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Proposal For A Priority Site For The Conservation Of Biodiversity In The Huancavelica Region – Peru

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Abstract
This research aims to propose a priority site for biodiversity conservation in the region of Huancavelica - Peru, using the methodology of fine filtering through the analysis of biodiversity, delimiting the proposal area, identifying the objects of conservation, sources of pressure, and threats of ecological processes; and zoning according to the legal regulations of SERNANP. Using digital tools such as ArcMap, Google Earth, SASPlanet, Microsoft Excel, and state geoportals such as SERNANP, MINAM, and IUCN. Besides suggesting a conservation area in Huancavelica, the study aims to stimulate research in the design of natural protected areas (NPA) in the country with the ultimate goal of conserving biodiversity, allowing better management of natural resources. The results show that the priority site would be located within the provinces of Castrovirreyna and Huancavelica with an area of 179 227.92 ha, identified 6 objects of conservation of cultural, natural and ecosystem aspects, among the sources of pressure, is the sustainable agricultural expansion, the development of road infrastructure projects, mining or other liabilities in which there is a change of land use and poaching and indiscriminate.

Keywords: Biodiversity, Priority Site, Conservation, Ecosystem, Huancavelica, Sources of Pressure, Zoning

1. INTRODUCTION

The loss of biodiversity is one of the most important issues on a global scale [1]. Increasing anthropogenic pressures on biological diversity, particularly caused by the high land use change rate and the overexploitation of natural resources, leads to an irreversible loss of species and deterioration of ecosystems [2].

In the Huancavelica region, the advance of the agricultural frontier and urbanization have left few remnants of natural habitats, which present varying degrees of modification [3]. In this context, the ANP's protected areas play an important role in conserving regional biodiversity. However, many ANPs have been established without scientific criteria and opportunistic

reasons, with biases in representing species' biodiversity and ecosystems and deficiencies on the surface [1] [4].
Currently, in the Huancavelica region, there is no declared protected natural area that is not attached to any level of administration of SINANPE or as a priority site for conservation, being very important since it is an area that fulfills the function of connector-corridor between Large protected areas and forms a dynamic system of ecological patches, for this reason, the objective of this research is to carry out the proposal of a priority site that contributes to the conservation of biodiversity in the Huancavelica region [4].

2. LITERATURE BACKGROUND

Priority Sites

Systematic planning emerged as one of the branches of conservation biology to provide a clear and complete guide in creating representative systems of areas for conservation by identifying priority sites or regions that include the most vulnerable elements and irreplaceable elements of biodiversity that must be protected, and to make more efficient the allocation of resources that allow the implementation of conservation actions that dissociate them from processes that threaten their permanence [5] [6]. The priority sites for conservation are natural geographic spaces whose values are irreplaceable and must necessarily be destined to conservation their biological diversity (ecosystems, wild flora, fauna, genes, water, soil, and/or landscapes) of cultural heritage. associated [7] are places that, due to their natural and cultural values, are key for the conservation of species and ecosystems and the continuity of essential processes for the life and well-being of people [8] [9]

Conservation Objects

A limited number of species, natural communities, or ecological systems represent the biodiversity of a landscape to be conserved or of a protected area and that, therefore, can be used to measure the effectiveness of conservation measures [10]. The Nature Conservancy states that VOCs are "a set of elements of biological diversity, defined by this methodology as focal elements that represent and capture the biodiversity or cultural aspects that we want to conserve" [11].

Pressure Sources

The pressure is the functional damage or degradation of a conservation object's key attributes, diminishing its viability. The forces will directly affect the critical environmental factors causing our conservation targets [12]. Effective actions are those that help us combat the source of pressure. To be effective, we have to work on them how the source originates [13].

Table 1. Pressure source levels.

Level	Descripción
Very high	The source is a very large contributor to the particular pressure (principal or one of the principals). For example, if our pressure were the “loss of river connectivity” and a hydroelectric dam caused this, the source's contribution would be rated “very high” due to the effects that hydroelectric plants cause on the movement of aquatic species.

High	The source is a large contributor to the particular pressure. For example, the selective extraction of species tends to have a "high" contribution in areas where the combination of population growth and economic dependence on these species creates intense pressure on them once harvested sustainably.
Medium	The source is a moderate contributor to the particular pressure. For example, mass tourism is usually shocking in a protected area. However, when localized, its contribution to habitat disturbance is usually rather "medium."
Low	The source is a small contributor to the particular pressure. For example, subsistence hunting in areas with low population density is often described as a "low" contribution to reducing game species.

Protected natural areas

They are those that allow the use or extraction of resources, primarily by local populations, in those areas and places and for those resources, defined by the area's management plan [14]. The National Service of Natural Areas Protected by the State - SERNANP, is a specialized technical public body attached to the Ministry of the Environment, according to Legislative Decree No. 1013 of May 14, 2008, is in charge of directing and establishing the technical and administrative criteria for the establishment and management of ANPs, and to safeguard the conservation of biological diversity [15]. SERNANP is the governing body of the National System of Natural Protected Areas by the State (SINANPE). In its capacity as a technical-normative authority, it carries out its work in coordination with regional and local governments and owners of properties recognized as private conservation areas [16].

Its objective is to contribute to Peru's sustainable development by the conservation of representative samples of the country's biological diversity [17].

Figure 1. Map of Protected Natural Areas in Peru. Source: SERNANP, 2018.

Biodiversity

It refers to the variability of living organisms from any source or origin, including, among others, terrestrial and marine ecosystems and other aquatic ecosystems and the complex ecological systems of which they are part [18]. Biodiversity, also called biological diversity, includes the variety of ecosystems, species, and genetic resources of the national territory and involves the State's participation at all levels of action, as well as the economic sectors and civil society in its use and administration. [16] [19].

