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# Protected Area Profile
# Perú
# Junín National Reserve

**ParksWatch Perú**
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**Date of last field evaluation:** January 2006
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**Location:** Departments of Junín and Pasco
**Year established:** 1974
**Area:** 53,000 ha
**Ecoregion:** Puna of the Central Andes
**Habitats:** Tropical mountain steppes, Andean grasslands, and wetlands

## SUMMARY

*Description*

The Junín National Reserve is located in the Central Andes of Peru. Its 53,000 hectares border Lake Junín, the second largest lake in the country. The lake drains toward the northeast into the Mantaro River, which is one of the principal Andean tributaries of the Amazon Basin. This lake forms an important hydrographic system fed by 12 rivers and 20 streams. The Oriental, Central, and Occidental Mountain Ranges converge in Junín, creating the Nudo de Pasco to the north and an extensive flatland, known as the Bombón Plateau.

*Biodiversity*

The biological diversity of Junín National Reserve is typical of the high Andean landscape, or the puna (humid alpine grasslands) of the Central Andes. The dominant vegetation communities are high dense grasslands with Andean wetlands and puna grasslands. The presence of the lake attracts a special, diverse population of birds to the area, including resident and migrant species. The Junín grebe inhabits the area, which is an important conservation target. Mammals are scarce, however, the Andean fox, montane guinea pig, pampas cat, and vizcacha (a large rodent) are found in the reserve.

*Threats*

Lake Junín is a highly productive ecosystem with a unique biological diversity that, over the years, has experienced strong pressure from resource extraction, overgrazing, and contamination from mining residues and municipal wastewater. The main threats to the Junín National Reserve include agriculture, ranching, nearby mining operations, the hunting and fishing of threatened species, the removal and burning of cattails and other vegetation, and hydroelectric power operations impacting the lake.

*View of Junín lake in an area of cattail communities*

## DESCRIPTION

The Peruvian Government established the Junín National Reserve with an area of 53,000 hectares bordering Lake Junín and its adjacent territories, through Supreme Decree No. 0750-74-AG on August 7, 1974.

### Location, area, and boundaries

Junín National Reserve is located in the Central Andes of Peru, in the Carhuamayo, Ondores and Junín Districts of the Department of Junín and the Ninacaca and Vicco Districts of the Department of Pasco. The area is surrounded by an extensive high plateau known as the Bombón Plateau, as well as small lagoons such as Lulicocha, Chacacancha, Tauli, Cusicocha, Ahuascocha, and Rusquicocha.

The lake is situated in the far northeastern pampas of Junín, at the geographic coordinates of 10º 50’ 50” S - 75º 59’ 25” W and 11º 09’ 55” S - 76º 15’ 40” W (8800000 – 360000 and 8760000 – 400000, UTM coordinates) The elevation of the National Reserve ranges from 4080 to 4125 meters above sea level (masl).

### Geology and Geomorphology

The origin of the plateau dates back to the last glaciation (during the Pleistocene Era, 12,000 to 15,000 years ago). In the north, the glaciers converged on both sides of the plateau from the mountains and deposited moraines which formed a dike in this area. In the far south, deposition fans impeded drainage, which led to the formation of Lake Chinchaycocha, also known as Lake Junín.

Although the origin of the lake is not well established, it is possibly related to tectonic phenomena. Another theory maintains that a slight, progressive sinking which occurred once the raising of the Andean Mountains concluded, generating a depression which formed the lake.

The Oriental, Central and Occidental Mountain Ranges converge in Junín, creating the mountain peak known as the Nudo de Pasco to the north. An extensive plateau is formed here, known as the Bombón Plateau, a name which alludes to the ancient people of the region known as the Pumpush, or Pun-Pun. In the reserve there are somewhat deteriorated archaeological artifacts, found near the Upamayo Dam in the northern part of the protected area.

The origin and composition of the geologic strata pertain to continental facies and marine sediments. Continental facies, which are found in deposits on the southern, eastern, and northern shores of the lake, are from Quaternary sedimentary rocks composed of conglomerates and clays formed by moraine and glacial fluvial deposits which settled in depressions. Marine sedimentary deposits from the late Triassic and early Jurassic Periods are seen on the western shore. These are the oldest deposits, which are principally sedimentary limestone rocks corresponding to the beginning of the Mesozoic Era.

**Physical Geography**

*View of Lake Junín and the surrounding area*

The topography of the land surrounding the northern, eastern and southern shores is predominantly flat, with gradients of 1% to 4%, which can be observed from the Upamayo Bridge and from Paucarcoto, points on the border of the pampas of Huampuay and pampas of Vicco, respectively. The topography of the southwestern, western and northeastern shores is totally different, where hills ranging from 50 to 150 meters above the surface border the lake, with gradients of up to 45%.

**Soils**

The principal soils of the Junín National Reserve are: eutric histosols, which are soils developed from lacustrine sediments, found on slopes of 0 to 2% and permanently hydric conditions; phaezoms, which develop from weathered sandstone, quartz, and occasionally limestone or calcium carbonates; and eutric litosols, soils that develop over intrusive volcanic materials, limestone, calcium carbonates, calcareous sandstone.

## Climate

The climate of the region is characteristic of the lower puna, where the temperature fluctuates between 3 and 7 degrees Celsius, with the coldest months being between May and September. Annually, there is an average of 940 millimeters of rainfall, mostly in the months from December to April, with the least rainfall during the months between June and September.

## Hydrography

*Mantaro River Basin*

The Mantaro River Basin in Peru contains the greatest number of lagoons of any watershed on the Atlantic slope of the Andes, many of which are larger than 400 hectares. Lake Junín, or Lake Chinchaycocha, is located in this watershed and is second only to Lake Titicaca in area. Its variety of landscapes, size, and biodiversity, make it the characteristic environment of the region.

*Lake Junín*

Lake Junín is located within the Mantaro River basin. The lake drains to the northeast, initially into the Upamayo River, above the Upamayo Dam. This dam, which began operating in 1936, regulates the level of Lake Junín and is used to generate electricity at the Malpaso hydroelectric plant. Below the dam, the Mantaro River begins, which forms one of the principal Andean tributaries of the Amazon Basin.

Twelve rivers and twenty streams gather the water of the humid, wet areas of the region and feed into Lake Junín. These include the Yahuarmayo, the Mararychaca, the Condorcocha, and the Huascán Rivers, all of which are located to the west of the towns of Carhuamayo and Ninacaca. Other rivers of the system include the San Juan, San José, Chacachimpa Rivers.

*Limnology*

The lake reaches a maximum depth of 12 meters (10 kilometers offshore of Huayre), with a surface elevation of 4082.7 masl. The temperature of the lake decreases with depth, from 17ºC at 15 cm, to 15.5ºC at 1 meter, 15ºC at 3 meters, and 14ºC at 6 meters.

The lake is extremely contaminated by mining waste in the northeastern section. Also, the decomposition of submerged vegetation and the discharge of wastewater from the towns of Junín and Carhuamayo lower the available oxygen and increase the phosphorous load in the lake. In the center of the lake, oxygen availability is higher due to deeper water and greater aeration. Decomposition of organic matter at depth also increases the ammonium content of the lake water.

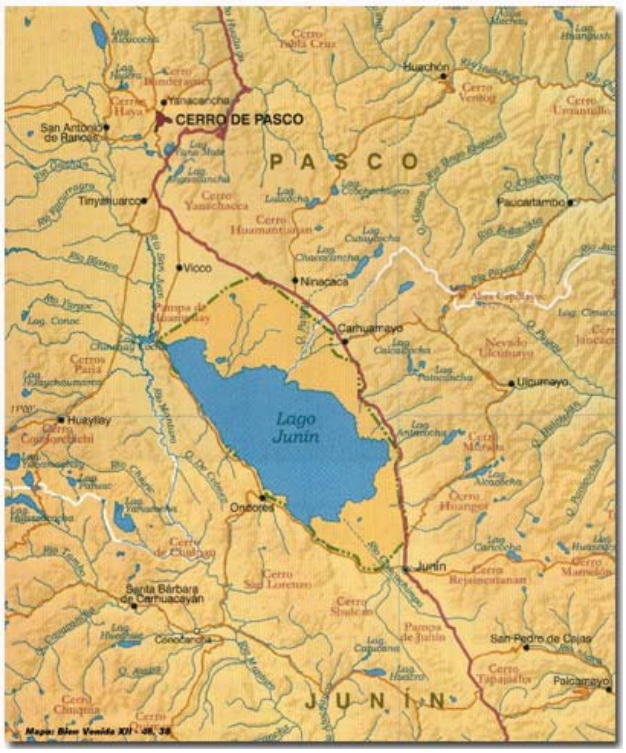
Lake Junín is a undergoing a process of eutrophication, and any addition of nitrogenous compounds will accelerate this process. For this reason, wastewater discharged into the lake poses a serious problem.

