

Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated: October 1995

2. Country: ARGENTINA

3. Name of wetland: Laguna Llanquanelo

4. Geographical coordinates:

35°30'S - 36°S
69°W - 69°15'W

5. Altitude: 1,280 metres above sea level. The highest elevation in the reserve is the Trol Volcano at 1805 metres above sea level.

6. Area: 65,000 hectares

7. Overview:

This is a semidesert salt lake in a depression at the base of the Central Andean Range. It is an endorheic system of water, salt deposits and surrounding mangrove environments with 74 species of aquatic birds and a total population of up to 150,000 birds.

8. Wetland type: R, Y, N

9. Ramsar criteria: 1b, 2b, 2c, 3a, 3b

10. Map of site included? Please tick yes -or- no

11. Name and address of the compiler of this form:

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12. Justification of the criteria selected under point 9, on previous page:

13. General location: This reserve is in the southern part of the province of Mendoza, in the department of Malargüe, roughly 45 kilometres east of Highway 40. It is surrounded by private cattle ranches.

14. Physical features:

This reserve is an enclave in the extreme southern part of the Los Huarpes Depression and is also part of the Greater Central Plateau, Neopatagonia and the western Argentine border regions. The lake is in the Llanquanelo lowlands and covers approximately 65,000 hectares. At the present time, it has been reduced to a third of its former surface. This reduction is due to the loss of the natural hydraulic balance that existed between the inflow of water of the Río Malargüe and its tributaries and the outflow of water through evapotranspiration and runoff.

The Llanquanelo lowlands is an enclave in a region with a semiarid climate of cold winters, large thermic variations (approximately 19°), temperate winters with an average temperature of 3°C and summers with an average temperature of 21°C. Annual winter-summer precipitation is less than a total of 200 mm. This

area is the sump of an endorheic basin supplied by the Río Malargüe, whose flow is not well known, but according to data provided by Vitali (1941), the average flow is calculated to be 6 m³ /second.

In addition, the volume of water in the lake depends on loss through evapotranspiration and variations in the flow of the Mocho and Chacay streams in the north and the Menucos and Carilauquen streams in the south that supply water to the lake. Runoff from the hills in the Cadena del Nevado also flow to the eastern shore of the lake. As a result of this system, the lake reflects seasonal fluctuations in its shores and in the depth of the lake (some 30 centimetres in average depth). The lake forms a small basin sloping toward the centre, influenced by the surrounding elevations. The soils forming the substratum of the sump are lacustrine and marsh deposits of mud and saline clays. Basaltic soils, dunes and marshes complete the landscape.

The main tributaries are the Río Malargüe, the Mocho and Chacay streams, which transport surface water and the Menucos and Carilauquen streams, which provide subterranean water to the lake. Perhaps, the most important contribution is from the underground water table. All inflow has a common origin in accumulated snow. As a result, the amount of snow accumulated in winter determines seasonal fluctuation in the lake. Thawing produces a significant increase in the level of the lake in the summer, which drops during the winter. The water is saline (a maximum of 75 g/litre), with a permanently alkaline pH (7.2 to 10). Water temperature is between 20.7°C and 24.3°C, and turbidity is between 0.24 and 0.36.

15. Hydrological values:

1) Erosion prevention: The lake is located on a large salt marsh protected from erosion as long as there is water in the lake. When the water level drops, however, the marsh remains exposed and is subject to wind erosion. At certain times of the year, winds can reach 150 km/hour and act on the salt flat, blowing away the surface material, depositing it on the surrounding soils and rendering productive soils saline.

2) Capture of sediments: Because it is endorheic, the lake plays an important role as a basin for capturing lacustrine, river and alluvial material of pyroclastic characteristics.

3) Contribution to grazing: As mentioned previously, this activity is becoming increasingly important, because the Llanquanelo area is an important grazing area of natural pastures and is an enclave in an extremely arid region.

4) Education, tourism and recreation: The lake and its environments represent a true touristic and educational attraction because it is an ecosystem that offers distinct landscapes, natural elements and unique fauna and flora compared to the desert areas common in the province of Mendoza. Educational possibilities are well used by groups of school children, especially secondary school students. The touristic resources have a high potential for attracting persons interested in visits, hikes, photographic safaris, camping, ecotourism and adventure tourism. At the present time, the lake is available for guided hikes using interpretation trails. There is currently no infrastructure or plan for developing tourism. Tourism at the lake represents an important economic resource, which can substantially benefit the department of Malargüe, if this activity is well managed and satisfactorily developed.

