

Information Sheet on Ramsar Wetlands

1. Date this sheet was completed/updated:

2. Country: CHILE

3. Name of wetland: Salar de Tara

4. Geographical coordinates:

23°01'S
67°18'W

5. Altitude: 4,400 metres above sea level

6. Area: 5,443 hectares

7. Overview:

This is a high-altitude salt marsh with permanent and seasonal lakes. On the northern and eastern edges of the salt marsh there are vegas and bofedales that depend on a source of water. This area is the main nesting site of the James's flamingo (*Phoenicopterus jamesi*).

8. Wetland type:

permanent brackish lake

9. Ramsar criteria:

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

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

Sección Fauna Silvestre
U.G. Nacional Patrimonio Silvestre
Corporación Nacional Forestal
Santiago de Chile

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

13. General location:

This reserve is in Region I of Tarapaca, in the province of El Loa, 235 kilometres from Calama and 135 kilometres from San Pedro de Atacama.

14. Physical features:

Geology and geomorphology: According to Gardeweg, et al. (1985), the exposed series in the reserve are made up of volcanic and sedimentary rocks from the Pliocene to the early Quaternary. They are from the volcanic complex II (Pliocene) represented by the Hualitas volcano, and there are ignimbrite Atana (Pliocene), ignimbrite Filo Delgada (Pliocene) and lacustrine, alluvial and saline deposits, all from the Quaternary. The most important geomorphological feature is the Tertiary volcanic plateau, which is broken by volcanic structures such as the Hualitas volcano, partly by the La Quilapana Range and the Salar de Tara, formed primarily of sulphates.

Hydrology: The Salar de Tara on the Andean plateau at 4,300 metres provides the balance in the international endorheic basin that includes part of Argentina and Bolivia. The Chilean portion of the basin covers 92,300 hectares (Niemeyer, et al., 1983).

This eastward draining basin is formed by the R₁o Zapaleri, the Angostura stream and the Cueva Pintada marsh and in the west by the R₁o Chico y Hualitas. In addition, there is a system of seasonal streams, some of which are without names. At the base of the Tara Hills, there is a flow of fresh lukewarm water into the salt marsh. There are also small lacustrine systems that fill closed depressions throughout the volcanic landscape, including Helada and Joyitas lakes and the Guachalajte complex.

The R₁o Zapaleri is the main source of water for the Salar de Tara and the lake with the same name. Measurements taken in the river, between the months of April and November over several years, record flows of between 300 and 700 litres/second. The balance in this sub-basin shows a flow of 909 litres/second. For the whole basin, the total flow reaches 2,169 litres/second (D.G.A., 1983).

Throughout the salt marsh, there are shallow bodies of water, including Lake Tara whose extension varies greatly with the seasons because of the influence of rain and snow on the area. The proposed area of influence covers roughly 19,502 hectares.

15. Hydrological values:

Limnology (Physical and chemical parameters)

There are important studies available that suggest several geological influences leading to the physical and chemical conditions creating the brine of the Salar de Tara, and several places in the salt flat have been analyzed.

The Salar de Tara has a few salt deposits with halite (NaCl), gypsum (CaSO₄.2H₂O) and ulexite (NaCaB₅O₉ 8H₂O) (Chong, 1970). Parada (1990) studied in greater detail the chemical characteristics of seven spots in the Salar de Tara, for solids, chlorides, sodium, sulphates, arsenic and for pH. These analyses were carried out under the project "Conservation of Flamingos in Northern Chile," and the results are presented in the following table.

Chemical analysis of the water

(in mg/l)

source: Parada, 1990

Area and sample	solids	chlorides	sodium	sulphates	arsenic	pH	
Vertiente Refugio (M1)	876	345	250	38	0.28	7.3	
Lake Tara (southern shore) (M2)	52372	28248	26100	2503	4.80	7.9	
Lake Tara (northern shore) (M3)	420	66	40	25	0.08	9.1	
R ₁ o Zapaleri (M4)		454	51	40	54	0.06	8.1
Salar (eastern portion) (M5)	1124	195	160	196	0.18	9.0	
Laguna Interna I (M6)	8620	4598	2730	89	0.26	7.9	
Laguna Interna II (M7)	2194	1050	760	120	0.36	9.1	

According to Parada, the water shows considerable variation in chemical composition between lakes and within the same body of water. An example of this is the case of Laguna Interna I and Laguna Interna II, where, in spite of their being separated by less than 550 metres, they have significant differences in pH and chemical composition. Laguna Interna I is four times more saline than Laguna Interna II, with high concentrations of both sodium and chlorides. Important variations in salinity are also observed in Tara lake.