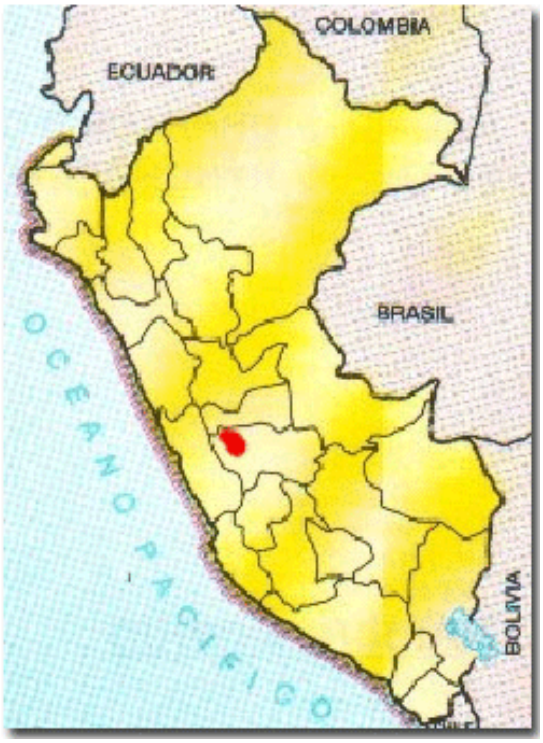
Iron content and turbidity are higher in the area of the Upamayo bridge as a result of the accumulation of mining waste in the lake. The high iron content of the water also leads to lower

dissolved oxygen content. The pH is almost neutral, although it tends to be lower, especially during the dry season and times of drought.[1]

### Access

The most common access to the Junín National Reserve is via the Central highway, taking the exit to Tarma in Oroya, and then the exit for Junín. It takes approximately 5 hours to travel to Junín from Lima. In the dry season, there are two alternatives routes to the zone. One is the highway from Canta-cordillera La Viuda to Pasco, which will soon be paved and takes approximately six hours to travel, while the other, lesser-known route goes from Canta-cordillera de La Viuda through (Yactac) Marcapomacocha-Corpacancha-Conocancha-Atocsaico-La Cima to Junín.[2]




## BIODIVERSITY

The biological diversity of Junín National Reserve is typical of the high Andean landscape, or puna of the Central Andes. The dominant plant communities are high dense grasslands with high Andean wetlands, puna grasses, and cattail communities along the lakeshore. The lake attracts a special and diverse population of birds, including both resident and migratory populations. In particular, the Junín grebe is an important conservation target for the area. Mammals are scarce, although the Andean fox, montane guinea pig, pampas cat, and vizcacha are found in the reserve.

## Vegetation

The vegetation of Lake Junín is typical of the high Andean landscape, or lower puna, with its characteristic natural plant communities of as dense grasses with high Andean wetlands, puna grasslands, and cattail communities along the lakeshore.

Plant diversity in the region is important. In a study of the types of vegetation and floral diversity of the Mantaro River basin, 1460 plant species from 120 families and 560 genera were encountered within the entire basin (from Lake Junín to the confluence with the Apurímac River), and many species remain undiscovered. However, the National Reserve, due to its elevation, is the area of the basin with low species diversity, containing only a fraction of the number of the species noted above.

Within the Junín National Reserve, data has been gathered on a total of 155 plant species. The best-represented botanical families are Poaceas (43 species, 12 genera), Asteraceas (15 species, 12 genera) and Fabaceas (10 species, 5 genera).

*Pasturas altoandinas cercanas al lago*

The best examples of high Andean grasslands are found in the puna grass communities, a zone where local ranching activity is concentrated. The extensive Junín pampas is very degraded due to overgrazing. The Special Use Zone of the reserve primarily contains introduced grass species.

"Maca" (*Lepidium meyenii*), an endemic plant of the Bombón Plateau, is a small, herbaceous plant with a yellowish-white tuber root cultivated in the region. It is considered a nutritious source of amino acids and carbohydrates. Medicinal plants are of vital importance to the traditional use of plant resources in the region, and local residents use the plant to rebuild their strength.

*High Andean pastures near the lake*

Several crops cultivated in the area are economically important. Agricultural activity only occurs in the lower hills near the pampas, because it is too cold in the flatter parts of the plateau. Potatoes, barley (for forage), and other tuber vegetables, such as olluco (*Ullucus tuberosus*), mashua, (*Tropaeolum tuberosum*) and oca (*Oxalis tuberosa*), are grown sporadically throughout the area.

Native shrubs, including mutuy (*Cassia sp.*) and huamanpinta (*Chuquiraga spinosa*), among others, are common in the area, as well as a condiment plant called halunish (*Senecio condimentarius*), also called amañacay, which has a fragrance like cilantro (*Coriandrum*).

Vegetation communities in the area are affected by both contamination from mining waste and the extraction of vegetation as a fuel source.

Moving from the lake outward, four distinct zones of vegetation are observed:

*Aquatic vegetation*

Submerged aquatic plants, including *Myriophyllum quitense, Elodea potamogeton, Potamogeton ferrugineus, Potamogeton filiformis*, *Utricularia sp.*, and some species of algae, such as *Chara fragilis, Scytonema sp*. *Zygnema so*., and *Mougeofia sp*., are found in the lake. The floating plants *Lemna sp*., *Spiodela sp*., *Azolla filiculoides* are also seen here. No studies exist regarding the present situation of these species.

*Cattail Communities*

Cattails form extensive communities along the lakeshore, which consist of two robust species that can reach nearly two meters in height (*Scirpus californicus var tatora* and *Juncus articus var andicola*). These communities are known as tortoras, and in most areas, the vegetation is very dense, to the point of being impenetrable. During times of low lake levels, cattail communities in shallow areas may become partially or completely dry.

*Cattail vegetation in the southern part of the lake*

Along the exterior of these communities, several herbaceous plant species occupy areas that are not inundated, or flooded only occasionally. These include: *Ranunculus flagelliformis, Isoetes andicola, Hypsella reniformis, Lilaeopsis macloviana, Hydrocotyle ranunculoides, Rorippa nasturtium-acuaticum, Alchemilla diplophylla, Scirpus spp*., *Eleocharis sp*., and "cocha yuyo" (*Nostoc commune*).

*Pampas*

High Andean wetlands and, in dry soils, puna grasses are found in the zone surrounding the lake. Andean wetlands are observed in the pampas of Junín, near springs or small ditches that run into the lake. The characteristic vegetation consists of herbaceous plants such as *Distichia muscoides*, champa estrella (*Plantago rigida*), waca curu (*Hypsella reniformis*), *Alchemilla diplophylla*. On the edges of the ponds and lagoons, algae species such as ilullcha (*Nostoc sphaericus*) and cocha yuyo (*Nostoc comune*) are commonly encountered.

Puna grasslands, the dominant plant community in the pampas, are composed of smaller vegetation. Crespillo (*Galamagrostis vicunarum*), the dominant species, is approximately 8 – 15 cm tall. Several other smooth-leaved grasses are common, and there are also other small plants such as cuhipelo (*Scirpus rigidus*), putki (*Geranium sessiliflorum*), *Werneria nubigena, Astragalus backenridgei, Lupinus brachyphyllus*, *Paranephelius ovatus*, *Alchemilla pinnatay* and, in the driest areas, garbancillo (*Astragalus garbancillo*), huarajo-quichca (*Opuntia floccosa*) and yareta (*Azorella diapensioides*).

*Surrounding hills*

Rocky clay soils characterize the areas of gentle slopes, rocky soils are found on the surrounding hills. The dominant vegetation community is puna scrub, which consists of grasses with hard, pointed leaves called "ichus." The most notorious are *Calamagrostis rigida*, *Calamagrostis recta*, *Festuca dolychophylla*, *Stipa ichu*, *Stipa obtusa.* Other plants exist in the lower strata.

Certain resinous shrubs, including *Baccharis tricuneata*, *Chuquiraga spinosa*, and *Ribes cuneifolium*, exist sporadically in rocky soils. Although *Polylepis* has not been observed in the wild in this area, it is common in other puna ecosystems and can be seen planted around some houses in the area.[3]

**Fauna**

Bird species are most important to the National Reserve. The birdlife of Lake Junín is the richest of all high Andean wetlands in Peru, equaled only by that of Lake Titicaca. There is an abundant variety of birds of different origin, interest, and management needs, including those that use the lake as a stop on long migration journeys, those that nest at high altitude, and the endemic species and subspecies of the area. All of these benefit from the protection of the Lake Junín National Reserve.

*Junín grebe (Courtesy Photo)*

Among the endemic species of the reserve, the most well-known is the Junín grebe (*Podiceps taczanowskii*), a species on the brink of extinction. As this species evolved, it lost the ability to fly, which prevents is from relocating to other lakes. Its extinction appeared imminent in 1992 when the population dwindled to only 80 individuals. However, thanks to several years of good rainfall and a gradual improvement in water quality, according to the mining companies, the species has partially recovered.