According to the Convention on Biological Diversity [17], often considered as the leading international instrument for sustainable development, three fundamental purposes are proposed at a global level, which is: a) the conservation of biological diversity, b) the sustainable use of its components, and c) the fair and equitable sharing of the benefits derived from the use of genetic resources. The benefits obtained from biological diversity are multiple and come from all organizational levels: ecosystems, species, genetics, and culture. The benefits are classified as direct and indirect, depending on whether they are obtained from the use of the exploited resources (for example, the consumption of fish, terrestrial fauna, or plants in food) or the action of any component of biological diversity on the development of the elements that are finally exploited [19] The precise link between diversity and the capacity of an ecosystem to provide services is somewhat complicated and constitutes a field that science is still exploring [18]

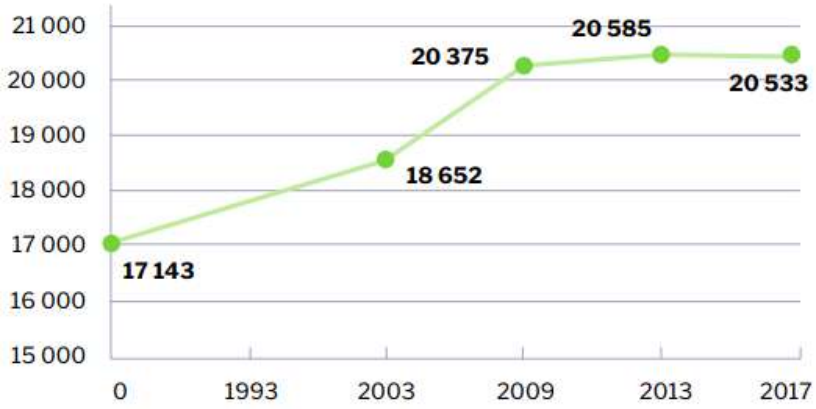
Biodiversity Variations

Diversity of Species.

Peru is a megadiverse country, where our knowledge of existing biological species is constantly growing [20]. The lists and the number of known species for each taxonomic group change frequently due to the description of new species, the registration of species not previously reported in the national territory, and taxonomic revisions, which produce changes and arrangements nomenclature.

Flora Wealth

The number of recognized Peruvian plant species, including vascular and avascular plants, is estimated at 20 533. Between 2014-2018 at least 171 new plant species have been described and 19 species recorded for the first time, giving a total of 190 additions new to the benefit of our rich biodiversity. For example, the number of vascular plants is encrypted at 19,147 in Peru (Ulloa, 2017) and 761 species of mosses (bryophytes) for the tropical Andes (Churchill, 2009).



Graph 1. A chronological record of recognized Peruvian plant species. Source: Biodiversity Report, 2019

Wealth of Fauna

Of 32 Phyla in the animal kingdom, in our country, 19 Phyla of them have been enlisted; there are no investigations of 9, and the remaining 4 have not been registered yet. Phyla is a subdivision that groups animals based on a body pattern [6].

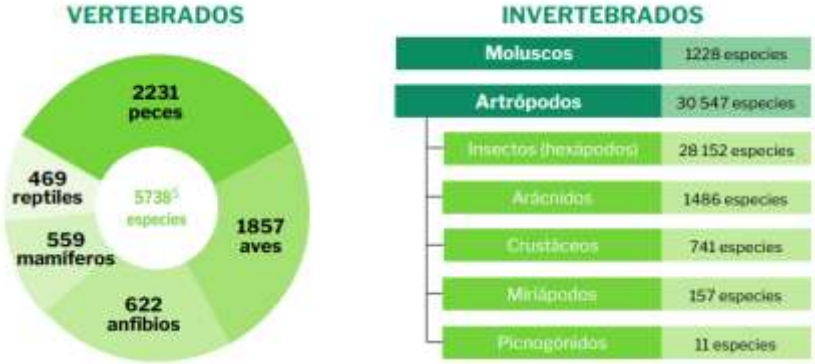


Figure 2. Vertebrate and invertebrate data. Source: Biodiversity Report, 2019

Cultural diversity

Peru is a multicultural country. In this report, this cultural diversity is presented through ethnic and linguistic diversity and their population and territory they occupy in the country and their traditional knowledge, which are so intrinsic to biodiversity [16].

Table 2. ANP's rating

Protected areas for the use and habitat of indigenous peoples	**% Area**
National Parks	52,0 %
National Reserves	16,0 %
Regional Area	14,6 %
Communal Reserves	12,5 %
Reserved Zone	2,7 %

Natural Shrines	1,2 %
Forest of protection	1,0 %
33 protected areas are closely related to indigenous peoples	17 46 124.66 ha

3. MATERIALS AND METHODS

Objectives and methodology

Based on the hypothesis that the proposal for a priority site contributes to conserving biodiversity in the Huancavelica region. This work used as a starting point, the results obtained for the determination of priority conservation sites at the eco-regional level developed for Costa Rica, Panama, and Colombia [5] particularly concerning:

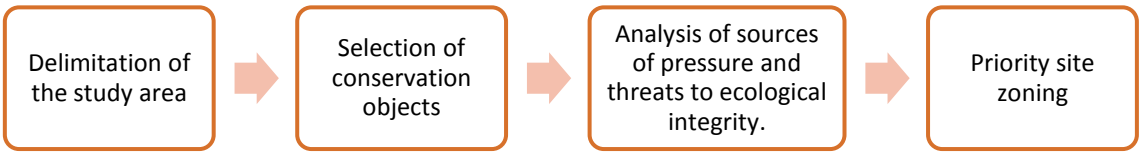


Figure 2. Methodological processes for identification

Subsequent in the analysis, they used methodological steps to identify the conservation gaps developed [8]