Samples 1, 2 and 3 were taken in the northwestern part of the lake (figure 26). There is an important flow of warm water (sample 1) of low salinity (total solids: 876 mg/l) and an almost neutral pH (7.3). The water on the northern shore (sample 3) is characterized by low salinity (total solids 420 mg/l), although its pH is quite alkaline (9.1). Proof of the variation in salinity of these waters are the data obtained on the southern shore of this sector (sample 2). The water in this area is 100 times more saline and its concentration in arsenic is more than 17 times greater than those observed in the area of upwelling and on the northern shore.

Similar characteristics of low salinity are found on the R_{jo} Zapaleri (sample 4), where water at the point of entry to the Salar creates conditions for the development of an area rich in fauna and flora. Sample 5, taken at the extreme southeastern point of Laguna Tara, shows low salinity of the water (total solids: 1124 mg/l).

Only one survey was made of the lake at the northwestern edge of the salt flat. This area is very strongly marked by the conditions created by the mouth of the R_{jo} Zapaleri. A sample was taken in an area of concentration of James's flamingos where a total of 911 specimens were counted. The following is the result of the analysis of the water.

Chemical characteristics of the water sample at the Salar de Tara

Parameter	Value
pH	8.49
salinity (ppm)	5.00
NO ₂ (g-at/l)	5.00
NO ₃ (g-at/l)	10.00
PO ₄ (g-at/l)	6.20

The sample shows a basic pH in agreement with Parada's (1990) findings in sample 4, taken from the R_{jo} Zapaleri. There is low salinity and high levels of nitrogen, compared to samples taken in similar environments.

It seems that the highly alkaline water of the R_{jo} Zapaleri influences the mouth, creating special conditions for the development of important quantities of species of microalga, responsible for the high concentration of flamingos observed in this sector. This is confirmed fully by that found in the biological sample of benthic plants for which an analysis is given later in this study.

The R_{jo} Zapaleri in the Salar, in addition to promoting conditions favourable for life at its mouth, forms the most important tributary and is responsible in large part for the water conditions and the physical and chemical characteristics of the water by creating permanent processes of dissolution and drying in the areas along the flow of surface water.

These processes can be explained by the great variability in concentrations of dissolved solids and arsenic found by Parada even towards the middle of the lake as is the case of the northwestern part of Lake Tara (see the attached map). Samples 1 and 3 of his study were taken in areas influenced by the tributaries and by conditions along the edge in which are found vegetative communities and soil characteristics of low salinity. On the other hand, sample 2 was obtained from the shore of the lake where there are manifestations of saline conditions typical of the salt flat. The permanent repeated dissolving of salts determines the other parameters. These conditions confirm the delicate balance between these saline environments and the resulting high fragility of their ecosystems.

Biological characteristics of the lakes

Microalgae

In the sample taken in the lake of the Salar de Tara, at the same place described for the physical and chemical sample, 17 species of microalga were found. Fifteen of these belong to the Bacillarioficea family (diatoms) and two to the family of Cyanophyta (table 8 of annex II).

The most abundant species are *Navicula* spp., which represents more than 40 per cent of the total cells per litre. Other abundant species are *Surirella ovata* and *Fragilaria* spp., which together represent 20 per cent of the total number of cells per litre found. It is important to point out that this sample shows the greatest diversity (0.7925), in relation to the other wetlands covered in this study. According to the findings of Gallardo et al. (1992), the diatoms of greatest abundance in this sector are one of the main dietary components of the James's flamingo, found in abundance (911 specimens) feeding in this area.

Microinvertebrates

Few microinvertebrates are represented in the sample. Only two species were found, both were larva of dipterons of two species. Both items were no greater than 0.2 specimens per litre.