*Junín grebe (Courtesy Photo)*

Little is known regarding the biology or conservation situation of another endemic species, the Junín coot (*Laterallus tuerosii*). Apparently, the bird is threatened by the reduced area of its typical cattail habitat, which are being contaminated by pollution from the mines and burned during guinea pig hunts. The silvery grebe (*Podiceps occipitalis*) and the white-tufted grebe (*Rollandia rolland*) are also considered endemic subspecies of the lake.

Aquatic birdlife includes the speckled teal (*Anas flavirostris*), yellow-billed pintail (*Anas georgica*), puna teal (*Anas puna*), ruddy duck (*Oxyura jamaicensis*), huallata (*Chioephaga melanoptera*), coot (*Fulica ardesiaca*), moorhen (*Gallinula chloropus*), black rail (*Laterallus tuerosi*), Chilean flamingo (*Phoenicopterus chilensis*), lique-lique (*Vanellus respiendens*), and Andean gull (*Larus serranus*).

Mammals are scarce within the reserve, however, the Andean fox (*Pseudalopex culpaeus*), the long-tailed weasel (*Mustela frenata*), the hog-nosed skunk (*Conepatus chinga*), the vizcacha (*Lagidium peruvianum*), pampas cat (*Onicifelis colocolo*), and the mountain guinea pig (*Cavia tschundii*). Among the most well-known amphibians of the lake is the Junín frog (*Batrachophrynus macrostomus*), an edible species. The *Orestias spp*. and *Trichornycteris oroyae* are the most important fish species in the reserve.

The list of threatened wildlife of Peru (Supreme Decree No. 013-99-AG), includes various species which inhabit the Junín National Reserve. There are important resident populations of birds, as well as significant proportions of other bird populations which benefit from and depend on the protection of the lake. The Junín grebe (*Podiceps taczanowski*) is in danger of extinction. The Andean gull (*Larus serranus*) and Chilean flamingo (*Phoenucopterus chilensis*) are classified as vulnerable. The Andean avocet (*Recurvirostra andina*) and the Andean flicker (*Colaptes rupicola*), are considered rare. The status of the crested duck (*Anas speularioides*) is undetermined. The Junín frog (*Batrachophrynus macrostomus*) is locally extinct at the lake due to excessive hunting, pollution, and increased water temperatures from the effects of El Niño.

There are very rare species found around the lake, but the space does not offer adequate protection, and their protection should be pursued in other conservation areas. These include the condor (*Vultur gryphus*), the peregrine falcon (*Falco peregrinus*), and the giant coot (*Fufica gigantean*), all of which are considered vulnerable.

Certain species have only been observed in the park a few times. Their presence in the park is probably incidental and the reserve does not generally benefit their populations. These include the vulnerable torrents duck (*Merganetta armata*), neotropic cormorant (*Phalacrocorax olivaceus*), as well as the fulvous whistling duck (Dendrocygna *bicolor*), and comb duck (*Sarkidiornis melanotos*), both of which are of undetermined status.

Among the mammals, pampas cat (*Oncifelis colocolo*) and the Northern Andean deer (*Hippocamelus antisensis*) are both in danger of extinction, while the vicuna (*Vicugna vicugna*) is considered vulnerable.[4]

## MANAGEMENT

The objectives of the Junín National Reserve include the integrated conservation of the ecosystem, its associated flora and wildlife, and the scenic beauty of the lake, as well as the support of socioeconomic development in the region through the sustainable use of its renewable natural resources.

Since 1991, Peru has been a signatory nation to the Ramsar Convention on Wetlands of International Importance as Aquatic Bird Habitat, also known as the Ramsar Convention, which was established in Ramsar, Iran in 1971. The fundamental objective of the convention is the conservation of wetlands due to their importance in various ecological processes and for the fauna and flora that they shelter. The Junín National Reserve is one the sites listed by Peru as a Wetland of International Importance. It was accepted by the Convention Secretariat in January of 1997, and it was a Ramsar Fund Small Grant for the Conservation of Wetlands that financed the development of the proposed

Master Plan of the Junín National Reserve. This plan was approved through Chief Resolution 089-2000-INRENA on March 20, 2000.

**Master Plan**


*Interpretive center in the town of Ondores*

The Master Plan is a planning document of the highest level, in which zoning, strategies, and general policies of the reserve are defined. Its objective is the integration of the public and private efforts to achieve the sustainable development of Junín National Reserve. It grants protection to the resident and migratory birds, for which the reserve serves as a habitat and refuge, and seeks to preserve a representative sample of the species of flora and fauna and maintain the biological processes of the high Andean wetlands. The Master Plan also seeks to contribute to economic development by promoting the sustainable use of natural resources of the reserve, raising local and regional awareness of the importance of conservation and reasonable use of natural resources, and encouraging scientific research regarding natural resources.[5]

**Zoning**

Zoning is a necessary planning tool for adequate management of the area. Zoning for Junín National Reserve was established according to the provisions of the Law of Protected Natural Areas (Law No. 26834), the Directive Plan (Supreme Decree No. 010-99), the physical characteristics of the protected area, the diversity of the flora and wildlife, and the uses of local communities or visitors to the reserve. According to these provisions, the following zones were defined:

Wild Zone: Areas that have suffered little to no human intervention and which have a predominantly wild character. Aside from monitoring and administrative activities, scientific research, educational, and recreational activities are permitted as long as they do not alter the natural state of the zone. The wild zone borders almost the entire body of the lake and the cattail communities, because these areas are essential habitat for the aquatic species protected by the area.

Tourist and Recreation Zone: Areas of scenic landscapes which attract visitors and those areas suited to low impact recreational activities. Educational and research activities are permitted, as well as service infrastructure needed for visitor access, including passable roads, shelters, and motorized vehicles. In Junín National Reserve, this zone is composed of two sectors, the first in Pariacancha, on the east side of the reserve, and the second, north of the town of Ondores, in the western part of the reserve.

Direct Use Zone: Areas where direct utilization of flora or wildlife is permitted, including fishing, according to specified conditions which are compatible with educational, research, and recreational activities. The direct use zone covers almost the entire the lakeshore, including wetlands and surrounding pastures. Independent of the seasonal variations in the lake level, fishing is permitted within 500 meters of the shore, except in cattail communities (which is not respected). The activities that occur in these areas depend on technical guidelines established by the administration such as closed seasons, grazing capacities for the pastures, take limits, and other needed regulations.

Special Use Zone: Areas in which some type of agriculture, ranching, agroforestry, or other activities occur which transform the original ecosystem. It includes towns which existed prior to the establishment of the reserve. The special use zone consists of two sectors: the northeastern sector of the reserve, including the towns of Condorcayan, Condorcocha, Hagopuquio, Oxapampa, Rallway, Huaylas, Aco, Tambo del Sol, Yachicancha, Huacllacancha, Rocan, Comac, Murquish, Malqui, Colca, Cascán, Yuracaya, Paucar, Cantra, Picón, Gueguesh, Chagshatambo, Jucjuccha, and Guñoc; and the southern sector of the reserve, including Santa Maria de Llacta.

Restoration Zone: A transitional zone encompassing environments that have suffered significant damage from either natural or anthropogenic causes and require special management efforts to restore their stability and environmental quality. Once an area has recovered, it is reassigned to one of the other zones. These areas are designated for research, environmental management applications, and monitoring activities. This zone should include the northeastern sector of the reserve from Upamayo and Condorcayan to Cuchucancha in order to restore the lake's water quality.

Historic/Cultural Zone: Areas which have important historic or archaeological value and which should be maintained within their natural environment. The service infrastructure in this zone should be minimal and developed with special care to not affect or interfere with their cultural or scenic value. This zone is compatible with research, educational, and recreational activities, and it encompasses the town of San Pedro de Pari.

Buffer Zone: The zone immediately surrounding the protected area that requires special management, due to its nature and location, in order to guarantee the conservation of the reserve.[6]

**Programs**

The general policy of the reserve gives priority to restoring the value of the area, protecting the natural scenery, and facilitating its traditional use according to legal regulations. Envisioning that the protected area will contribute to organized and systematic local development, a series of programs for the management and utilization of the reserve have been defined.

The conservation and resource management program seeks to ensure the physical integrity of the reserve, guaranteeing effective conservation of natural and cultural resources, while respecting the established zoning plan and official regulations, as well as the Ramsar Convention. It includes the protection and enforcement sub-program, resource management sub-program, and research sub-program.

The public use program seeks to increase local awareness regarding the need to preserve natural resources in order to guarantee a permanent economic base of goods and services. It includes the education sub-program and tourism sub-program.

The operations program seeks to promote the efficient operation and development of infrastructure, maintenance, security, and visitor services for the protected area from an administrative perspective. It includes the administration sub-program and the monitoring and evaluation sub-program.[7]

**Administration**

For years, the administration of the national reserve was limited to a manager and one park ranger. Due to a lack of finances, mobility, and motivation, the administration did little in the performance of their duties. Only recently, the administration has conducted environmental education activities in Ondores (about the conservation of natural resources) in the schools and local communities, meeting a favorable reception. Presently, the reserve has a manager, a specialist, two official park rangers, and five volunteer park rangers.