5) Creation of wildlife habitat: There are populations of 150,000 aquatic birds in the summer and 54,000 aquatic birds in the winter, representing 155 species of birds (74 of which are aquatic birds of which 24 species regularly nest in the reserve including colonies of 10,000 nesting flamingos, 1,500 cisne de cuello negro nests, 120 nests of mac plateado and mixed colonies of up to 400 nests of Ardeidos and 15 species of migratory birds including more than 12,000

chorlos in the summer). Concentrations of 24,000 cisnes de cuello negro and 8,000 coscorobas take refuge in the water during periods of the *mancada* (dry season).

These are some of the characteristics that reveal the value of this lake as a refuge for the nesting, feeding and resting of migratory species and as a winter refuge for a large number of aquatic birds.

16. Ecological features:

The reserve's geomorphological characteristics define it as a piedmont plain in the portion called the Los Huarpes Depression. This is a large area clearly set off by hills, hillocks and badlands (*huayquerías*). The *Serranías del Carrizal* are to the north and the *Huayquerías* and the *Mesetas del Guadal* to the east; towards the south, the reserve ends in the volcanic region of La Payunia. All of this area is very sparsely inhabited, but ranching is increasing. Biogeographically, the lake belongs to a transitional area between provinces of scrub hills and the Andes/Patagonia, with fauna and flora from both the Pampa and the Andes/sub-Andes.

17. Noteworthy flora:

Because Laguna Llanquanelo is an enclave in an arid region, the hydrophilic vegetation is of particular importance as a natural resource for both the grazing of herbivores and as a refuge and nesting area for a considerable number of species of aquatic and other birds.

It is for this reason that communities of *Juncus*, *Scirpus* and *Stipa*, as well as other plants, forming real barriers at the mouth of most of the tributaries entering the lake, should be protected. These communities suffer seriously from the effects of overgrazing. According to local inhabitants, barriers of cattail (*Stipa domingensis*) formerly covered a much larger area and were so dense and high that domestic animals became lost for days. At the present time, there are only scattered patches, and these rarely reach one metre in height. (See photo in the appendix.) Another community of special interest is *Frankenia juniperioides*, growing in fields subject to wind erosion. This species helps retain the soil. Finally, there is a landscape resource on the Trapal volcano, a quite visible community of cacti of the genus *Denmoza* with a columnar trunk of considerable height (up to 4 metres), giving the environment a special panorama.

The flora in most of the Llanquanelo basin is xerophitic and halophitic. Nonetheless, in an area around the lake there is flora that is representative of the hills to the north and the Patagonian steppe basin to the south.

The halophitic communities (occupying Quaternary soils of lacustrine origin) are modified by two factors: soil salinity and the amount of available water. The soils with the highest concentration of salt are usually where water most frequently accumulates and also in the lowest parts of the basin. In the soils that remain free from flooding, but nonetheless where salt accumulates an important community of *Suaeda divaricata* and *Atriplex lampa* forms an extensive band of open cover around the northern shore of the lake. In floodable soils, where water frequently accumulates, and there are usually clay soils, small, semipermanent lakes frequently form that can exist for a few days or several months. A bushy strata of *Atriplex* spp. and *Prosopis strombulifera* often form.

In periods of prolonged flooding, a community of *Baccharis spartioides* (forming dense patches) and *Distichlis spicata* develop where the water table rises to within a few metres of the surface. In relatively dry soils containing concentrations of saltpeter, communities of pure *Heterostachys riteriana*, *Salicornia ambigua* and *Distichlis spicata* form.

Most characteristic of the halophitic flora of the basin is *Frankenia juniperioides*. Near the water of the lake, there is a flatland around the northern sector, which reaches 60 km in width in some sections, which are completely occupied by this vegetation.

Based on soil characteristics and vegetation type, the area of the wetland was classified using digitized satellite images. The areas surrounding the lake were classified with the Image Multi Spectral Scanned digitization process (1982) by the Comtal team of the CRICYT-Me (Torres, et al., 1989).

