow guaiac and white-tailed deer are symbolic species of the region and can serve as indicators of the health of the ecosystem.

**Conservation potential:** The feasibility of conserving the species is considered. If there are realistic and feasible opportunities to implement effective conservation strategies for yellow guaiac and white-tailed deer, their selection as conservation targets is justified.

To identify the main threats, general data were collected from the tropical dry forests of Ecuador. This data includes illegal logging, land use change, and illegal hunting. These data were analyzed and synthesized to identify the main threats affecting each conservation target.

As a planning tool for conservation plans, the Open Standards for Conservation recommends the situation model, which is presented in a conceptual framework. It is a structured representation of the current status of the species and its environment, based on the collection and analysis of relevant information about the species, its habitat, the factors affecting it, and the interactions between them. The main objective of developing a conceptual status model is to understand the current status of the species and its threats, to identify the factors affecting its conservation, and to make informed decisions for its management and conservation.

The conservation objectives for each conservation object were constructed based on the SMART (Specific, Measurable, Achievable, Relevant and Timely) methodology, which allows for the establishment of clear and achievable goals that increase the probability of success and effectiveness in achieving the established objectives. The goals were proposed in a time frame of 3 to 7 years.

## RESULTS AND DISCUSSION

The scope of the proposal includes strategies to conserve and restore the natural habitat of the yellow guaiac and white-tailed deer. In this way, we aim to reduce the following identified threats: logging for timber, agricultural expansion and anthropogenic recreational activities. In addition, local communities will be involved in all proposed strategies and objectives. Within this framework, the following vision was established:

By the year 2030, the habitat of the yellow guayacan tree and the white-tailed deer in the Arenillas Ecological Reserve will be conserved.

Figure 2 illustrates the conceptual model of the yellow guayacán. One factor contributing to the decline of the guayacán was the indiscriminate harvesting of trees from the 1950s to the 1990s, driven by commercial timber interests. Guaiacán wood was used for a variety of applications, including the construction of railroad ties, poles, and the manufacture of furniture and handicrafts. Guaiacán sawdust is also used to make mosquito repellents. The shipping industry also benefits from the economic resources generated by guaiacán, as its wood is used in the production of some ship parts.

The expansion of the agricultural frontier was driven by towns such as Chacras, Carcabon, Palmales and La Cuca, which border the reserve. Settlers took advantage of the space left by the trees to plant citrus trees and introduce grazing cattle (Espinosa et al., 2016). The proximity to the Peruvian border has had its consequences, such as the construction of trenches and bunkers in the reserve between 1972 and 1998, as well as the construction of clandestine roads for smuggling.

All these factors contribute to the decline of the tree population and the deterioration of the habitat. Therefore, three conservation strategies are proposed: 1) an environmental incentive program for land use change; 2) implementation of a sustainable forest management program; and 3) establishment of a land regulation policy in the areas surrounding the REA.

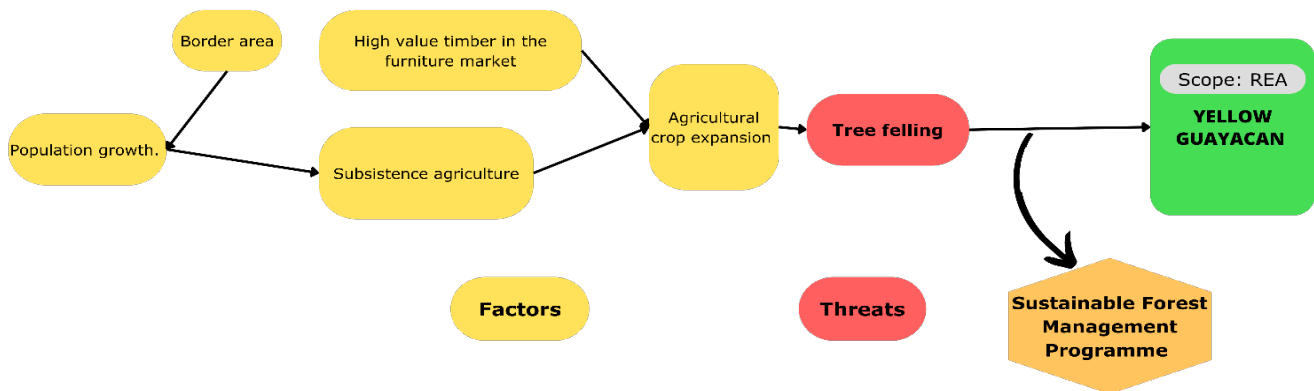


Figure 2. Yellow Guayacán conceptual model.