**Organizational Structure**


The Junín National Reserve, as part of the National System of Protected Natural Areas, is under the authority of the National Institute of Natural Resources (INRENA), through the Office of Protected Natural Areas (IANP). A coordinator from IANP works with the manager of the reserve, who works within the reserve. This manager has a professional, an administrator, and four park rangers working underneath him. For budgetary reasons, the manager of Junín National Reserve and his personnel carry out similar duties for two nearby protected areas, the Huayllay National Sanctuary and the Chacamarca Historic Sanctuary.

**Infrastructure and Equipment**

The administration of Junín National Reserve operates out of an office in Junín in the headquarters of the Ministry of Agriculture. Also, an interpretive center for the reserve, located in Ondores, has a small museum, an administration office, and a storage area. There is a metal boat with a small motor which requires maintenance. Soon, a guard post will be established in Huayre, which will offer support in that area.

On the Junín-Ondores road (the one most frequently used by visitors) signs have been posted – on small concrete walls – marking the boundaries of the national reserve. These types of signs are also found at the entrance of the city of Junín and in Carhuamayo and Vicco, on the same highway.[8]

**Budget**

The protected area receives the standard resources from the National System of Natural Areas Protected by the State (SINANPE), funding specifically for infrastructure from the PAN Program of the German KFW Aid for International Development Program, and contributions from the Canadian Fund for the Junín Grebe.

## HUMAN INFLUENCE

Lake Junín, also known as Lake Chinchaycocha, and its surrounding territories, have been used for several centuries by the local population for agricultural activities, raising livestock, obtaining meat, eggs, fish, and energy, as well as other economic activities.[9]

Human activity in the region is predominantly in communities which support mining and agricultural activities. These communities are fundamentally agricultural, producing food (principally potatoes and meat) for local consumption and for sale in larger cities such as Lima and Huancayo. In the towns neighboring the reserve, small businesses operate and agricultural products are sold, while in rural areas, residents grow their own crops, including potatoes, mace, olluco, and peas, and raise cows, sheep, and, to a lesser extent, alpacas and llamas. Mining activity in the region has increased business activities, road construction, and increased the opportunity for cultural exchange.

*Ondores, on the western side of the reserve*

The land surrounding the National Reserve pertains to private landholders and the communities established there. The reserve was established with local communities within its territory, and those communities retained property rights to their land. There are many disputed areas of overlapping property among neighboring private landholders (not with INRENA), exacerbated by a lack of proper titling. By law, bodies of water (such as Lake Junín) are property of the State, therefore nearby populations have no property rights over these areas. However, many property owners claim to own land all the way down to the lakeshore, including land exposed due to low lake levels during the dry season, which is not valid. Land use should be in accord with the objectives of the protected area, but this is often not the case.

Approximately 46,000 people live around the Lake Junín National Reserve, distributed in five districts. Inside the area, there are around 4000 people (personal communication, Reserve Manager). The Junín District is the most populated, while the least populated district is Vicco District in the Department of Pasco. The towns and villages within the National Reserve are: Vicco, Paucarcoto,

Paclicush, Condorcayan, Condorcocha, and Upamayo in Vicco District, Department of Pasco; Ninacaca, Oxapampa, Tambo del Sol Viejo, Huaylas, Tambo del Sol, Aco, Huacllacancha, Malqui, Rocan, Comas, Murquish, Colca, Cascan, and Yuracaya in the Ninacaca District, Department of Pasco; Carhuamayo, Paucar, Cantra, Picón, Gueguesh, Chasshatambo, Jucjucha, and Pariacancha in Carhuamayo District, Department of Junín; Junín, Cantana, Santa Maria de Llacta, Huarmipuquio, Sasicucho, in Junín District, Department of Junín; and Ondores, Pari, Paccha in Ondores District, Department of Junín.[10]

*Plaza and municipal building of Ondores. Pari Plaza and recently constructed arbors. Often, modern concepts clash with traditional environments, creating a strong visua contrast*

Improved highways have contributed to increased business activity and settlement in the area by people seeking to improve their economic situation. The cities of Junín, Carhuamayo, and the surrounding towns have grown noticeably in recent years, increasing the pressure on resources and increasing the amount of wastewater discharged from these towns, exacerbating water quality problems.[11]

The cultural values of the settlers around the lake vary according to their origins. Often the farming communities are most interested in conservation of the lake, because it is their primary resource. However, private landholders, small business owners, and migrant populations do not identify with this perspective, resulting in serious damage to the ecosystem.[12]

**Tourism**

Junín National Reserve is an important part of a tourist circuit that includes the provinces of Huarochirí, Canta, Junín, and Pasco. It includes two other natural areas protected by the State, the Huayllay National Sanctuary and the Chacamarca Historic Sanctuary. These complementary sites form the Conservation Complex of Junín, which has great potential to promote tourist activity. This circuit includes natural, historic, archaeological, and religious points of interest. Its advantageous location near Lima is easily accessible by land, which is particularly attractive to domestic tourists.

Although this circuit is relatively well known by the Peruvian population and especially travel agents, it does not currently offer a viable alternative income for local reseidents. The lack of basic lodging infrastructure and services (only Carhuamayo has some acceptable lodging), the scarcity of

investment, and a lack of promotion efforts has led to reduced flow of tourists to the area. However, that could change in the future.[13]

Junín National Reserve hosts around 300 birdwatchers per year, between the months of April and November, 80% of which are foreigners. These visitors are brought to the area by only four tourist expedition companies (Colibrí Expeditions, Manu Expeditions, Tanager Tours, and Thomas Valquí), which is a reflection of the low tourist activity in the zone and the region not taking full advantage of the potential of the area for tourism. Tourist operators from the city of Tarma do not include Lake Junín in their expeditions, more commonly guiding excursions to the nearby Chacamarca Historic Sanctuary.

**Institutional Context**

Regional institutions include the Provincial Municipality of Junín, the Provincial Municipality of Pasco, the regional authorities of the Ministry Agriculture, the Ministry of Energy and Mining, the Ministry of Industry, Tourism Integration, and International Business, the National University of Central Peru, Daniel Alcides Carrión National University and the regional management offices of the mining companies.

Management efforts in Junín National Reserve cannot ignore the need for coordinated action, since all of these institutions affect the achievement of the conservation objectives of the reserve, either through function or action. Lake Junín was declared to be in state of emergency in 1999. The Decentralized Multisector Commission was formed (Law 27642), which later became the Chinchaycocha Environmental Management Committee through Supreme Resolution No. 551-02-PCM. It includes representatives from nine communities, and the Pasco and Junín Regional Governments alternately serve as the president of the committee. The resolution also approved the Sustainable Environmental Management Plan for the Chinchaycocha basin. However, the participating communities did not approve of the structure of the committee as established in Resolution No. 551-02-PCM, and the structure was modified through Supreme Resolution No. 092-2004-PCM.

The Chinchaycocha Environmental Management Committee is the organization responsible for the functioning of the Chinchaycocha Management System, which facilitates interinstitutional cooperation for the integrated and coordinated management of the Chinchaycocha Basin (Lake Junín National Reserve, its buffer zone, and its area of influence). It coordinates, monitors, evaluates, and publicly reports the progress of the “Chichaycocha Plan,” whose programs must be included in regional budgets to ensure their execution.

The Chinchaycocha Environmental Management Committee is composed of the following members, officially designated by the President of Ministries: one representative each for the presidents of the Regional Governments of Pasco and Junín, one representative from the Provincial Municipalities of Pasco and Junín, one representative from the Universities of Pasco and Junín, four representatives from the interested farming communities, one representative from a regional non-governmental organization, one representative from the mining companies, one representative from the hydroelectric power companies, and one representative from the regional Environmental Commission. Also, there is one representative from each of the following public institutions: INRENA, the Technical Administration of Riego District (ATDR PASCO), the General Director of Environmental Concerns of the Ministry of Mining and Energy (DGAA – MEM), the General

Director of Environmental Health of the Ministry of Health (DIGESA – MINSA), and the National Environmental Council (CONAM).[14]

In order the implement the Sustainable Environmental Management Plan for the Chinchaycocha basin, five subcommittees have been formed: the natural resource management subcommittee under INRENA, the decontamination subcommittee under the Ministry of Mining and Energy, the environmental monitoring subcommittee which is coordinated through DIGESA, the dam engineering subcommittee under the ATDR, and the compensation and indemnification subcommittee, presently under the charge of the community of Vicco.[15]

The Regional Government headquarters is located in Huancayo, but has an office and a representative, in Junín, in charge of managing education and health issues, as well as coordinating with the public institutions of Junín.

Since 2000, the Regional Government has taken the initiative to maintain the efforts in progress in the zone, attempting to coordinate all projects undertaken by public institutes. Among these are projects of the National Social Development and Compensation Fund (FONCODES), the Ministry of Agriculture, Ministry of Health, Ministry of the President, and municipal governments, among others.