16. Ecological features:

There are three identifiable habitats in the wetland. First, highly saline shallow lakes: a habitat limited to microalgae (primarily Bacillarioficea) and microinvertebrates including copepods, ostracods and the larva of quironómidos. This microbiota is the basis of the ecosystem present in the surface water in the salt marsh that includes three species of flamingos, caitjes, Andean gulls, chorlos and shore birds. The second habitat covers the area of greatest irrigation, of bofedales and meadows in the salt marsh, which are the preferred habitat of the guallata, pato juarjual, pato puna and pato jergón chico. The third area is formed by dry pastures where high steppe vegetation dominates and where species of birds such as the suri, kiula and mammals such as the vicuna, vizcacha and fox live.

17. Noteworthy flora:

This salt marsh is located in the ecological region of the High Andean steppe, sub region of the altiplano and puna represented by the vegetative formation "Sub-desert steppe of the Atacama Puna," as described in the study by Gajardo, R. et al., (1983) entitled "Sistema b sico de clasificacin de la vegetacin nativa chilena."

This type of vegetation is widespread throughout the Antofagastan Andes with characteristic low brush steppe and low density Gramineae in which there are large areas without vegetation because of soil conditions (Gajardo, 1983).

The following vegetative communities are found:

Baccharis incarium-*Lampaya medicinalis*
Fabiana bryoides-*Parastrephia lepidophylla*
Festuca chrysophylla- *Fabiana bryoides*
Pycnophyllum molle-*Oxalis exigua*

In the area chosen for this study, the following species are found in the association of *Festuca chrysophylla*-*Fabiana bryoides*:

Adesmia horrida
Azorella compacta
Baccharis incarium
Chuquiraga espinosa
Conyza deserticola

Lampaya medicinalis
Parastrephia quadrangularis
Pycnophyllum molle

The Fabiana bryoides-Parastrephia lephidophylla association is represented in the eastern part of the salt marsh and along the edge of the salt marsh. The following species are found:

Artemisia copa
Fabiana denudata
Mulinum crassifolium
Phacelia viscosa
Stipa crysophylla
Stipa frigida

Study area

In general, there are three distinct vegetative communities. On the southeastern exposed slopes, steppe vegetation is formed by Deyeuxia antoniana, Festuca chrysopylla, Festuca orthophylla and Stipa leptostachya. This vegetative community thrives, covering approximately 30 to 50 per cent of the area. On the northern border of the salt marsh and in parts along the northwestern border, there is a formation of vegas (bofedales) that cover a total of approximately 150 hectares. In this formation, the following species predominate: Deyeuxia velutina, Distichlis humilis, Festuca orthophylla, Parastrephia spp., Patosia clandestina and Triglochin palustris (Fañdez., 1993).

On the eastern edge of the salt marsh are communities of low shrubs and grasses among which are found the species in this association. These scrub formations have been recorded in transitional areas between zones of vega on the edge of the salt marsh and hill slopes.

According to a study made by the University of Chile (Castro et al., 1993), there are two vegas of importance near the Salar de Tara associated with the system of lakes: the Tara Vega with an area of approximately 100 hectares and the Rjo Chico Vega of 50 to 100 hectares.

None of the species mentioned are considered to be endangered (Benoit, 1987).

18. Noteworthy fauna:

The reserve has two distinct environments with associated fauna: vegetation surrounding the salt marsh, the freshwater streams and formations of meadows and associated bofedales, and then the low-saline waters of the Rjo Zapaleri and the saline lakes in this wetland (Parada, 1990).

These environments provide an opportunity to observe more species than in other wetlands. There are a total of 38 different species of which 10 per cent are mammals and 90 per cent are birds. At least 7 species reproduce in the wetland: 4 mammals and 3 birds.

The following table lists the species found in the Libro Rojo de Vertebrados Terrestres de Chile (Glade, 1993).

Species found in the Salar de Tara included in conservation categories

Conservation status	Species
In danger of extinction	Lagidium viscacia Pterocnemia pennata tarpacensis Vicugna vicugna

Vulnerable	Chloephaga melanoptera Fulica cornuta Larus serranus Phoenicopterus andinus Phoenicopterus chilensis Phoenicopterus jamesi Tinamotis pentlandii
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Rare -

Not evaluated -

Poorly known Pseudalopex culpaeus

Mammals of interest

Andean wolf (*Pseudalopex culpaeus*): often found in rock piles and along the edges of the salt marsh, living off small rodents, lizards, eggs and young birds. It sometimes attacks young vicunas (Parada, 1990). There are no estimates of the populations of this species.