According to the information gathered, cattle ranching has a significant impact on white-tailed deer habitat (Figure 3). Ranchers allow their cattle to graze freely in areas close to the reserve, which negatively affects the availability of shrublands, an important food source for deer (Cuesta & Peralv, 2008). This reduces the deer's food supply and forces them to disperse to areas near the Pan-American Highway or outside the Ecological Reserve in the region, increasing their risk of being hit by vehicles.

In addition, the tourist activity causes disturbances in the deer's behavior. Therefore, it is crucial to implement effective conservation measures to counteract these impacts. Possible actions include restoring habitat affected by deforestation and implementing regulations to control livestock and tourism activities within the reserve.

One viable option is to establish selective reforestation programs to restore shrublands and provide suitable habitat for deer. In addition, agreements could be made with ranchers to promote sustainable practices that minimize habitat impacts and reduce conflicts between ranching and species conservation.

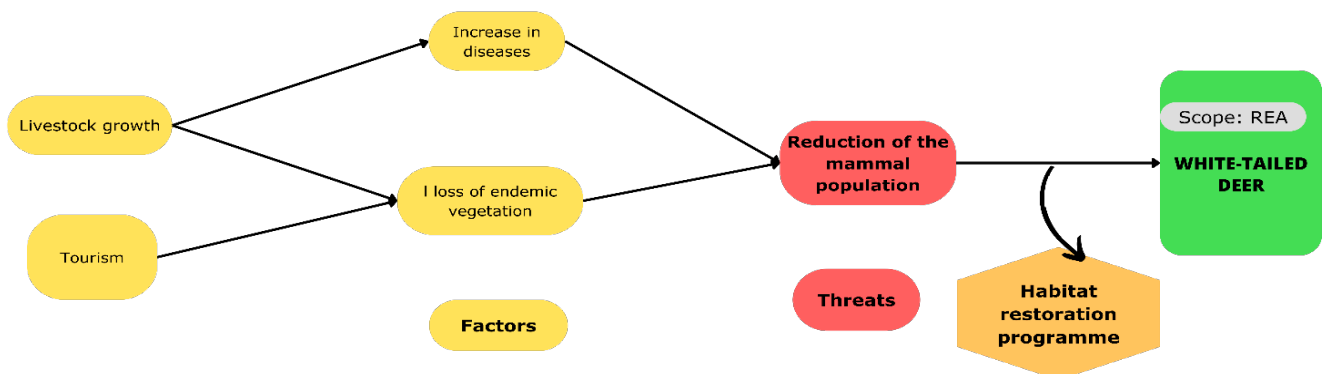


Figure 3. White-tailed Deer Conceptual Model.

### The relationship between factors, threats and conservation objects

The yellow guayacán, besides being an emblematic tree of the region, plays a crucial role in ecological dynamics, as pointed out by Solórzano et al. (2021). Its showy yellow flowers attract pollinators such as bees and hummingbirds, which contributes to the reproduction and dispersal of other plants in the ecosystem (Luna Florin et al., 2022). For example, birds that pollinate guaiacum flowers also pollinate shrub flowers that white-tailed deer depend on as a food source. As the deer feed, they also spread the seeds of the plants they consume, helping to regenerate the forest.

The results chains shown by Stem et al. (2016), are useful in many ways, they help conservation teams make strategic approaches explicit. They also allow stakeholders to have a common understanding of the factors considered and options available before making decisions, and support coordination among multiple donors, grantees, and implementing partners (Danielsen et al., 2009).

Objective: By 2030, at least 2,000 yellow guaiac trees have been planted in deforested areas adjacent to the Arenillas Ecological Reserve.

Of the strategies identified in the situation model, the team prioritized two strategies to minimize illegal yellow guaiac harvesting:

Strategy 1: Environmental incentive programs for land use change.

Strategy 2: Implementation of forest management programs.

These strategies require collaboration with strategic partners, such as international organizations that provide funding to communities for carbon sequestration and biodiversity conservation.

The objectives for these strategies were as follows:

Objective 1: By 2026, 100% of farmers who signed the agreement receive the incentives.

Objective 2: By 2028, deforestation is reduced by 45% compared to 2024.

Objective 3: By 2030, at least 75% of farmers maintain forest on their land and 25% or more have replanted 2000 trees in areas identified as deforested.

Under this scenario, it is expected that the results chain shown in Figure 4 will lead to a reduction in deforestation, based on training and participation in the forest management program. Activities will focus on promoting the cultural, symbolic and ecosystem values of the species. It is expected that 80% of the villagers will care for and protect the Guayacán.