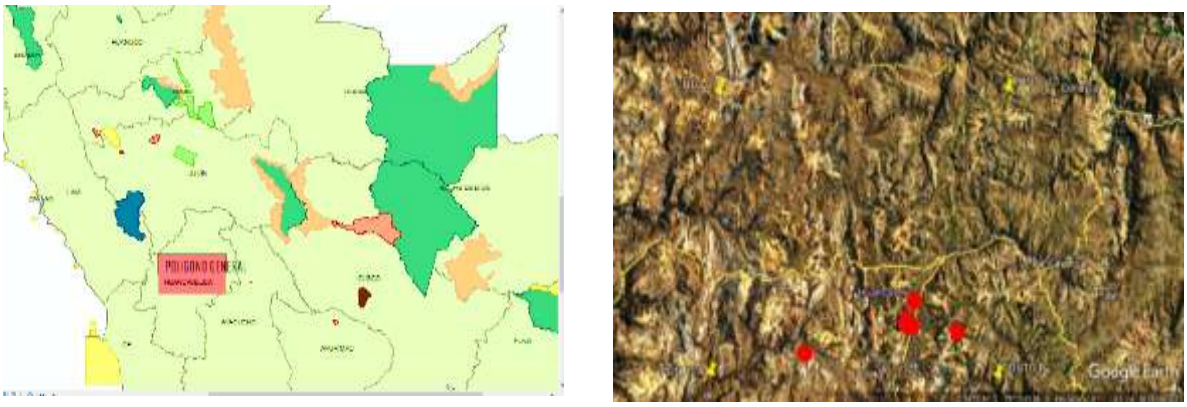
The process of delimitation of the priority area for conservation has included the use of thematic maps of the national environmental information system (SINIA) as a base mapping for the elaboration of thematic maps of the delimited area, as applied the Arcgis system with its Arcmap extension, which allows the use of GIS geographic information systems for the elaboration of maps and complementary content that grants us additional information and results of the delimited area for later analysis.

In addition to this, the Google Earth pro computer tool was used to visualize satellite images(Landsat), making the three-dimensional spatial comparison of the physical state of the place. The web browser will enable us to view aerially at different scales and with high resolution the 3D images and with the help of the program extensions other features such as site photographs, updated routes, infrastructure, among others over a time slot. With this, achieve the comparison of the place with different shots of satellite photographs.

Through the office system and its excel extension, data management has been carried out, information tables on the different elements offered by the mapping of geoportals and official information of technical studies to collect, organize and classify the information according to interest.

Delimitation of the study area.

Within the selection of the site was initially raised an area between the north area between the departments of Huancavelica-Huancayo because no protected area is located in it and has potential for the priority establishment for conservation by exercising a corridor between the protected areas of area UTM 19 and UTM 18 of the south-center of the country [22]



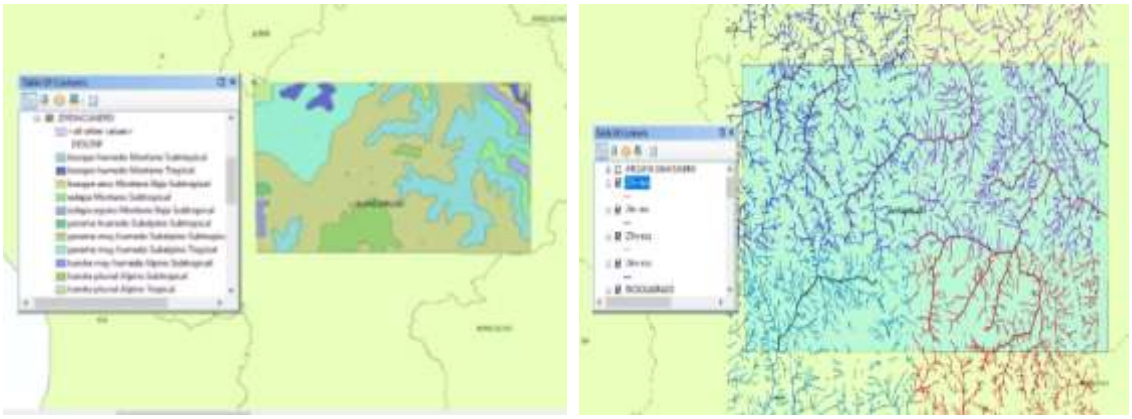
(a) **(b)**

Figure 4. Selecting the study area. (a) SERNANP Geoportal General Polygon Area (b) Identification of Large Red Hill of Huancavelica in Google Earth

The criteria of living area, ecosystems, and ecoregions are searched and overlapped to cover areas of protection and ecological conservation by the presence of strategic ecosystems for the provision of ecosystem services in the Andean region of mountains that are considered in

turn in an area with faunal richness, endemic floristic and endangered as an active zone in historical and natural vestiges of cultural importance [24].

The specific delimitation of the priority conservation area is carried out according to the comparative characterization and image supports and thematic cartography in the two computer programs, carrying out the delimitation according to the basins, which are considered the minimum management unit in the territory [25].

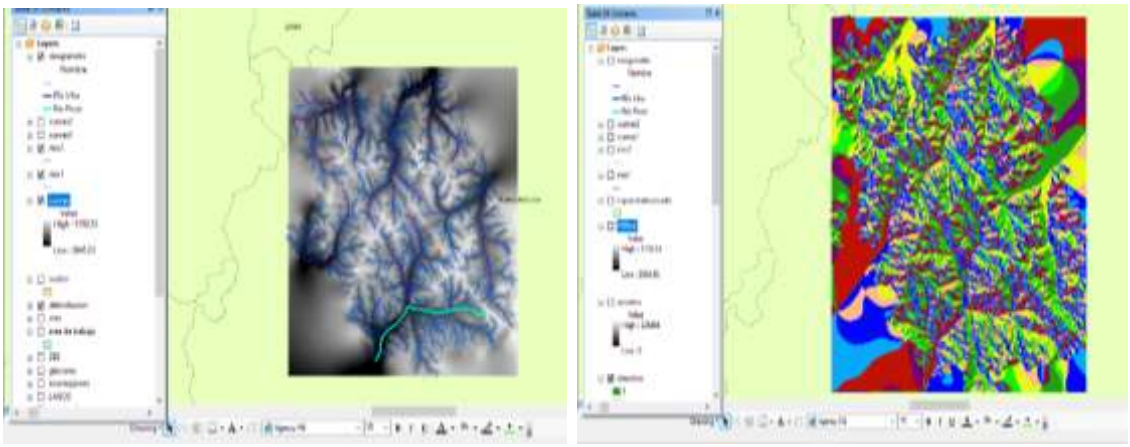


(a) **(b)**

Figure 5. Overlapping layers of natural-cultural interest (a) Establishment of priority zone based on life zones (b). Delimitation based on the conditions in the priority area.