Vicuna (*Vicugna vicugna*): often seen feeding on the borders of the salt marsh or drinking from springs or the Rjo Zapaleri (Parada, 1990). There are no records of populations found in this region. Nonetheless, a group was recently observed on the edge of the basin with a composition of 1:6:2 (male:female:young) and then, later, 1:2.

Chululo (*Ctenomys fulvus*): This is a frequent rodent in the flatlands and slightly sloping sandy soil. It digs galleries in areas dominated by *Festuca* and *Parastrephia*, preferring to eat roots (Parada, 1990). There are no estimates of this species's population.

Vizcacha (*Lagidium viscacia*): This gregarious rodent lives in rock piles along the edges of the salt marsh in large colonies called vizcacheras of usually more than 100 specimens. They feed both during the day and at night, preferring to feed off pajonal (*Festuca chrysophylla*) (Parada, 1990).

Birdlife of interest

The most predominant family is the Phoenicopteridae, represented in the salt marsh by three species of flamingo. One of these, *Phoenicopterus jamesi*, uses this site for reproduction. This is now the second most important nesting site for this species. According to Santoro (1990), 5000 chicks hatched here in 1988. Surveys made under this project have determined that this is the most abundant species in the reserve. It represents 48 per cent of the total bird population followed by the Chilean flamingo (37 per cent) and the Andean flamingo (4 percent) (See table 3 in annex II).

There are more flamingos in the Salar de Tara during the summer than during the winter. The decrease in the winter population is because the lakes freeze over, causing migrations especially of *P. jamesi* toward more benign areas such as the central altiplano in Bolivia, at a lower elevation, and the Peruvian altiplano, at a lower latitude (Parada, 1990). In addition, there are partial migrations recorded in Chili from the Atacama puna (primarily the Salar de Tara) to lower altitudes in the Salar de Atacama (Parade, 1990); a situation also observed during the present study.

Another species of interest is the *Pterocnemia pennata tarapacensis*, an inhabitant of the flatter land. It is frequently seen feeding and drinking around the salt marsh. No survey has been made of the populations of this species.

19. Social and cultural values:

There was hunting much earlier in the Salar de Tara, given its resources of flora and fauna created by the confluence of the two bodies of surface water that supply the basin. In the northern part of the Salar de Tara are found fragments of pottery at the surface and rock materials. This archeological site is in the rocks near the former shores of Lake Tara. During the summer, this area was recently used for grazing of domestic animals belonging to the inhabitants of Camar. Lately, groups of tourists visit this area.

20. Land tenure/ownership of:

The government owns the land at the site and in the surrounding area.

21. Current land use:

Grazing

The town of Camar occupies the grazing area of the Cueva Blanca, Tara and Zapaleri vegas; all three are near the Salar de Tara. The Tara vega is a high-altitude vega (bofedal). Other high-altitude vegas used by this community are Laguna Helada and Laguna Guachalajte and at lower altitudes the vegas of Camar and Gelana. These vegas are used seasonally (in the summer). Nonetheless, parts of these are used during the whole year by a small ranch near the Nevado de Poquis, whose inhabitants have family ties with the inhabitants of this community.

The species of vegetation most frequently grazed by the cattle are cachiyuyo, hojalar, kumi, malva and pasto chico.

The community of Talabre is apparently most closely tied to the vegas as grazing sites, because it has the largest number of llamas (*Lama spp.*) which in 1994 reached 737 animals (SAG, 1994). This community uses the vegas of Aguas Calientes 1, Tara and Zapaleri, adjoining the Salar de Tara and Aguas Calientes 1. The first vega is a high-altitude salt flat vega and the second is a salt flat vega. They also use the high vegas of Quepiaco and Alitar, near the salt flat of Pujsa and others such as Acamarachi Chica, Acamarachi Grande, Colachi, La Azufrera and Pujsa, farther from this salt flat. The first six are high vegas at the end of a canyon, while Pujsa is a salt flat vega. They also use the low vegas of Tambillo and de Carvajal. These vegas are used seasonally (in the summer) by the community, except that of Tambillo, which is used year-round.