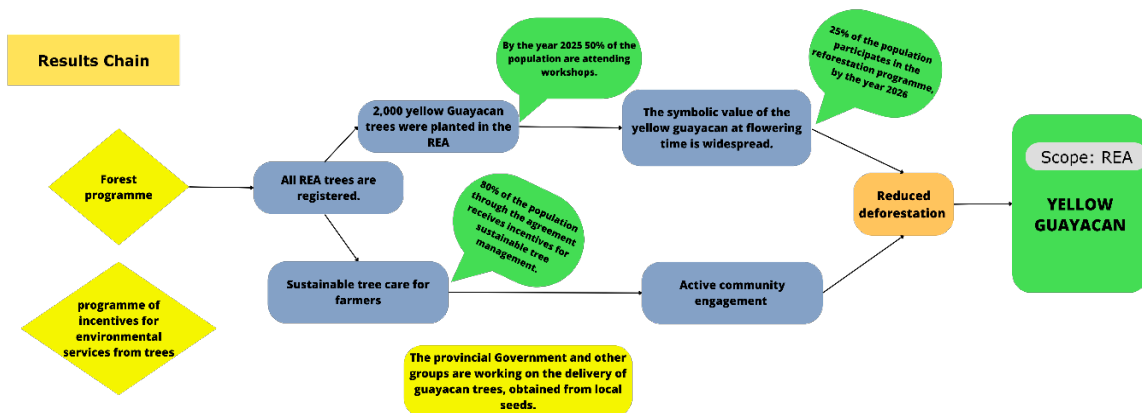


Figure 4. Yellow guayacan chain of expected result.

### White-tailed Deer Conservation Objective

Objective: By the year 2030, the number of offspring of the white-tailed deer population found within the Arenillas Ecological Reserve has increased by at least 20%.

Similarly, for the second objective identified in the REA, only two of the three initial strategies were prioritized:

Strategy 1: Wildlife education

Strategy 2: Development of community tourism projects and agroecological farms.



Meta 1: By 2026, at least 50% of the villagers have received lectures on conservation for the evaluation of the species and its importance in the REA.

Meta 2: By 2028, the white-tailed deer population will have increased by 20% compared to 2024.

Meta 3: By 2030, illegal hunting has been reduced by 70% compared to 2023 through educational talks on environmental awareness.

In order to increase the deer population, a census should first be conducted to determine the actual population. Then, several environmental education campaigns should be conducted, which is proposed as the primary method for local people to recognize the importance of the species in the reserve's ecosystem. Finally, it is hoped to achieve a 70% reduction in illegal hunting by 2030 (Figure 5).

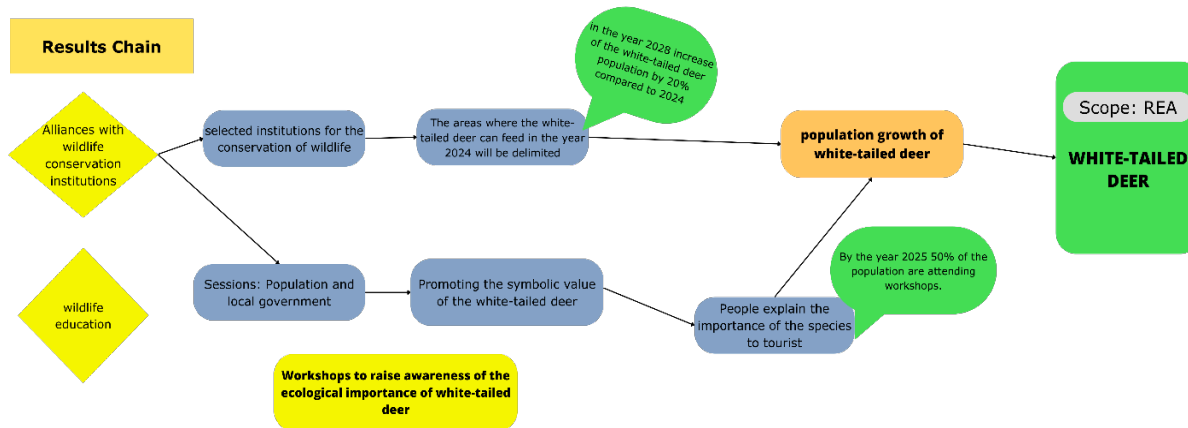


Figure 5. White-tailed Deer Results Expected Chain.

## CONCLUSIONS

The expansion of agricultural and livestock frontiers, deforestation, and global warming are threats to biodiversity, so it is urgent to implement conservation programs to alleviate some of the pressures on biodiversity. We seek to involve local communities in all proposed objectives, such as promoting sustainable practices to preserve the habitat of the white-tailed deer.

In conclusion, this thesis presents a solid and ambitious proposal for the conservation and restoration of the yellow guaiac and white-tailed deer habitat in the Arenillas Ecological Reserve.

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