The following zones have been identified using this method.

Zone A: marshes and estuaries of the Río Malargüe and the Mocho and Chacay streams. This area, prone to flooding, is dominated by *Cortaderia rudioides*, *Distichlis spicata*, *Juncus balticus*, *Phragmites australis*, *Scirpus californicus* and *Typha domingensis*.

Zone B: a saline flatland subject to flooding with scattered halophilic, shrub-like cover of *Atriplex* spp., *Baccharis spartioides*, *Frankenia juniperioides*, *Heterostachys ritteriana*, *Salicornia ambigua*, *Schinus fasciculatus* and *Suaeda divaricata*.

Zone C: low dunes subject to salinity where *Chuquiraga erinacea* (dominant species), *Lycium chilense*, *Schinus fasciculatus*, *Sporobolus rigens* and *Suaeda divaricata*. Also included in this zone are the dunes near the estuaries not subject to salinity with *Cortaderia* spp., *Lycium chilense* and *Schinus fasciculatus*.

Zone D: a highly saline flatland, subject to flooding and completely lacking in vegetation.

Figure IV: Vegetative communities [renumber as figure I]

Vegetative Communities

Hydrophytes

Halophiles [place genera in italics]

Psammophiles

Volcanic soils

(Eduardo Martínez, personal communication, 1995)

On the lower parts (where water accumulates), usually clay soils, small semipermanent lakes frequently form, lasting for days or sometimes months. In these areas, there is a shrub base of *Atriplex* spp. and *Prosopis strobilifera*.

When the period of floods is prolonged and in areas where the water-table rises to within several metres of the surface, there is a community of *Baccharis spartioides* (forming dense patches on the ground), accompanied by *Distichlis spicata*. In very saline, but relatively dry soils, a community of pure *Heterostachys ritteriana*, *Salicornia ambigua* and *Distichlis spicata* grows.

The most characteristic vegetation of the basin with respect to the halophilic flora is *Frankenia juniperioides*. There is a flatland on the northern side of the lake, which reaches 60 kilometres in width in certain sections and is totally covered by this vegetation.

It is possible to map this area in function of soils and type of vegetation using satellite images. The land around the lake has been classified, using the Multi-spectral Scanned Image process in 1982 (Torres et al., 1989).

18. Noteworthy fauna:

There are species of fauna in this wetland from the following areas: Chaco (from the north), Pampa (from the east), Patagonia (from the south), as well as Andean and sub-Andean. The latter are the most important species here.

From the Chaco, there are marsupials such as the *Marmosa pusilla* and the *Didelphis azarae*; the rodent *Chaetophractus villosus* and the pichi ciego (*Chlamyphorus truncatus*), which lives in the meadows and is in danger of extinction. *Oncifelis geoffroyi* and *Felis pajeros* are two species of cats found here. There are too many birds to name all those in the Llanquanelo area, but highly representative are the *Rhinocrypta lanceolata* and *Teledroma fuscus*, both gallitos and inhabitants of dunes and sandy soils north of the lake.

From the Pampa come primarily aquatic birds of the *Anas*, *Coscorobas*, *Cygnus* and *Larus* genera and terrestrial birds such as the *Eudromia elegans* and *Pseudoseisura lophotes*.

One interesting species found in halophilic areas, the rata del salar (*Tympanoctomys barrerae*), is endemic to the province of Mendoza and is listed as a species in danger of extinction.

Patagonia has made an important contribution to the composition of the fauna: a mammal, the fox (*Dusicyon culpaeus*) and the herons (*Lyncodon patagonicus* and *Galictis cuja*). The representative rodent in this area is the pichi (*Zaedius pichiy*).

Several authors documented about fifty years ago the presence of the huemul (*Hippocamelus bisulcus*), an American deer almost extinct that has already disappeared from the province.

The Andean region has contributed the guanaco (*Lama guanicoe*), but around Llanquanelo it is seen only on rare occasions in the Cerrillada del Nevado to the east or in the south near the Carapacho Volcano.

Among the Andean birds visiting Llanquanelo for wintering are the cauquén (*Chloephaga picta*), which migrates to the high Andean meadows during the spring and summer to nest along streams, and the *Attagis gayi*. On the other hand, others, such as the *Geossitta cunicularia*, remain the year round. During the winter, the condor (*Vultur gryphus*) appears sporadically.