The species most frequently grazed by livestock are aja, campaya, chasquiar, chichicón, forecilla, grama, navia, ojar, oreja de ratón, paja blanca, paja blanda, pako, pasto de campo, pasto de semilla, pasto pako, perfilla and unquillo.

The communities of Peine and San Pedro de Atacama do not use wetlands covered under this study. Nonetheless, as reference, the community of Peine has access to the vegas of Agua Delgada, Kapur, Palao, Pular, Puruchare, Silolao, Tarajne, Tilocalar, Tilomonte, Tilopozo and Tuln. While the community of San Pedro uses the vegas of Cejas, Oyape Purificar and Tebinquiche, among others.

Gathering of plants

Information available on this subject is sparse and covers species of vega and stream vegetation used by the local inhabitants

Settlement	Species used	Purposes
Camar	Brea and cachiyuyo	Roofing
Peine	Rica-rica	Medication

S.P. de Atacama	Brea and unquillo	Fodder, roofing
Socaire	Paja brava	Roofing, medication
Talabre	Catarate, paja and paja grande	Casual construction
Toconao	Brea, cachiuyuyo paja and unquillo	Fodder, fuel, roofing

The table identifies four types of use for wild plants: fodder, fuel, construction (roofing) and medication. Local inhabitants do not feel that the use of plants has negative effects on the vega. Nonetheless, it should be pointed out that the use of cachiuyuyo has been greater than its capacity for regeneration. This has led to a considerable decrease in population, especially that in the glacial sediments east of the Salar de Atacama.

Extraction of water

There is no use of water in the Salar de Tara. Nonetheless, the private company ESSAN has a confirmed right to take water from the Rjo Zapaleri, the main source of surface replenishment of the Salar de Tara. While there have been requests for authorization to use the surface and underground water in this area, these have been turned down by the Direcci3n Nacional de Aguas.

Mining

There are no mining activities in this area.

Capture of wildlife

The hunting of wild animals was a common practice of the pre-Hispanic population living in the Andes. This situation continued after the arrival of the Spanish, although the conquerors establish a European economic model, oriented to the extraction of minerals, which led to the breakdown of the existing social structure, traditional rural activities and the use of dispersed natural resources at various levels of the Andean ecology.

More recently, the hunting of wildlife has persisted, reaching a high point between 1930 and 1950, then gradually declining to the present situation where it is now marginal in the local communities. This is not the case of hunting by external communities, which continue to hunt wild animals ruthlessly.

The following results were obtained from this study and indicate the most frequent species hunted, by area, parts and derivatives and season of capture.

Species	Area hunted	Parts and derivatives	Period
Vicuna	1,2,3,5,6	Hair, fur, meat	Spring and summer
Guanaco	1,5,6	Fur, meat	Spring and summer
Fox	1,2,4,5	Fur	Year round
Viscacha	1,2,3,4,5,6	Meat	Spring and summer
Mountain lion	1,2	Fur	Sporadically
Chinchilla	5,6	Fur, meat	Spring and summer
Chululo	2,5	Meat	Spring and summer
Ducks	1,2	Meat	Spring
Condor	1,4	Feathers	Sporadically
Flamingo	1,2,5,6	Feathers	Year round
Yandu	2	Feathers, meat	Spring and summer
Puna quail	2	Meat	Spring and summer

1)Toconao, 2) Camar, 3) Talabre, 4) Socaire, 5) Peine, 6) S.P. de Atacama

While hunting concerns twelve species, there are conservation problems for at least nine of these (75 per cent). Of special concern are aquatic birdlife and three species of flamingos, which reproduce in the Antofagastan Andean salt flats and later migrate to more benign sites in the Peruvian and Argentinean Andes during the fall.

Local inhabitants consider the cause of the decrease in the flamingo populations to be the result of mining activities carried out in the Salar de Atacama, which produces noise and the circulation of heavy trucks and vehicles near the reproduction and feeding sites, as well as the disturbances caused by the increased presence of humans and tourist activities.