*National Institute of Natural Resources (INRENA)*


INRENA is a decentralized governmental organization under the Ministry of Agriculture responsible for promoting the rational use and conservation of natural resources in accordance with the Organizational Law of the Ministry of Agriculture (D.L. No. 25902) established on November 29, 1992.

The Director of Natural Protected Areas of INRENA, according to Article 17 of the rules of organization and function (Supreme Decree No. 055-92-AG) is the functionary in charge of proposing policies related to the management of the various units of the National System of Natural Protected Areas. The Director regulates natural protected areas, proposes policies and plans regarding the sustainable use of these areas, and supervises the enforcement of these regulations.

*Ministry of Fisheries*

The General Fisheries Law (D.L. No. 25977) established the jurisdiction of the Ministry of Fisheries to manage hydrobiological resources, including those within protected areas. However, management of the protected area is overseen by the Ministry of Agriculture, and any project must receive prior approval through the Ministry of Agriculture. For example, the management of the Junín frog as a hydrobiologic resource is under the jurisdiction of the Ministry of Fisheries, but subject to the Ministry of Agriculture because the species inhabits a protected area.

*Minsitry of Industry, Tourism, Integration, and International Business (MITINCI)*

The General Tourism Law (Law 24027) of December 13, 1984, notes in Article 51 that the Ministry of Industry, Tourism, Integration, and International Business (MITINCI) will coordinate with INRENA in order to realize the potential of conservation areas for tourism. The Development of Tourist Activity Law (Law No. 26961) designates a period of thirty days for INRENA to approve tourism projects within its jurisdiction, including areas within SINANPE.

According to the Directive Plan for Natural Protected Areas (Supreme Decree No. 010-99-AG) tourist activity is permitted in protected areas only when the developed in accordance with the objectives and zoning plans of the area, as defined in the master and operational plans.

*National Cultural Institute (CONAM)*

According to Article 13˚ fo the Organizational Law of the Ministry of Education (D.L. No. 25792) of 1992, the National Cultural Institute is the national institution charged with the promotion of cultural activities which highlight the preservation of the country's cultural heritage. The National Cultural Institute has authority in the reserve over archaeological zones and cultural heritage areas. Any projects which affect these areas require the prior approval of the Institute.[16]

Mechanisms for inter-institutional cooperation are lacking for conservation efforts in wetland areas. Each organization conducts independent efforts, often with the same goal, for the management of the protected area (including the buffer zone) and administrative purposes. An example of this is the uncoordinated efforts of the five district governments to promote ecotourism in their own jurisdiction. The same lack of cooperation is seen with the Ministry of Agriculture, Ministry of Fisheries, MITINCI, the regional governments, and CONAM.[17]

## CONSERVATION AND RESEARCH

Scientific interest in the lake and its surrounding areas began in the XIX century with the descriptions of the Junín grebe by Taczanowskii (1874) and Graf Von Berlepsch & Stolzmann (1894). On various occasions, scientists and researchers have demonstrated the importance of the lake, through many studies of the flora and fauna as source of biological diversity:[18]

A list of publications from research projects in Junín appears in the "References" section at the end.

### THREATS

Lake Junín is a highly productive ecosystem of unique biological diversity that has been subjected to strong pressures over the years due to the extraction of its resources, overgrazing, and contamination of the lake from mining wastes and municipal wastewater.

*Uso de terrenos en ladera para agricultura*

## Agricultural activity

Agriculture is sparsely developed, limited to small fields and family gardens because few crops can thrive at the high altitudes of the area. Those that do prosper include the potato (*Solanum tuberosum*) and the maca (*Lepidium meyenii*), a traditional crop whose cultivation has been reintroduced and promoted since 1996.

### *Agricultural activity on hill slopes*

Water quality studies of Lake Junín have detected the presence of agricultural insecticides, which wash into the lake from the surrounding fields and through drainage systems from villages around the lake. This is a fundamental consequence of the bad practices of farmers in the region using these products.

## Ranching

Lake Junín has been a resource since ancient times, however, the utilization of natural resources has been badly managed in the last few decades, and overexploitation is occurring. Various neighboring towns currently have an overpopulation of livestock, due to the tendency to wait for better market prices for wool and meat. The problem is exacerbated during times the dry season, when all of these animals graze in the wetlands surrounding the lake, resulting in overgrazing, compaction, and loss of these highly productive environments.[19]

The livestock raised around the lake consists mainly of sheep, but there is also cattle and, to a lesser degree, alpacas and llamas. Junín department ranks third in the nation in overall sheep production, behind Puno and Cuzco, with an estimated 60,000 to 70,000 head in the area surrounding the lake.

The protected area permits the use of cultivated grasses only in the Special Use Zone. However, many people request permission to plant introduced grasses in sectors where it is not permitted, especially along the road towards Ondores.

There are many fences for livestock within the reserve. These fences fragment habitat and restrict the free circulation of wildlife populations. Livestock has reduced vegetation cover, negatively affected the health of grassland, and led to replacement of wild grasses, which are good forage for animals, by undesirable plant species. Grazing does not allow grasses to recuperate, and as livestock move on to other areas, vegetation is continuously impacted.

## Mining Activity

The Lake Junín basin, like most places in the Peruvian mountains, is not free of the mining activity which began during the period of the conquistadors, and has suffered a large amount of ecological degradation, as a result. Lake Junín has been the confluence of streams that transport significant quantities of mining wastes containing heavy metals and other substances which accumulate in the ecosystem, and consequently harm both the environment as well as human beings. This contamination limits the productivity of the lake and affects a large number of plants and animals of the lake, either directly or indirectly.

Contamination from mining waste is the main problem facing the lake. In the northeastern section, where the San Juan River drains into the lake, the water is characteristically a brick-red color and contaminates a large part of the ecosystem. These wastes not only produce chemical contamination, but also result in increased turbidity due to the high concentration of suspended particulate matter. Consequently, aquatic plants and algae die off because they are unable to carry out the process of photosynthesis. Highly concentrated, dissolved chemicals affect water quality in almost one third of the lake. Mining activity also contaminates pastures when these are flooded with water polluted by mining waste.

*Sedimentación minera en el agua que llega al lago*

Over the years, studies have indicated high concentrations of total dissolved metals, low concentrations of dissolved oxygen, and high turbidity. This is mainly to the oxidation of iron and manganese and high concentrations of copper, lead, zinc, arsenic, cadmium, chromium, mercury, iron, and manganese, all of which have reduced populations of aquatic flora and fauna. Heavy metal concentrations are very high in the northern part of the lake, until just offshore of the town of San Pedro de Pari, at which point it gradually declines. High concentrations of zinc, copper, and lead extend for several kilometers into the main basin of Chinchaycocha Lake, exceeding the EPA criteria for the protection of aquatic life.[20]

Even now, after scientific advances have allowed the incorporation of new technologies to mitigate mining impacts, the reversal of ecological impacts is a slow and costly process. However, there are encouraging signs from some mining companies that they are working to mitigate the impacts caused over the years.[21]

Environmental Mitigation Programs (PAMA) have been implemented to combat pollution from mining wastes, and impacts have been reduced significantly because miners have begun to use drainage fields and residual water is being recycled. However, these programs, supervised by the Ministry of Energy and Mining, are also an indication of the slight advancement toward the completion of these programs. The PAMAs should have been completed in 2002, but are still

ongoing through the solicitation of extensions, which implies that, in reality, many mines are essentially operating without PAMAs.

A closer analysis of the PAMAs shows that they address the environmental impacts of mining operations, and only partially address the mitigation of cumulative environmental damages caused by the activity. Mining activity has occurred in Pasco since colonial times, generating impacts that are not considered in the PAMAs, within the terms of current legislation. The PAMAs do not address responsibilities for the mining wastes discharged in the San Juan River course and delta, the deposition of sediments containing heavy metals in the San Juan River delta in Upamayo, and the presence of minerals on the banks of Lake Chinchaycocha. Additionally, the issue of waste disposal from carbon scrubbers in the old smelting works of Tinyahuarco is not addressed. This waste acidifies the Huachuacaja Stream during the rainy season, which flows into the San Juan River.

Mineral sedimentation on the pastures along the Mantaro River, on the stretch of the river by the communities of San Pedro de Pari and San Juan de Ondores, and fine metallic dust from the former bed of the San Juan River affect the soils, grasses, livestock, and water quality.[22]

Presently, there are three mining companies, Volcan Mining Company, Aurex Mining Company, and the Brocal Mining Society, that discharge effluent water into the lake, above the Upamayo Dam. These companies primarily mine for lead, silver, gold, and zinc. Previously, the state mining operation, Centromin, contributed significant volumes of effluent into the lake for many years. On the whole, mining activity is filling the lake with sediments that affect the aquatic and terrestrial vegetation, as well as the local residents and their activities. The community of Vicco continues to complain about the fields affected by the iron oxides and wastewater from the Brocal company. Regional governments have taken no action against the company, citing their social responsibility to protect the miners. But in reality, no action is taken because the mining and energy taxes which they receive from these activities are a guaranteed source of income.