It is intended to manage as the main conservation value the wasteland ecosystem and thus its water sources, which supply populated centers in the region; archaeological elements, bodies

of water of important cultural and natural significance, glaciers, flora, and fauna were also identified; which is categorized within IUCN's red lists [26,27].
With this specific delimitation, it is intended to take a significant sample of the values that are considered important to preserve within this proposed area.



(a) **(b)**

Figure6. Delimitation of the study area (a) Modelo Elevation model for delimitation of selected basins of the area and raster of elevation of reduced zone basins (b). Application of tools for water representation Fill.

Selection of conservation objects

The search for information for selecting conservation objects within the acceptable filter methodology was applied, looking for species of importance for the conservation of their populations by presenting some degree of threat. This is within the lists of IUCN, CITESand other classifications worldwide [28].
One of the criteria for the choice of species is the consideration of their representation at the national or regional level and that are relevant is biological aspects and whether for the area endemic species, flag, umbrella or key, therefore, proceeds to access these online platforms for the search under these criteria [29].
Spatial Data on the distribution of mammals, birds, reptiles were discharged to carry out a delimitation of these species within our priority area of conservation [30].
After obtaining shapefiles from this distribution data, validation of species within the delimited area was performed within the ArcMAP software.

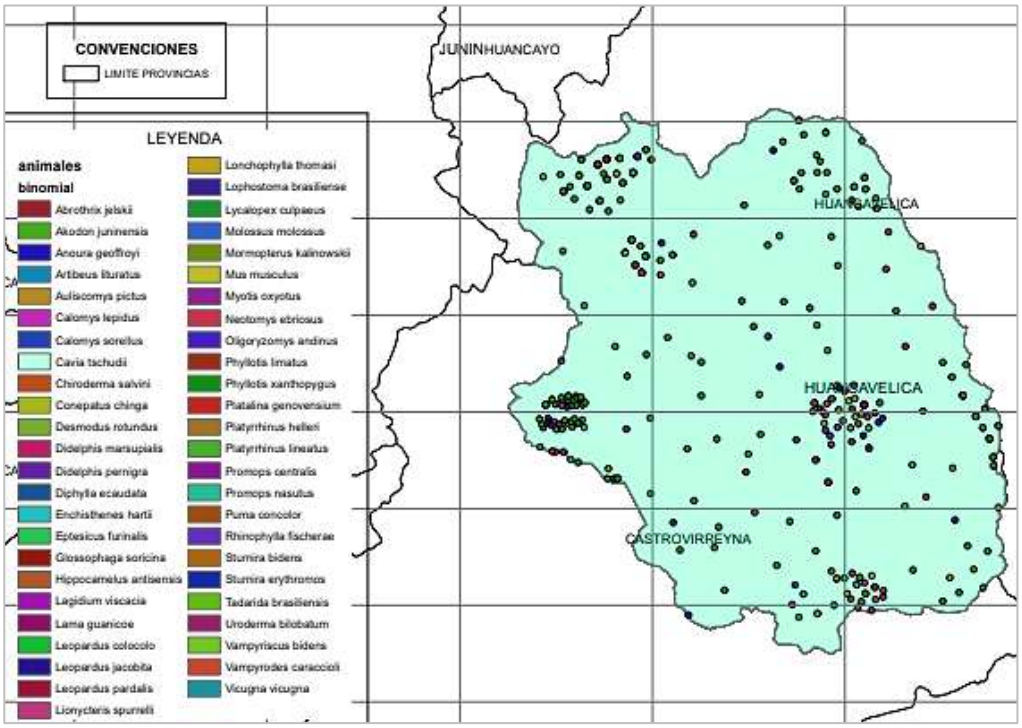
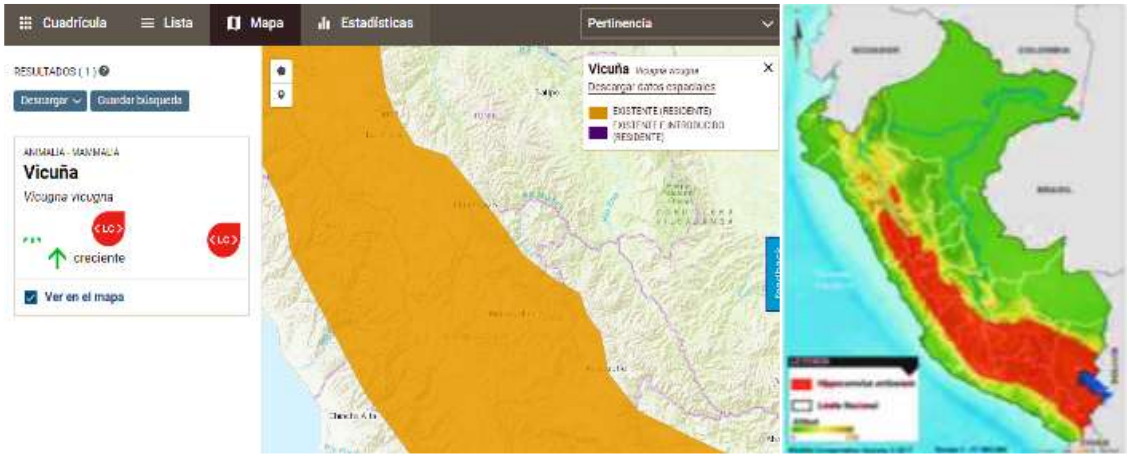


Figure 7. IUCN Wildlife Spatial data section. Distribution of species of a high degree of conservation in the priority area.

Linked to the previous process, the species review was carried out to consider their degree of threat and importance within the Red List, CITES, and the Law on Flora and Wildlife of Peru. To do the species review, the Red Book of Threatened Wildlife of Peru, all species found within the priority zone in the Huancavelica province region of Castrovirreyna and Huancavelica, was used see the degree of threat in which they are located [31].



(a) (b)

Figure 8. Results found on the IUCN portal. (a) IUCN Geoportal (b) Distribution map of conservation objects.

To analyze those sources of pressure and threats

A list of pressure sources and impacts considered on conservation objects was made to select the ones that are most widely represented in the six objects because for multiple objects they

can infer the same source of pressure or cause the same impact, those that will eventually be used in the hierarchical matrices made [32] are underlined in yellow.