It is interesting to note that the community of Peine states that the population of flamingos was much greater in the sixties and seventies. At night, during the spring, it used to be possible to hear hundreds of flamingos, which descended from the mountains to live and nest in places near this town.

Gathering of eggs

The communities admit having collected eggs of at least seven species of birds, which were used for local consumption, except flamingo eggs which were usually sold locally in Calama and S.P. de Atacama. The Salar de Atacama (Barros Negros, Salada, Saladita and Interna) and Tara, are the most important centres for gathering flamingo eggs and at Miscanti and Miñiques lakes eggs of the tagua are gathered and, to a lesser extent, those of ducks and the Andean gull. This information is represented in the following table.

Species	Salar or lake	Town
Flamingo	Salar de Tara	1,2,3,4,6
	Laguna Barros Negros	1,2,4,6
	Laguna Salada	5
Tagua cornuda	Laguna Miscanti and Miñiques	3,4
Gull	Laguna Miscanti	6
Noonday	Laguna Miscanti	2,5
Ducks	Laguna Miscanti Lagunas in the extreme southern part of Salar de Atacama	2,3,4,6

Local inhabitants report that the gathering of wild bird eggs no longer takes place because of the small bird populations and because of regulations prohibiting this practice. Nevertheless, based on information provided, this practice was important in the Atacaman communities at least until the mid-1980s when the creation of protected wildlife areas and the conservation of wildlife began.

Tourism

Tourism was of little importance and without change until the 1970s when a rapid and steady increase in this activity took place and has remained until the present. The Servicio de Turismos estimates that more than 30,000 persons visited S.P. de Atacama last year, which has 330 beds in hotels, guest houses and camp grounds, 12 restaurants and 14 tour operators.

The following table indicates the sites visited by tourists, benefits to the local community and the effects of tourism on the wetlands.

Wetlands	Town	Benefits	Negative effects
S.P. de Atacama (Burro Muerto)	1,2,5,6	handicraft services sale of fruit	Disturbance of wildlife Vehicular traffic Creation of garbage
Miscanti and Miñiques	6	handicrafts	Disturbance of wildlife
Salar de Tara	3,4,6	handicrafts	Creation of garbage
Laguna Lejia	4,6	handicrafts	Disturbance of wildlife
Salar Aguas Calientes	5,6	handicrafts	Disturbance of wildlife

In general, local communities consider the benefits of tourism to be very marginal and few participate in offering services such as accommodation, food and transportation. Their participation is limited to the sale of handicrafts and fruit.

Currently, the most visited salt flats are the Salar de Atacama (Laguna Burro Muerto), the Miscanti and Miñiques lakes, Lejia and the Salar de Tara. Other wetlands visited outside of the range of this study are the Salar de Aguas Calientes II, the vegas of Del Tatio, Jauna, Putana, Tambillo and the El Tatio geyser.

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

Pressure on the use of water resources

Little water is available in the region around Antofagasta and varies considerably in magnitude and distribution. Total rainfall and the seasonality of rainfall are extremely variable, leading to conditions of vulnerability and fragility for the environment (University of Chile, 1994).

On the other hand, in the past few years, in addition to natural common fluctuations in climate, there is the threat of permanent climate change with uncertain effects on this area, which can have seasonal variation and intense dryness that affects these environments and which, as a result, affects the conditions of life and activities of the local inhabitants (University of Chile, 1994).

Patterns of rainfall will change to an unknown degree. Based on available information, it is strongly likely that global warming will intensify dryness instead of attenuating it and that surface runoff and replenishment of underground water will be reduced leaving less water available for nature and local communities in large areas (University of Chile, 1994).

One of the threatening factors that could cause a major impact on these wetlands is the use of surface or underground water resources, which has increased in the past ten years. This aspect is of great importance because the water resources being used or requested is fossil water.

In the specific sector of the Salar de Tara, the largest user of water resources is the Empresa de Servicios Sanitarios de Antofagasta (ESSAN), which holds rights to water in the Rjo Zapalero, but which has not begun to use that right.

Unregulated tourist activities

The area of the pre-puna and puna offer a variety of attractions of interest to tourists, among which are cultural and archaeological resources, a typical fauna and flora and unique scenery large volcanoes and high-altitude lakes that create a unique landscape.