Rodents such as the chinchilla (*Lagidium viscacia*) live on the Carapacho and Trapal volcanos. Of less importance is the tuco-tuco (*Ctenomys mendocinus*), which lives in loose soil. The *Microcavia australis* has been seen in flat woodlands.

It was the characteristic birdlife of this area that was the main reason why the provincial government declared this a protected area.

So far, 155 species of birds belonging to 16 orders and 39 families, 74 species of which are aquatic, have been recorded at Laguna Llanquanelo and the surrounding areas. This includes old sightings and species reported, but requiring confirmation.

Figure I: Communities of aquatic birds (by family, maximum numbers surveyed in summer and winter over six years (1990-1995) and number of species per family)

[renumber as figure II]
Family Quantities Number of species

[change family names to end in "aea" instead of "os"]

Figure II: Species with more than 20,000 specimens and others of equal numerical importance

**** [renumber as figure III]
Species Number of specimens
[place scientific names in italics]

Figure III: Total number of aquatic birds surveyed over six years (1990-1995) during two seasons (summer and winter)

**** [renumber as figure IV]
Year Winter Summer

*Owing to poor visibility, only the *Phoenicopterus chilensis* was recorded.

** aerial survey

- no survey was made because of bad weather and the impossibility of reaching the site

19. Social and cultural values:

Social values: grazing, education, tourism and recreation.

Research: The site offers a wide range of possibilities for scientific research not only in the natural sciences but also in other fields of equal importance. The following reasons justify research.

Anthropology: Very close to Laguna Llanquihue in the La Payunia Reserve, there are pictorial remains of geometrical drawings thought to have a close affinity with the ornamental geometrical art--the Grecian style of Patagonia--which is dated as roughly 1000 A.D. There are even older drawings in a style that is a combination of three styles. These styles cover periods of more than 7,000 years of human occupation in the region. (See the attached management plan for La Payunia.) Furthermore, until the middle of the eighteenth century, a population called the Puelches lived in or near Llanquihue. Their economy was based on hunting and fishing of which there are only archaeological remains (arrowheads, pottery, pipes, stone knives and shell beads). Los Puelches is the name given them by the Araucanos (another indigenous group from Chile). The Spanish called them "Pampas," and they called themselves the Gennaken or Gennak.

History: All of the indigenous groups in this area were decimated during the well-known Campaña del Desierto led by Rufino Ortega in the area around Malargüe. A map from 1910 shows where Ortega camped around Laguna Llanquihue.

Geology and vulcanology: The Laguna Llanquihue basin belongs to the geomorphology of the volcanic region of La Payunia and is a flatland surrounded by eruptive and basaltic soils from the Tertiary and Quaternary and pre-Tertiary sedimentary rocks. There are many volcanos: two of which have special characteristics because they erupted under water (Carapacho to the south of the lake and Trapal to the west of the lake).

Biology: Research is important in all of this area because of the biological and ecological resources. Also important is the study of the hydrology, because this is the only endorheic basin in the province.

Soils: The soils in Llanquanelo have an electrical conductivity greater than 20,000 micromhos.

2) Cultural values: Folklore in this area is very important because after occupation of the land by the criollos (rural inhabitants descending from the indigenous groups and the Spanish) following the Campaña del Desierto, there were no significant changes in the culture, which has continued to evolve up to the present time. This folklore has special characteristics, ranging from clothing, dress for horse riding, ranching practices, handicrafts, food and traditional music. All of these values should be recovered and preserved as part of the provincial cultural heritage.

There are traditions that encroach on the preservation of fauna, such as the well-known boleadas de choique--hunting with boleadoras on horseback in a group with dogs of the choique (mandí or American ostrich--Pterocnemia pennata). A typical meal is the chaya, prepared with the meat of these birds and cooked with hot rocks inside a pot. Another tradition encroaches on the conservation of a small armadillo (pillar), hunted by hand with the help of dogs. These small armadillos are rodents in the *Zaedyus* and *Chaetophractus* genera. They are cooked al rescoldo (in the hot ashes of a stove) or in a clay pot. This typical dish is used to entertain visitors, especially city dwellers (pueblerinos).