Table 3. List of impacts considered in research

Impacts Pre-selected		
Habitat Loss	Extinction of the species	Habitat fragmentation
Population migration	Ecosystem degradation	Habitat pollution
Species decline	Landscape disturbance	Changing sub-water regimes
Water source pollution	Population decline (flora - fauna)	Government deficiency
Habitat disturbances	Loss of genetic diversity	Breaking biological corridors
Alteration in breeding cycles (animal)	Erosive processes on water margins	Decreased water supply quality
Despondenging water resources	Loss of plant cover	Change in water levels
Soil degradation and loss	Changes in plant composition	-

The process of ranking sources of pressure and impacts was carried out to each of the conservation objects in which the automatic weighting is made according to the qualification granted by the work team, for which it has been identified that the same sources exist pressure with similar impacts for different conservation objects, achieving qualifications to rank those with the highest preponderance in each of them [33].

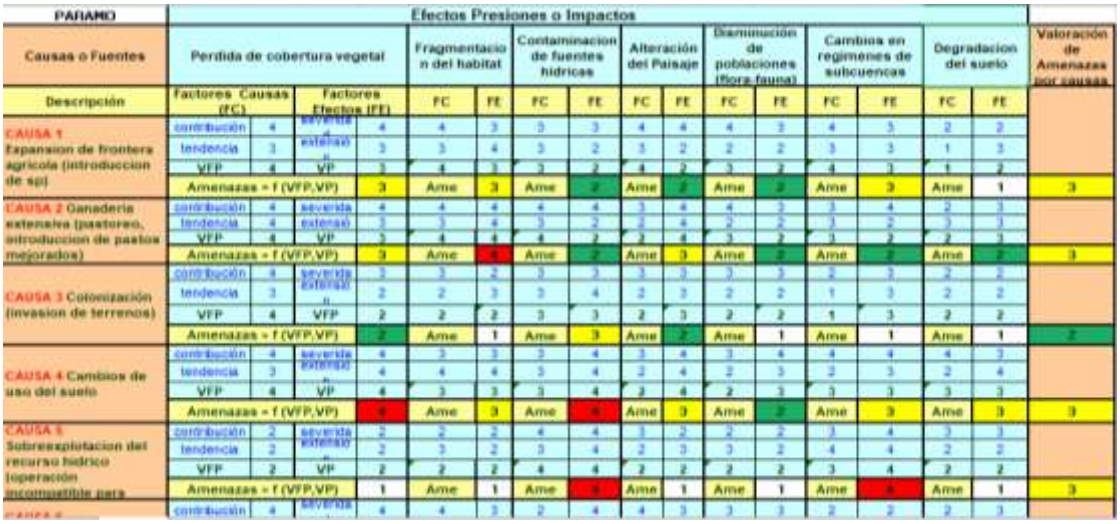
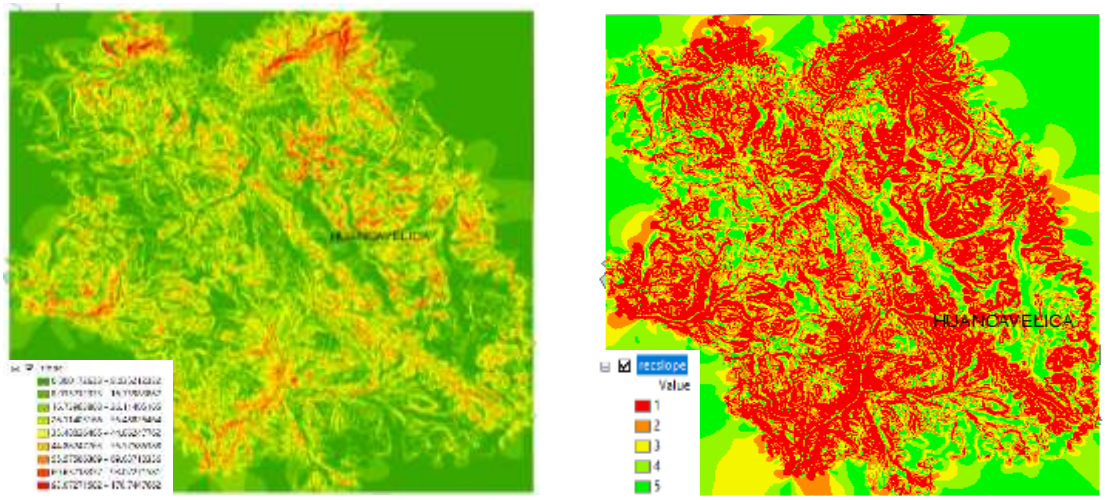


Figure 9. Hierarchical process for conservation objects. Selection of pressure sources and impacts based on each conservation object.

Zoning the priority site

It is intended to perform a weighted overlap in multi-criteria analysis of the study area in which 5 layers are used to perform the zoning of the place, in the first instance, the layers of ecosystems, pathways, cultural samples, economic-ecological zoning, and water sources [34] are used.

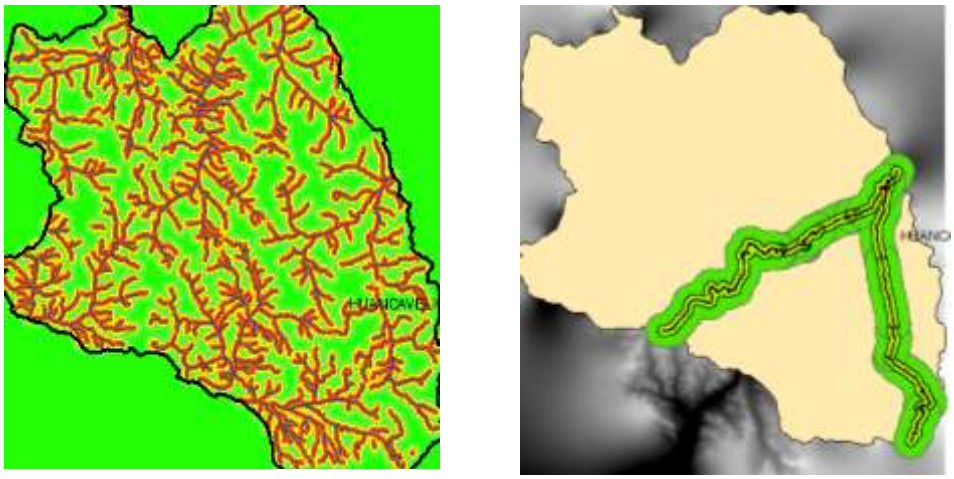
The raster analysis process is performed for slopes, reclassifying from low to very high considering slopes from 1 to 5% as accessible, 5 to 10% accessible with restriction 10 to 15% restricted, 15 to 25% not accessible, and> 25% prohibited access.