This potential for the development of tourism is exploited by private agencies that transport tourists from the towns of Calama and San Pedro de Atacama to the areas of greatest cultural and natural beauty.

The following table describes the most common tourist itineraries and the wetlands currently visited by the greatest number of tourists.

Itinerary	Wetlands	Total visitors
Salar de Atacama	Soncor	10,000*
Valle de la luna- Aldea Tolor	-	20,000
Salar de Pujsa- Salar de Tara	Pujsa and Tara	4,000
Miscanti-Miñiques	Miscanti and Miñiques	3,000

*Estimated number of visitors for 1994 (CONAF, Region II)

Minibuses and pickups with a capacity for 6 to 12 persons are usually used for these itineraries without a trained guide. Most of the tourist agencies are located in San Pedro de Atacama, with approximately 18 agencies during the tourist season and 10 to 12 permanent agencies.

There is presently no plan for developing tourism for this region that takes into account legal requirements and that lays out regulations for making tourist activities compatible with the conservation of natural resources.

A negative impact on the wetland's natural resources is caused primarily by the creation of garbage, circulation of persons in highly fragile areas (for example in vegas), the gathering of wild flora and changes in the habits and reproduction of wildlife.

The influence of the proximity of persons on the behaviour of wildlife is of special importance in the context of protecting populations of migratory birds of international importance. It is certain that in the case of flamingos living in the Andean wetlands, the phases of the reproductive cycle namely, courtship, mating, incubation and care for chicks, can be considerably changed by the presence of humans. An interruption of any of these phases can produce irreversible changes in reproductive colonies and a significant decrease in the rate of incorporation of chicks in the adult population.

According to systematic field studies (CONAF, Region II), it is possible to ensure that during reproduction there are changes in the behaviour of flamingos in the presence of persons at distances of approximately 1.5 kilometres, becoming critical at distances of 500 metres. When human presence is permanent or frequent, the probability of abandoning nesting colonies, at all stages, is significantly higher. More direct activities such as the hunting of adult specimens, circulation among active nests or the gathering of eggs usually produce an immediate interruption of the reproductive phases and the abandoning of resting and nesting sites.

There are sites of confirmed flamingo mating activities that are variants of the present tourist itineraries. These important biological sites are the Soncor wetlands, Laguna Burro Muerto, Laguna Puilar and, to a lesser extent, the Tara wetlands.

Construction of roads

This activity merits mention because of the considerable adverse effects on the environment in this area. Roads are constructed for various reasons, primarily because of activities related to mining and civil engineering constructions for development.

The present international road, "Paso Jama," passes along the border of the Salar de Pujsa and Aguas Calientes 1 wetlands. Traffic should increase considerably once this highway is paved during 1997. The entrance to the Salar de Tara is off the international road and will not be paved.

The following negative impacts are produced by the construction of roads: an increase in the presence of persons affecting the behaviour of wildlife and the creation of means of access for predators such as the fox, which eats eggs and chicks of flamingos, causing an interruption of reproduction.

23. Conservation measures taken:

This salt marsh is part of the Los Flamencos National Reserve created in April 1990 by Decree No. 50 of the Ministry of Agriculture.

24. Conservation measures proposed but not yet implemented:

In addition to the management plan for this reserve, there is a strategy proposed for the sustainable management plan and regulation of activities in the salt marshes and their conservation.

Strengthening the system of protected wildlife areas

To strengthening the system of protected wildlife areas, the Corporación Nacional Forestal created Los Flamencos National Reserve in 1990, covering 73,986 hectares for the protection of representative environments in the pre-puna and puna. Within the national reserve are the wetlands of Aguas Calientes 1, Lagunas Miscanti and Miñiques, Pujsa, Salar de Tara and part of the Salar de Atacama that form an important area for the biological stability of populations of flamingos.