Finally, music in this area is typically cuyana (the Cuyo region of the provinces of La Rioja, Mendoza, San Juan and San Luis). Best known are "La Cueca," "La Tonada" and "El Gato," each with its own dance (except for "La Tonada" which is not danced). There are strong influences in this music of the Mapuches (Loncomeos) and Chilean indigenous groups (the Chilean cuecas). All of these forms of expression are played on guitars and sung. Handicrafts also form part of the folklore of this region, characterized fundamentally by braided leatherwork (trenzados) made from bovine or goat leather, weaving made on Indian looms, clothing made from sheep wool woven by hand and dyed with natural dyes. In several settlements, there are still families that make their own utilitarian, rustic pottery.

20. Land tenure/ownership of:

At the site, 42,000 hectares belong to the government of the province of Mendoza based on Decree 9/80, creating the provincial wildlife reserve Laguna Llanquanelo. The rest of the land is private property.

In the surrounding area, all the land is private and used for ranching or is left idle.

21. Current land use:

At the site, there are no dwellings, but the important economic activity of ranching of cattle, sheep, goats and horses has been carried out for the past 100 years.

In the surrounding area beyond the aquatic ecosystem but within the reserve, there are isolated farm houses and significant ranching activity in several sectors (see the annex).

Hunting and fishing were an important activity in the reserve up until 1980, but after the creation of the reserve, the importance of this activity decreased. With the permanent presence of park wardens since 1993, illegal hunting is under control (see appendices).

Soil use in the rest of the basin has acquired more importance towards the town of Malargüe where all available land is actively used for agriculture and ranching.

It should be pointed out that among the tributaries of the lake, the Rí o Malargüe is used for irrigation in accordance to water rights established by the Dirección General de Irrigación of the province of Mendoza.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

a) Water use - Part of the water of the Rí o Malargüe is used for domestic purposes in the centre of the department of Malargüe, and the rest is used for irrigation for agriculture. Irrigation represents a potential problem for replenishment of the lake because of increases in this activity. Efforts are being made to ensure a minimum of water reaching Laguna Llanquanelo (see appendices).

b) Overgrazing - There are no studies of the number of animals per hectare in these pastures and no studies on the impact of domestic animals on soils in the reserve. It is for this reason that steps have been taken to regulate and manage grazing. There are surveys of grazing animals, the number of ranchers that use the pastures in the reserve and several studies that point out the possible negative impact of this activity (see appendices).

c) Contamination - The oil industry carries out activities in this area, but is regulated (environmental control and impact assessment) by the Dirección de Recursos Naturales of the province of Mendoza through environmental management companies and the Cooperative Inti-Natura Ltda. Impact assessments are made by interdisciplinary technical commissions from governmental agencies in the province (IADIZA-CRICYT).

The National Atomic Energy Commission has a former industrial site one kilometre northeast of the main square of the town of Malargüe. This site, used for processing uranium ore, left a deposit of residue from the processing of 700,000 tons of ore. All of this waste is stored in a large residue stockpile, 400 metres by 300 metres and up to 6 metres in height. This stockpile is located in an area where the alluvial fans of the Rí o Malargüe and the Arroyo Chacay intersect and where flood waters empty into the Llanquanelo River and onto the lacustrine plain. There is a potential threat of contamination by seepage from the stockpile into the water-table, which continues underground into the lake.

Given this problem of contamination, an agreement on scientific co-operation was signed between the Instituto Argentino de Investigación de Zonas Áridas (IADIZA) and the National Commission for Atomic Energy (CNEA) for a study of whether contamination really exists and what is the effect on the ecosystem of the stockpile and drainage from it (see appendices).

d) Hunting and fishing - These activities present a potential problem because of the hunting and fishing resources found here. There is illegal hunting of the coipo (*Myocastor coypus*) for commercial trade, and there are still traces of a former installation for raising coipos just north of the lake. It is estimated that up to 2,000 animals were taken from the lake each season.