(a) **(b)**

Figura 10. Análisis ráster del sitio prioritario. (a). Sitio prioritario sin categorización de ponderación (b). Proceso con ponderación de alta a bajo.

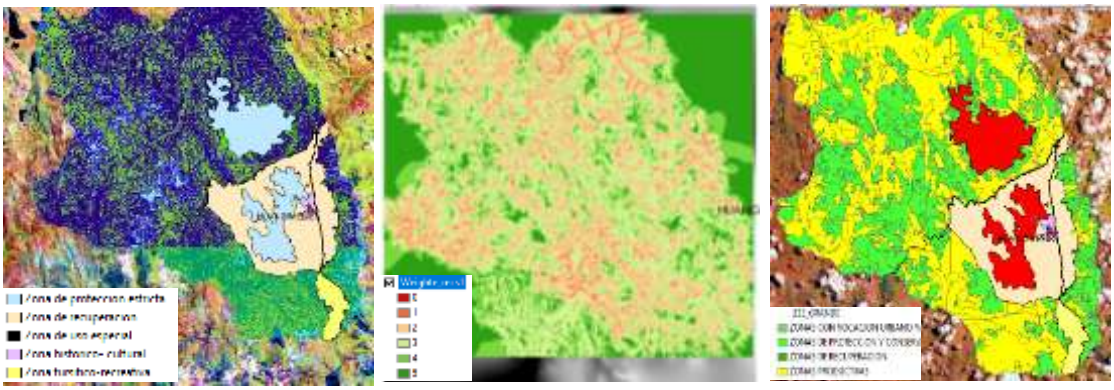
The raster is made based on the distance to water sources, in which less than 100 m is considered to be a low category, between 100 and 300 m., Medium, 300 and 1000 m high and more than 1000 m away is a very high category or optimal for delimiting conservation areas and that are far from human access. And the analysis of distance from roads and archaeological samples to contemplate areas that suffer impacts due to road expansion and load capacity in those areas [35].



(a) **(b)**

Figure 11. Identification of areas. (a). Evaluation of hydrological aspect using those of basins of the study area (b). Analysis of roads and access roads within the study area.

As a result of the analysis, the zones are classified for zoning according to the importance given in the categories, allowing polygons to be made over the areas and determining the zoning in the zone. After this, a comparative analysis of the coverage shown in satellite images is carried out with the result to make the respective polygons with contour guidance, water sources, and elements of interest for zoning, for which overlap between layers of ecosystems, EEZ, rivers, archeology to make the areas that were consistent with the topography of the place [36] [37].



(a) (b) (c)

Figure 12. Zoning. (a). Based on the criteria of the legal regulations of Peru (b). Analysis of optimal locations of the study area. (c) High biodiversity areas.

4. RESULTS

Delimited study area.

The priority site is located in the department of Huancavelica in the south west of the country, hosts the provinces of Huancavelica and Castrovirreyna, the districts of Acobambilla, ascension, Aurahua, Castrovirreyna, Chupamarca, Huachocolpa, Huancavelica, Manta, Nuevo Occoro and Santa Ana.

It comprises 179 227.92 ha, located in the southwest area that borders to the north with the department of Junín, to the west with the Pisco River, to the east with the province of Angaraes to the south with the province of Huaytara.

The limits are described in the following table:

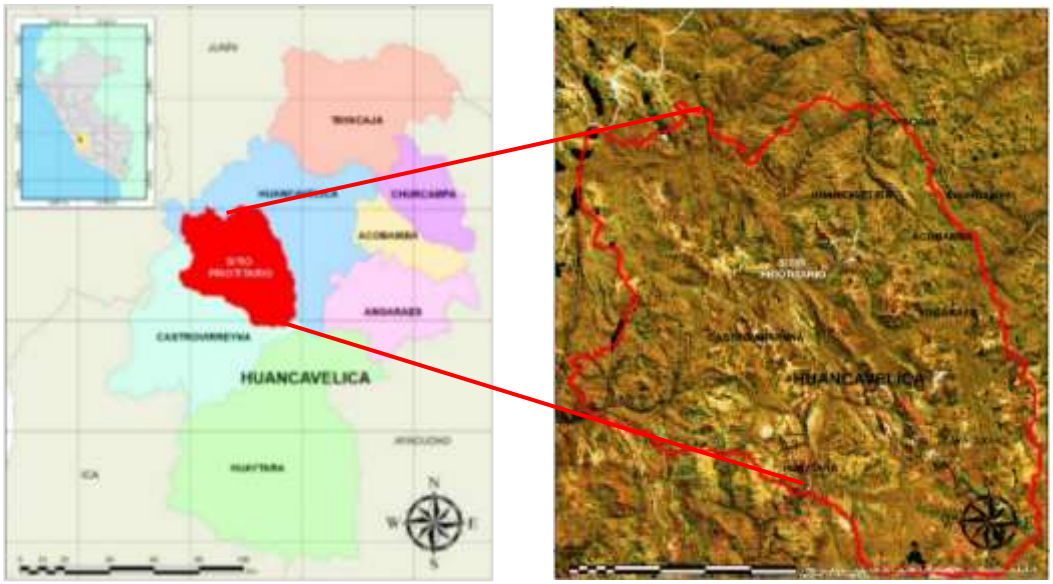
Table 4. Geographic coordinates of the Priority Site in Huancavelica

Coordinates	Latitude	Length
Northeast	12º39’21.00” S	75º11’09.37” W
Southeast	13º07’01.95” S	75º03’57.43” W
Northwest	12º40’50.92” S	75º28’58.85” W

Southwest	12º54'26.55" S	75º29'09.71" W

Table 5. UTM coordinates of the Priority Site in Huancavelica

Coordinates	Area	North	Abscissa
Northeast	18L	8600356.84 m	479809.12 m
Southeast	18L	8549321.19 m	492851.18 m
Northwest	18L	8597552.10 m	447554.55 m
Southwest	18L	8572486.31 m	447274.07 m



(a) **(b)**

Figure 13. Location of the study scope. (a) Priority site location map on Google Earth. (b) Priority site location map with a satellite image. Source: Own elaboration.