*Mining sediments on the lake's shore*

The majority of the bird species of the lake have suffered a dramatic decline in numbers, which is primarily attributed to the prolonged contamination of the lake by mining activities. There is sufficient circumstantial evidence which confirms that this pollution is by far the most significant environmental impact on the fauna, including: a) during the dry season evidence of pollution is plainly observed and hundreds of dead birds appear on the lake shore, b) most bird populations are concentrated in the southern part of the lake, with decreasing distributions in the highly contaminated areas at the mouth of the San Juan River, and c) iron oxide sediments cover the algae on the bottom of the lake occasionally killing vegetation, leading to the desertification of large areas of the lake. These algae are a principal food source for many birds, and the impacts of desertification are obvious. Other species suffer due to the scarcity of fish, which is attributed to the lack of water quality. Heavy metal concentrations are above the recommended level for healthy animal life.[23]

The General Director of Environmental Health (DIGESA) is responsible for monitoring water quality in Lake Junín and conducts evaluations every three months. Distribution of the results of these analyses by DIGESA is slow, and INRENA only receives these reports once a year, often after the information is out of date. This does not allow INRENA to interpret this information in conjunction with events which occur in the lake (for example, bird or fish kills or increases in turbidity), which impedes their ability to take appropriate corrective measures.

Even though the Ministry of Energy and Mining supervises mining operations and DIGESA conducts environmental monitoring activities, there is a lack of public confidence in the results of evaluations conducted by the mining companies and governmental organizations, as well as a denial of their validity.[24]

**Hunting and Fishing**

Hunting is frequently mentioned as a factor in declining animal populations, however, there are relatively few hunters in the area and traditional practices of local hunters would be unlikely to have a significant impact on the bird populations. In general, healthy, mature birds are not caught by local hunters, rather, they pursue birds that are molting or unable to fly. After a long chase (twenty minutes to an hour) in a single-passenger canoe, the bird tires and is captured with a long stick which has two or three long nails on the end. Due to the present degraded condition of the lake, the number of active hunters has further declined. If the number of hunters increases, or their methods become more technologically advanced, the impacts of hunting could become more significant.

In Ondores, a hunting and fishing association was established 25 years ago. This association was dedicated to hunting the Junín frog for commercial use, and regulated their activities with closed seasons and size limits. Unfortunately, the drastic decrease in the frog population due to pollution and overexploitation has made it difficult for the association to continue its activities.

Birds are captured, by collecting eggs or hatchlings from their nests, both on land and on the lake using small boats. The montane guinea pig, which is part of the local diet, is hunted by burning the cattail communities where it hides. This has a negative impact on several other species that use the cattails as permanent habitat, particularly the Junín coot.[25]

The coot (*Fulica ardesiaca*) and various species of ducks are hunted commercially, especially the ruddy duck (*Oxyura jamaicensis*). Hunting mostly occurs in the areas of Santa Clara de Chuyro, Huayre, Ondores, and Paccha. A series of agreements permit subsistence hunting, with catch limits of 11 individuals of any species per week per hunter, and each village has a committee overseeing the rational use of natural resources.

Established closed hunting seasons are not respected by local hunters, either due to ignorance or because hunting is the only activity which meets their basic economic needs. To the extent possible, INRENA attempts to enforce the closed seasons and confiscates both equipment and products from violators.

### Extraction and burning of cattails and other vegetation

The extraction of cattails occurs on a small scale, relative to its use in other wetland areas where the fiber of this species is used for the construction of rafts, baskets, and mats, among other products. In Junín, cattails are harvested for use as forage for livestock and burned to encourage shoot renewal and facilitate the hunting of montane guinea pigs.

Traditionally, sod has been extracted in the area for use as an energy source because local residents lack an alternative source of energy. Communities have organized to limit extraction by each community to 1000 blocks of sod per year (previously the extraction of 2000 to 2500 blocks was permitted). However these agreements do not apply to private landholders, and they are able to extract an unlimited amount of sod.[26] The excessive removal of sod results in erosion and loss of soils.

*Impacts on soils from the extraction of sod (left). Collected pieces of sod*

### Water use and management

Lake Junín plays an important role in electric power generation for the country, contributing approximately 29% of the overall flow of the Mantaro River in times of low water. This permits the Mantaro energy complex (hydroelectric plants of Malpaso, Santiago Antúnez de Mayolo, and Restitución) to support their operations throughout the year. The Upamayo Dam stores the water of Lake Junín during the rainy season in order to ensure an adequate supply of water for energy generation during the dry season. This process causes the water levels in the lake to fluctuate during the year.

Fluctuating water levels in the lake, controlled by the Upamayo Dam at the source of the Mantaro River, pose a threat to the ecosystem. Rising water inundates bird nesting grounds, while receding water strands schools of fish or amphibians in dry areas and exposes them to predation. Also, this fluctuation directly affects the local inhabitants by inundating areas of pasture for longer periods than usual. Ranchers use pastures on a rotating basis, using the higher areas in the rainy season (January to May) and the lower area along the lake shore during the dry season (June to December). High water levels create larger areas of inundation for longer periods of time, and as a consequence, the ranchers suffer economic losses due to the inability to use land along the lake shore as pasture

for livestock. Also, the inundation of springs and wells affects public and private water sources used for human consumption.

The regulation of lake levels for hydroelectric purposes, in addition to water pollution, is a primary cause of the decline of the Junín grebe. It is responsible for the decline in the area of cattail habitat, of which relatively few areas remain in a permanently inundated condition. These areas are the preferred feeding grounds for the Junín grebe, which is suffering as much from the disappearance of the cattails as from the disappearance of its food source (fish of the Orestias genera).[27]

In October, 1993, the publicly-operated Electrocentro SA., Electro Peru SA., and Centromin Peru SA. drew up a contract for the provision and repayment of electricity, establishing coordinated procedures for regulating the use of water in Lake Junín in its ninth clause. A series of difficulties arose in the implementation of the contract due to issues with the authorization of water use licenses by the Technical Administration of Riego District, the existence of different criteria for the coordinated management of the waters of Lake Junín between the companies, changes in the quantity of water use permitted and points of extraction, petitions for additional resources through revised resolutions, etc. These problems were due to Ministerial Resolution No. 0149-98-AG which defines the limits of the water use licenses of Electroperú S.A. and Centromin Perú S.A. for the utilization of water resources in Lake Junín.

*Upamayo Dam in the northern section of the lake*

The contract established the period of water collection for the lake from January first to May 31st of each year (the floodgate remains closed). The regulated discharge of water occurs from June first until December 31st each year, operating in such a way that the following minimum reserves (as a percentage of the usable volume of stored water) are maintained in the lake: 100% as of June 1, 85% as of July 1, 70% as of August 1, 55% as of September 1, 40% as of October 1, 25% as of November 1, 10% as of December 1, and 3% as of December 31. The usable volume of stored water corresponds to the volume accumulated on May 31 of each year.[28] In this way, Ministerial Resolution 149-98-AG authorized the minimum volumes of reserves required, but not precise maximum amounts of water collection and discharge.

The diversion of irrigation canals, sewers, and drainpipes from neighboring towns into the lake elevates the organic material content, increasing the degree of eutrophication and the concentration of ammonium, and causing the reduction of dissolved oxygen and killing many organisms.[29]

*Wastewater discharged directly into the lake*

Untreated wastewater has noxious effects on the lake ecosystem. Lake Junín is naturally an oligotrophic lake (with low nutrient availability), but increased nutrient concentrations due to the influx of wastewater causes microorganism populations to increase. These microorganisms consume large quantities of dissolved oxygen, initiating the process of eutrophication which affects aquatic biota at all trophic levels. Also, solid wastes, primarily plastics, often accumulate in cattail communities. Solid wastes from the city of Cerro de Pasco, entering the lake through the San Juan River, accumulate in the northern part of Lake Junín and on the San Juan River delta.[30]

In the pas, the town of Junín discharged wastewater into the Chacachimpa River, which runs directly into the lake, causing a severe pollution problem. Today, treatment lagoons are used to treat drainage before it is discharged into the river. The town of Huayre does not have a sewage system, only latrines. The latrines do not directly contaminate the lake, but may affect groundwater quality. Carhuamayo, which is growing rapidly, has treatment lagoons that are not functional. Therefore, wastewater passes through the lagoons untreated and continues to contaminate the lake. Wastewater from Ondores flows directly into the lake, however, town officials confirm that construction of a wastewater treatment system will soon begin. In the towns of Vicco and Ninacaca, a sewage system is also currently under construction.