Another species often traded is the flamingo (*Phoenicopterus chilensis*). There are buyers of flamingos for illegal export to neighbouring countries. There is also illegal hunting, considered to be sport hunting, of several species of mammals and birds, including the red fox (*Dusicyon culpaeus*), grey fox (*Dusicyon griseus*), viscacha (*Lagostomus maximus*), Patagonian piche (*Zaedyus pichiy*), coipo (*Myocastor coypo*), a bird, the choique (*Pterocnemia pennata*), several species of Tinamidae (martinetas and partridge) and ducks. There is illegal fishing for sport from the shore and from boats catching the Patagonian pejerrey. All of these activities are prohibited by Law 9/80 and are monitored by park wardens.

e) Introduction of exotic species of fauna and flora: Man has introduced exotic species of shade trees, such as *Salix* spp., *Populus* spp. and *Schinus* spp. All of these species are found only around human settlement and are controllable because of their seed propagation strategies. There is one problem species, tamarisco or tamarind (*Tamarix gallica*), which was introduced for the same purpose but owing to its dispersion strategy (hydrochoric) it has succeeded in colonizing the most important affluents of the lake. For example, at the mouth of the Río Malargüe, dense thickets of *Tamarix* are forming, which, in addition to competing with native species of shrubs and grasses, form large trenches that obstruct the normal deposit of sediment. In several cases, they divert the course of the river or preventing flooding of sectors of the bañados and estuaries and the resulting canalization of the river bed.

The European hare (*Lepus capensis*) competes with native species of herbivores such as the liebre criolla or mara (*Dolichotis patagonum*). Another introduced species is the wild boar (jabalí) (*Sus scrofa*), which roots in the ground, deteriorating it and presenting a potential danger to birds of prey that nest in the sloughs and estuaries; primarily bird species that nest in colonies (parrots, herons, flamingos and swans).

23. Conservation measures taken:

Approximately 70 per cent of the reserve is formed by wetlands, which are legally protected in this reserve administered by the Dirección Provincial de Recursos Naturales of the province of Mendoza. Regulation and surveillance are the responsibility of the Cooperativa de Guardaparques Provinciales Inti-Natura Ltda., which is also responsible for managing the other conservation units in the province.

Approximately 100 kilometres southeast of Llanquihue is the La Payunia reserve, a volcanic area for which a management plan has been prepared. A management plan is also being prepared for Llanquihue.

Other details of conservation measures already adopted to protect nature areas in the province are specified in the basic law which is attached.

24. Conservation measures proposed but not yet implemented:

A management plan has been prepared and approved by the provincial government, but no funds have been made available for its implementation.

In June 1992, a study entitled "Regulatory Measures for the Initiation of Tourist Activities in the Laguna Llanquihue Reserve" (Puig, et al., 1992) made several recommendations for the development of tourism in the reserve, the scheduling of activities and construction of observation trails and camping sites. These measures have not yet been adopted.

In 1989, work was begun on marking out the reserve's boundaries and an initial report on this work in the northern part of the reserve is available. This report recommends completion of the marking of the rest of the reserve, but, so far, only the limits described in the annexes have been marked (Videla, Puig, Sosa, 1989).

25. Current scientific research and facilities:

A field survey is being carried out for the preparation of a map of the vegetation of Llanquihue (Mendez, Eduardo. Botánica y Fitosociología. IADIZA).

Steps have taken to find financing for a study of the seasonal fluctuation of the community of aquatic birdlife at Laguna Llanquihue. A copy of this proposal is attached. (Heber Sosa. Cooperativa Inti-Natura)

Facilities and infrastructure: It is difficult to find funds for field studies. There is no infrastructure, only a small caravan for the park warden.

26. Current conservation education:

At the present time, there are no facilities for educational programmes within the reserve. There are no organized programmes, although occasional talks are given at schools in the area, in the department of Malargüe and in the city of Mendoza.

The Cooperativa Inti-Natura Ltda. has prepared a plan for environmental education for primary schools in the area.

27. Current recreation and tourism:

During the spring and summer, tours are conducted by guides or park wardens for groups of visitors. While no programme has been prepared to develop tourism, regulatory measures have been drafted.

28. Jurisdiction:

Director de Bosques y Recursos Naturales Renovables

29. Management authority:

Ministerio de Medio Ambiente Urbanismo y Vivienda
Dirección de Bosques y Recursos Naturales Renovables
Gobierno de Mendoza

30. Bibliographical references:

Information Sheet on Ramsar Wetlands
Victoria Zentilli
4/8/99