Conservation Objects.

To select the values under conservation, VOC established the use of the fine-thick filter methodology used within the methodology by SERNANP to establish and modify ANP in the country.

Main criteria

The site's biodiversity and the conditions proposed to define ecosystems or communities represent the most biodiversity of the area.

Table 6. Classification of ecosystems in the priority zone

Life Zone	Ecosystem	Inegetación
Moor	1. Very humid subtropical subalpine 2. Very humid tropical subalpine	1. Wet-pointed pajonal 2. Andean bush
Andean Forest	1. Subtropical montane wet forest 2. Tropical montane rainforest	1. Queñoal forest 2. High Andean remnant forest
Tundra	1. Subtropical Alpine Rainforest 2. Tropical Alpine Rainforest	1. Bofedal 2. Pajonal 3. Periglacial zone

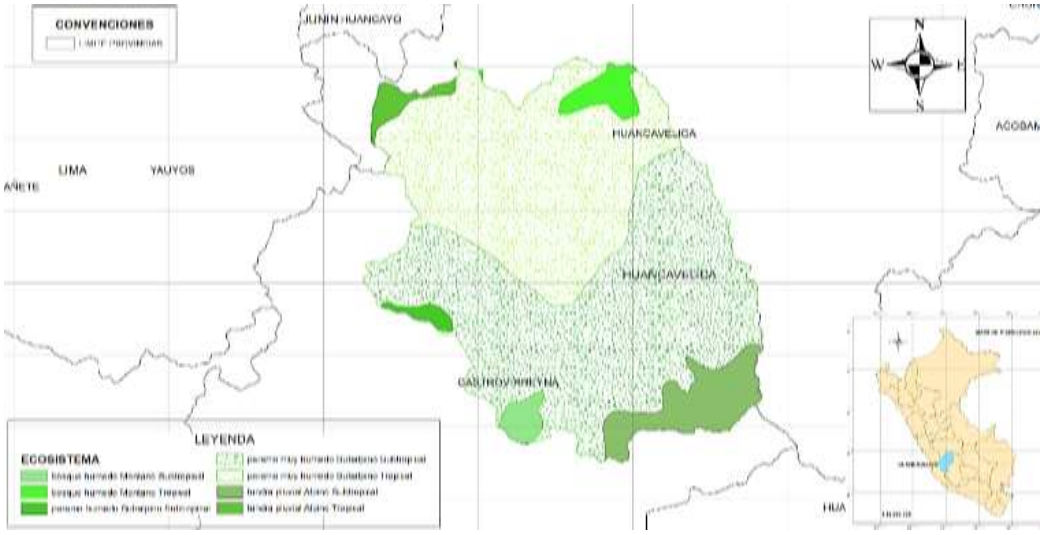


Figure 14. Map of moorland ecosystem location within Huancavelica priority conservation area

Of the living areas present in the prioritized area, the most important for the ecological value it has for the area in the proportion of the water resource and with greater extent is the ecosystem of Páramo according to its two subclassifications in which it is the conservation object selected within the thick filter, and that prioritizes its conservation with all the elements that make up it and those that are in the spatial-temporal configuration in the place [38].

Table 7. Preselected and selected species from Peru's Red Book of Endangered Wildlife present in the area.

Selected Species		
Puma concolor	*Lama guanicoe*	*Vampyrodes caraccioli*
Vicugna vicugna	*Hippocamelus antisensis*	*Leopardus pardalis*
Leopardus jacobita	*Leopardus colocolo*	*Cinclodes palliatus*
Atlapetes melanopsis	*Lagidium viscacia*	*Leopardus colocolo*

The selection of conservation objects related to cultural, recreational, historical, mythological, or interest importance is closely linked to the protected area's actors and communities. Archaeological displays of pre-Inca villages that have great cultural value in the region as a missing village of Conayquinos that inhabited the Llaqta Qolloy area which represents archaeological vestiges of the ancestral Conayquina culture [20]

Table 8. Archaeological pieces of Conayquina culture in the priority area.

Muestras Arqueológicas	
Astobamba Viejo	Llaqta Pata
Cruz Esquina	Llaqta Qolloy
Torre Qapa	Patacorral
Pikimachay	-

Figura 15. Objetos de conservación seleccionados. (a) *Hippocamelus antisensis*.(b) *Lama guanicoe.* (c)*Cinclodes palliatus*. (d) *Ecosistema Páramo.*