## RECOMMENDED SOLUTIONS

### Agricultural activity

Attention must be given to the use of agrochemicals in the areas surrounding the lake. Farmers should be trained regarding the most appropriate uses of chemical products for agricultural purposes in order to avoid polluting waters in the area, including Lake Junín. Stores and retail locations should be regulated to avoid unrestricted distribution of these chemicals. Only farmers trained to use agrochemicals should be allowed to purchase and use these products in the areas surrounding the lake, and a training certificate should be required to be presented at the time of purchase. These steps would allow some degree of regulation to be exercised over the use of these products in the area of the reserve.

### Ranching

The reestablishment of native flora and fauna populations of the region should be encouraged. The productivity of native pastures within the reserve and restored pastures in the buffer zone should be increased by capitalizing on the experience of local communities. Relocation agreements should be arranged for those ranchers that operate in the interior of the reserve in order to reduce the livestock

populations. Fences and corrals should be constructed in accordance with both the needs of local residents and technical criteria which minimize their impact on the reserve. Fence construction should be concentrated in the buffer zone, and the promotion of management practices which prevent livestock from entering the protected area should be encouraged to reduce overgrazing.

Land use regulations should be designed to establish a carrying capacity for pasture land. The master plan recommends limits of one cow per two hectares and two sheep per hectare in order to alleviate grazing pressure on the vegetation and soils. It also promotes the establishment of restored pastures in the buffer zone and the relocation of livestock currently inside the reserve to these pastures.

Strict regulations regarding livestock management within the reserve should be established, and the zoning plan for the area should be respected, which means that ranching activity should be restricted to the Special Use Zone. The administration should conduct periodic round-ups to capture livestock in violation of these regulations and collect fines for each head of livestock caught.

An organized system of sanctions and fees must be quickly established and legitimized through a resolution, in order to enable park rangers to proceed against offenders. These regulations need to include an explicit list of infractions and fines and should be enacted as soon as possible. The administration of the protected area should strictly enforce the zoning plan of the reserve and not allow users to violate the established rules.

*Substitution of cattle with alpaca and llamas*

Junín National Reserve is part of the nation's heritage, however, users of the natural resources of the reserve are benefiting at the expense of the integrity of the protected area. For this reason, it is necessary to create a system of fees for the use of pastures within the reserve as a compensatory measure. Rules should be established, as well as fees per head of livestock entering the reserve. Fees should not be prohibitively expensive. Rather, fees should fit the local economic situation and level of income. The current lack of a fee system cannot be justified under the pretext of the extreme poverty of the local residents, because an individual who owns 30, 50, or 80 cattle cannot be considered in a situation of extreme poverty. These payments will be a self-financing source of income for the protected area, which, unlike other protected areas, does not generate income.[31]

It is necessary to insist on that the gradual replacement of the remaining cattle and sheep with alpacas be `promoted in the reserve. Alpacas have great potential for the production of meat, leather, and wool. Their potential production is much greater than that of sheep, alpacas cause much less damage to the soils and vegetation.

**Mining**

The mission of the administration is to remain attentive to past environmental damages and ongoing mining activities which may impact the future equilibrium of the lake.

A more detailed study is recommended of the proposed solutions for sediments and mining pollution entering the lake from the San Juan River. The construction of a dike or dam at the mouth of the lake has been proposed, which would block the flow of sediments from the San Juan River into the lake. Due to the fact that the proposed dam would also block the direct flow of water for storage by the Upamayo Dam, it may be necessary to remove the sediments in this area of the Upamayo Dam, in order to ensure that there is sufficient storage space. Lake levels would then be regulated by the new dam.

On the other hand, there are those who contend that the removal of sediments will be counterproductive. The large quantities of sediments accumulated in the storage area of the Upamayo Dam and on the bottom of Lake Junín are highly toxic, and various studies have recommended that the best alternative may be to leave the sediments where they are to allow a natural recuperation of the lake's bottom.

Another alternative is to divert of water from the San Juan River through canals and pipes, in such a way that the wastes are directed away from the lake. It will be necessary to analyze the costs and benefits of these two proposals, and then implement one of the two solutions to avoid the complete contamination and eventual death of Lake Junín.


*Optimal site for preventing sediment input into the lake*

DIGESA should submit the results of water quality monitoring to INRENA, in a consistent and timely manner, in order to facilitate decision-making and rapid action to mitigate negative impacts to the flora, fauna, and water quality of the lake.

Completion of the monitoring plan and pollution controls should be adhered to strictly. Mechanisms for public participation in monitoring and supervision, as well as the necessary training activities, should also be established.

A solution addressing mineral accumulation on the lakeshore and bed is urgently needed. Centromín Peru has considered mitigation projects in the area, but these will only be a partial solution, therefore, responsibilities for environmental remediation must be explicitly defined.

Once mining wastes have been controlled, the restoration of the lake will require the management of the past environmental damages due to mining, municipal wastes, and treatment processes must be undertaken. This justifies the continuation of the Monitoring Plan for Environmental Quality.

In the short term, the mining companies must complete the Environmental Adequation Programs (PAMAs) in conjunction with the management plans and environmental performance systems, manage prior environmental liabilities, and participate in the general monitoring system. The Ministry of Energy and Mining should conduct periodic inspections and evaluate the progress of the PAMAs, public reporting, and preventative actions. Local communities should implement environmental monitoring systems and participate actively in the proposed environmental programs.

**Hunting and Fishing**

Periodic patrols are required with an emphasis on stricter controls on the hunting of threatened species, particularly the Junín grebe and the Junín frog. Hunting these uncommon and/or threatened species should be prohibited and hunting restrictions with respect to the zoning plan should be insisted upon.

Because the reserve allows the utilization of natural resources, it is necessary to establish a management plan for hunting and fishing with scheduled closed hunting seasons. The development of this plan should be coordinated with the Ministry of Fisheries and hunting association representatives, and should respect traditional hunting practices, when possible. A diagnosis of the situation of the Junín frog is advisable and the feasibility of their reintroduction in the lake should be evaluated.

**Extraction and burning of cattails and other vegetation**

Alternative sources of energy must be promoted to alleviate the pressure on vegetation resources in the area. Native tree species should be promoted for use in forestation efforts in the reserve, and especially in the buffer zone, in order to provide alternative fuels for local residents.

Local practices for managing cattail communities should be encouraged which do not involve extensive burning. Currently, this widespread practice is destroying these cattail habitats. As an alternative, crafts and boats made of cattail fibers could be produced and sold, which would facilitate the sustainable management of the resource and provides a source of income to local residents.

**Water management and use**

Municipalities in the area of the reserve should be required to treat their wastewater prior to its discharge into the lake, and a water quality control program must be developed and implemented for Lake Junín and its principal tributaries. Also, instruments for monitoring the environmental impacts of water storage and discharge from Lake Junín are urgently needed. These activities should be compatible with the traditional dynamics of local communities and the ecology of the wildlife communities protected by Lake Junín National Reserve.

According to the report of the Decentralized Multi-sector Committee, Environmental Protection Regulations for Power Generation Activities do not include rules addressing the environmental impacts of the use of the water reservoir by the hydroelectric power companies. Likewise, the Supervisory Body for Energy Investment (OSINERG) does not conduct supervisory activities regarding these operations. Hydroelectric operations should be required to have a PAMA.

Alternatives for the management of the San Juan River delta should be considered and studied in detail to avoid the continued contamination of Lake Junín.

The issue of wastewater being discharged into the lake from surrounding towns does not carry much weight with the public, as evidenced by the lack of demand for improvements in sewage services and the lack of priority given to water treatment projects. For this reason, it is important to include this topic in educational programs to reinforce the value of the water that is currently being lost. A warning mechanism is needed, which can inform the public of incidents which may cause changes in water quality caused by unauthorized mining discharge or increases in dangerous chemicals like grease, oil, etc., to ensure a rapid and effective response by the competent authorities.[32]

## MANAGEMENT

The protected area is officially designated as a National Reserve. National legislation defines this category as dedicated to the conservation of biological diversity and the sustainable use of both aquatic and terrestrial wildlife resources. The commercial utilization of natural resources is permitted under management plans that are approved, supervised, and controlled by the competent national authority. Presently, there are plans being developed for the management of birdlife, native grasses, sod extraction, and cattail habitats. These plans, corresponding to various activities of local residents in the area of the lake, must be completed. The integration of local populations into the process should be promoted in order to achieve consistency among management objectives ensure local participation. The authority of the National Reserve, in conjunction with the regional and local authorities, must regulate the residents within the reserve and their utilization of the resources of the area.

Scientific research regarding the natural resources of the area should be encouraged, especially of threatened species. A research priority plan should be developed for the reserve, especially for birds and native grasses. A monitoring and evaluation plan of the conservation of biological diversity in the national reserve also necessary. Monitoring activities should occur periodically, for which reason securing funding for these activities is indispensable. A monitoring plan for the Junín frog (*Batrachophrynus macrostomus*) and the Junín grebe (*Podiceps taczanowski*), that includes a toxicology study, is advisable, and a study regarding the continuing effects of water storage and discharge in the lake on dynamics of the cattail habitats should be done using satellite imagery.[33]

Stronger environmental education efforts and integrated informational programs are required, which involve local residents and raise community awareness. Also, training programs for personnel and for the creation of informative materials need to be designed and implemented.