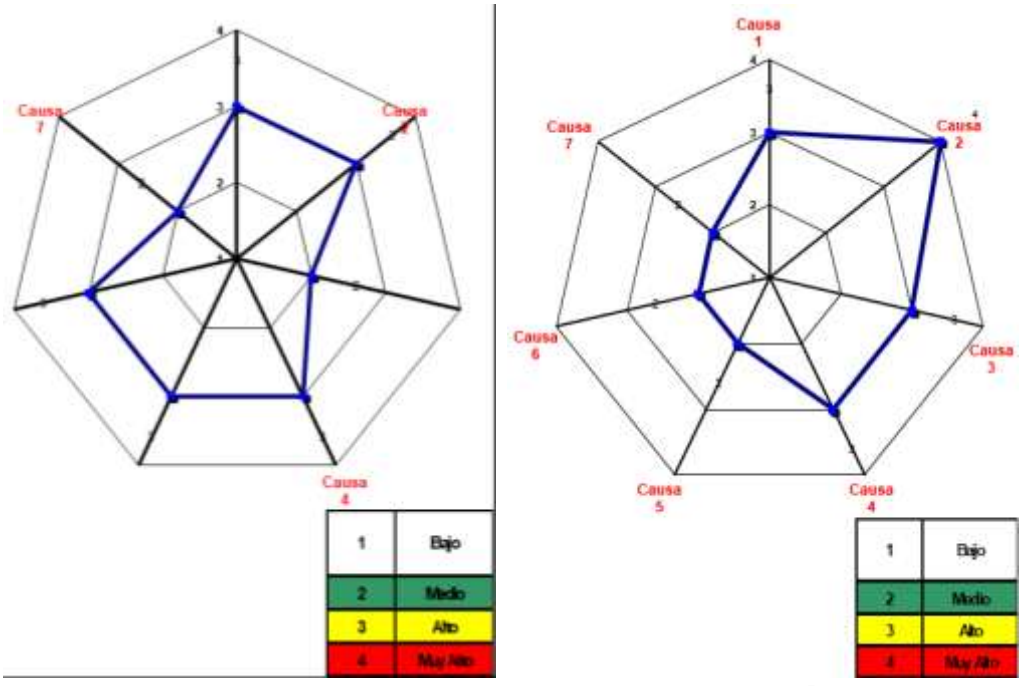
Identifying sources of pressure and threats

According to the identification and selection of sources of pressure, the main threats of anthropic origin affecting the six conservation objects are mainly the product of subsistence activities for the case of wasteland and threatened fauna such as sustainable agricultural expansion, the development of infrastructure projects whether road, mining or other liabilities in which land use change and poaching and indiscriminate hunting are, for the supply of water and archaeological samples are contemplated the first named and overexploitation of the resource either water or tourist generating loss of ecosystem and cultural order.

7 resulting impacts were identified for each of the 6 conservation objects, in which ecosystem degradation, biodiversity loss, and landscape alteration predominate due to pressure sources that directly or indirectly stagger each VOC and have an impact on composition, structure, and function criteria for the threatened ecosystem and fauna; functionality in the offer of services for the provision of the water resource and physical preservation and sociocultural impact within the Conayquina culture.

Table 9. Assessment of the threat of the priority zone

Object of conservation	Assessment of the threat of the priority site
Wasteland ecosystem	Very High
Hippocamelus antisensis (Taruca)	High
Guanicoe Blade (Guanaco)	High
Cinclodes palliatus (White Belly Churrete)	Middle
Water supply	High
Archaeological samples	Middle



(a) **(b)**

Figure 16. Hierarchy of pressure sources and impacts. (a) *Wasteland ecosystem has* a very high degree of threat *from* causes *3,4,5, and 6.* (b) *Hippocamelus antisensis has a high degree of threat.*

Zoning the priority site

Has established the zoning for the Historical Shrine of Conayquina, following Article 23 of Law 26834 Law on Protected Natural Areas, taking into account their already proposed needs and objectives, of which six areas were obtained, which are: special use area, area for tourist use and recreation, cultural, historical area, strict protection zone, recovery area and wilderness area with a total area of 187 499.7. It should be noted that within the zoning of the

protected area, there is no Strict Protection Zone due to the degree of recurrence of people by the Area for tourist and recreational use.
On the other hand, despite being categorized as a Historical Sanctuary, it has its extension the wasteland ecosystem, which provides various ecosystem services; in this area inhabit species of fauna of great importance, which are subject to sources of pressure. These conditions make the zoning process thorough work where wild areas should be considered.

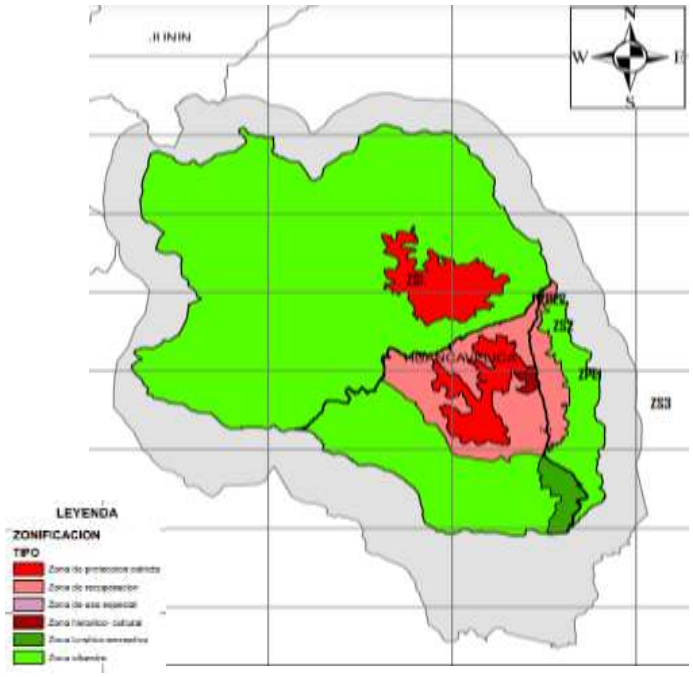


Figure 17. Zoning map based on SERNANP regulations for the priority site proposal.

Table 10. Priority Site Zoning Categories

Zoning	Area (ha)	Percentage (%)
Wild area	150424.303	80.2
Area for Tourist and Recreational Use	2580.551	1.38%
Cultural Historical Zone	558.336	0.30%
Recovery zone	18216.110	9.72%
Strict protection zone	14789.290	7.89%
Special use area	931.203	0.50%
Total	187499.78	100%

5. CONCLUSIONS

The proposal to create a priority site in the Huancavelica region aims to benefit environmental, cultural and social aspects; since the identification of conservation, objects

shows that it has a high degree of biodiversity of an international nature, presents unique species that need protection, remembering that moors are also fragile and vital ecosystems to maintain water cycles because they allow the transformation of mist into water resource that in turn generates the birth of lakes and rivers.
This priority site should be seen as a conservation strategy in the region, to maximize and potentialize the services offered as a tool, to be able to meet the needs of local communities and thus promote sustainable development through community and government interrelationship, taking as a concrete sample and contribution to the conservation of vegetation, fauna, landscapes that are considered one of the most fragile and endangered in the world.

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