Tourism should be more aggressively promoted in the reserve and the surrounding areas as a way to generate economic resources for the reserve and

*Thermal springs in the area of Huarmipuquio*

local residents. The development of a tourism plan for the protected area that includes an evaluation of the potential for tourism in complementary areas is needed. A diversification of tourist activities is needed which includes the full spectrum of environments and ecosystems in the reserve. Local residents should be trained to develop quality tourist activities. In order to avoid negative environmental impacts from tourist activity, waste disposal facilities, as well as medical posts, hygienic services, and telecommunication facilities should be constructed in nearby towns.

The reserve authorities should coordinate their activities with the various stakeholders in the area. Four more park rangers should be contracted to conduct various activities in the reserve, especially in the area of environmental protection and enforcement. At least one more professional should be hired to conduct research and elaborate management proposals.

An existing set of proposals for the management of Lake Junín and its resources must be implemented. For example, the Chinchaycocha Multi-sector Performance System includes plans with three basic components: economic, ecological, and socio-political. It offers many recommendations it hopes to achieve, most importantly, to maintain basic ecological processes, maintain biological diversity, stabilize human populations, satisfy basic necessities, reduce the use of nonrenewable resources, reduce the production of wastes, secure a stock of renewable resources over a sustainable baseline level, improve quality of life, rectify regional economic imbalances, and redefine natural resource property rights.[34]

## CONCLUSIONS

The Junín National Reserve is located in the central Andes of Peru, in the Carhuamayo, Ondores, and Junín Districts of the Department of Junín and the Ninacaca and Vicco Districts of the Department of Pasco. The reserve is surrounded by an extensive flatland called the Bombón Plateau, and it protects an important body of water.

The vegetation of Lake Junín is typical of the puna landscape, which includes several characteristic natural vegetation communities, such as dense grasses with Andean wetlands, puna grasslands, and cattail communities along the lake shore. The best-represented and most important animal species in the reserve are birds, and there is an abundant variety of birds of different origins, interest, and management needs. Several endemic species in the area, including the Junín grebe and the Junín coot, are found there.

The objective of the Junín National Reserve is the conservation of the ecosystem in an integrated manner which preserves the flora, fauna, and scenic beauty of the lake, and promotes the social and economic development of the region through the sustainable utilization of renewable natural resources. There is a master plan for the reserve, currently being updated, which includes a zoning plan and various management programs, several of which have yet to be implemented. Currently, two full-time and five volunteer park rangers, a chief, and a professional specialist work in the park, which is inadequate for efficient operation.

Human activity in the region is predominantly in communities which support mining and agricultural activities. Agricultural products are also sold in these communities. Mining has increased small business activity, highway construction, and the opportunity for cultural exchange in

the region. The lands surrounding the national reserve belong to private landholders and the farming communities established there. Local communities existed in the territory of the reserve when it was declared, and those communities retained ownership of their lands. Approximately 46,000 people live in the area around Junín National Reserve, distributed in five districts. In the interior of the area there area round 4000 inhabitants. The Junín District is the most populated, while the least populated is Vicco District.

The Junín National Reserve is an important part of a tourist circuit which includes the Huayllay National Sanctuary and Chacamarca Historic Sanctuary. Together these form the Junín Conservation Complex which has great potential for promoting tourism in the area. The low tourist flow in the zone reflects the fact that full advantage is not being taken of the area's potential.

The performance of the Junín National Reserve depends on the coordination of various institutions. Lake Junín was declared to be in a state of emergency in 1999, leading to the formation of the Multi-sector Decentralized Commission, which later became the Chinchaycocha Environmental Performance Committee. The committee approved the Plan for Sustainable Environmental Management of the watershed, and it is charged with facilitating inter-institutional cooperation for the integrated management of the watershed (Lake Junín National Reserve, buffer zone, and its area of influence). It coordinates, monitors, evaluates, and publicly reports the progress of the plan. In order to implement the environmental management plan for the watershed, five programmatic subcommittees were formed.

The Lake Junín ecosystem has been subjected to strong pressures over the years from various activities within its zone of influence. Agriculture is sparsely developed in the area surrounding the lake due to its high elevation, however water quality studies have detected the presence of agricultural insecticides in the lake. These wash into the water from the surrounding fields and through drainage systems of major towns. This is primarily a consequence of the poor regulation of the use of these products by farmers in the region.

Several nearby towns currently have an overpopulation of livestock, and overgrazing causes the compaction of soil and the loss of the highly productive wetland environments around the lake. The presence of livestock has reduced vegetation cover, negatively affected the health of grasses, and led to the replacement of wild grass species with less desirable vegetation.

Several tributaries converge in Lake Junín carrying significant quantities of mining wastes which contain heavy metals and other substances which accumulate in the ecosystem and harm the wildlife of the lake. High concentrations of dissolved chemicals have caused the deterioration of almost one third of the lake. Mining waste also contaminates pastures when these are flooded with polluted water. Thanks to the Environmental Adequation Programs (PAMAs), the problem of mining wastes has diminished somewhat because the mining companies have begun using drainage fields and recycling wastewater. However, the terms of many of these programs have expired or companies have solicited extensions. Most bird species of the lake have suffered a dramatic decline in numbers, which is attributed to the prolonged contamination of the lake.

The traditional methods of hunting and fishing used by local hunters do not have a significant impact on wildlife populations, and the number of hunters in the lake is fairly limited. However, the capture of birds and the collection of eggs and hatchlings from nests occur both on land and on the lake. The montane guinea pig is hunted by burning of the cattail communities where it hides, which

has negatively affects other species which have permanent habitats in the cattails. Closed hunting seasons are not respected by local residents, either due to ignorance or because there is no other activity which can meet their economic needs.

Cattails are extracted on a small scale, primarily as forage for livestock. Cattail communities are burned in order to encourage shoot renewal and during hunts for the montane guinea pig. Traditionally, sod is extracted in the area for use as fuel, however, the abuse of this practice generates erosion and loss of soil.

Fluctuating lake levels, regulated by the Upamayo Dam, constitute a threat to the ecosystem because waters inundate bird nesting grounds or strand fish and amphibians in dry areas, exposing them to predation. Also, this fluctuation directly affects local residents by flooding parts of their pastures for longer periods than normal. The diversion of irrigation canals, sewers, and drains from the neighboring cities and towns into the lake elevate the content of organic material, increasing the degree of eutrophication and killing many organisms.

The use of agrochemicals being used in the areas around the lake must be regulated. Farmers should be trained regarding the appropriate use of chemical products for agricultural purposes, in order to avoid water pollution. Agreements for the relocation of ranchers operating in the reserve should be promoted in order to reduce livestock populations within the protected area. Regulations for the use of grasses for grazing should be established based on the carrying capacity of the land. Strict livestock management guidelines should be enacted, and zoning regulations should be respected. Alpaca should be promoted as a gradual replacement for the cattle and sheep in the national reserve.

A more detailed study is recommended of the proposed solutions for preventing the flow of mining wastes and sediments from the San Juan River into the lake. The pollution monitoring and control plan should be strictly enforced. Mechanisms for the participation of local residents in monitoring, supervision, and environmental protection activities are needed, as well as the relevant training for these activities. In the short term, mining companies should strictly adhere to Environmental Adequation Programs (PAMA), management plans, and environmental performance systems, address past environmental damages, and participate in general monitoring activities. The Ministry of Energy and Mining should conduct periodic inspections, evaluating the progress of PAMAs, public reporting, and preventative efforts. Communities should implement local environmental monitoring systems and actively participate in the proposed environmental programs.

Periodic patrols are necessary which emphasize stricter regulations against the hunting of threatened species, particularly the Junín grebe and the Junín frog. Hunting uncommon and/or threatened species should be strictly prohibited, and zoning restrictions should be respected.

The promotion of alternative energy sources is needed to alleviate the pressure on vegetation resources in the area, and native tree species should be promoted for use in forestation projects. The local population should be encouraged to improve management of cattail communities, potentially through the production and sale of crafts, which could facilitate the sustainable management of the resource and provide a source of income for local residents.

Local municipalities within the area of the reserve should be required to treat wastewater before discharging it. Also, the development of performance instruments which permit monitoring of the environmental impacts of water storage and discharge operations in Lake Junín is necessary.

Monitoring activities should be compatible with the traditional economic dynamics of local communities and the ecology of wildlife protected by the Junín National Reserve.

Scientific research regarding the natural resources of the area should be encouraged, especially with regard to threatened species. Environmental education and extension programs should be strengthened to encourage local participation and raise community awareness. Tourism should be aggressively pursued as a way to generate economic resources for the reserve and local residents.

Management plans corresponding to the activities of local communities must be completed. The performance of these plans should be integrated to ensure consistency in management objectives and policies for the area and the participation and contribution of local residents.

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