The main conservation activities in the reserve are:

Patrols and monitoring of activities incompatible with the purposes of the reserve

Monitoring and providing information to visitors to the Soncor wetlands

Monitoring populations of flamingos in the wetlands of Aguas Calientes 1, Aguas de Quelana, Miñiques, Miscanti, Pujsa and Soncor

Monitoring populations of tagua cornuda in the Miscanti and Miñiques wetlands

Providing environmental education activities at the Environmental Information Centre in the town of San Pedro de Atacama

This reserve has an administration and management with headquarters in Toconao (Salar de Atacama), a staff member responsible for planning, supervising and technical control, a staff member responsible for operational planning and three park wardens. There are also a pick-up and two motorcycles.

The present management is insufficient, taking into account the characteristics of the distance between areas that need to be covered. As a result, activities are concentrated almost exclusively around Soncor, relatively close to the administrative headquarters in Toconao.

The following steps are proposed to strengthen the administration and management of the reserve:

Increase the number of park rangers in order to permit an increase in patrols and the regulation of incompatible activities (gathering of flamingo eggs and registration of visitors)

Obtain financing for the construction of basic accommodations in critical areas in order to increase the range and intensity of inspections especially in Soncor, Tara and the Miñiques and Miscanti lakes

Develop a system for monitoring resources and a data base to increase knowledge of the dynamics of these ecological systems primarily in the study of variations of water level in the lakes and fluctuations in populations of migratory birdlife

Establish a system for monitoring the atrophic activities that affect the reserve and propose measures for reducing negative effects on the wetlands, establishing priorities for the building of roads and requests for water use

Improve equipment to develop research and monitoring programmes

Train professional staff and park rangers on management techniques for resources and environmental education

Promote the development of a management plan by carrying out projects and technical programmes

Encourage the participation of the local community in conservation management, especially in the towns of Camar, Peine, San Pedro de Atacama, Socaire, Talabre and Toconao, involving them into the development of the management plan

Promote the creation of voluntary associations of local inhabitants and institutions that support conservation management

Regulating tourist activities

In order to decrease the negative impact of tourist activities on the wetlands, especially on the flamingo population, the following steps will be taken to promote the development of tourism based on respect for natural resources and that contribute to conservation management and the promotion of an awareness and environmental-friendly behaviour in tourists:

Development of training courses for tour operators emphasizing ecotourism, the conservation objectives of the nature reserve, planning and management considerations and knowledge of the characteristics of natural resources

Promotion of the development of tourist objectives shared between the National Forest Corporation and tourist agencies, local communities and officials, which should be clearly expressed within the context of a specific tourism development plan

Formulation and implementation of standards regulating the activities of tourists near the wetlands, especially near the Soncor wetlands, incorporating the active participation of tour operators in planning

Carrying out studies that will create the technical basis for defining regulatory norms for tourist activities, giving priority to determining the tourist capacity of the area of Burro Muerto-Puilar and identification of roads and accessible itineraries for the development of activities of ecotourism and adventure tourism (climbing of volcanoes, hiking in the Andes and bus tours)

Promotion of the development of ecotourism that reinforce the objectives of wetlands conservation

Improvement of access to areas with important scenic value in order to diversify tourist possibilities and to decrease the concentration of visitors in flamingo nesting areas

Development of environmental education programmes

Environmental education activities should be oriented to key groups that can contribute to the management of conservation, among which are local communities and officials, employees of mining companies, tourist agencies and public services. Special attention should be given to groups whose activities represent a threat to wetlands.

The aims of environmental education should promote the creation of an awareness of the importance of wetlands and major environmental problems in order to modify attitudes and increase the participation of individuals in the protection and conservation of wetlands. The public should be informed of the importance of knowledge, methods and standards that make it possible to sufficiently support conservation management and the solving of major problems.

The following specific actions are proposed:

Formulation and implementation of an environmental education programme based on a diagnosis of the expectations, concerns and interests of tourists and local communities and the development of management practices necessary for attracting financing

Creation of environmental education programmes at the CONAF Environmental Education Centre in the town of San Pedro de Atacama

Construction of paths to concentrate visitors and provide information promoting knowledge about the ecological dynamics of the wetlands

Preparation of didactic material emphasizing the ecological importance of the the Andean wetlands

Involvement of the private sector in conservation activities

Mining companies working in areas near these wetlands should be involved in the management of conservation activities. It is proposed to develop an agreement for the conservation of wetlands between CONAF and the mining companies working near the Salar de Atacama, taking into account the exchange of information obtained from the environmental programmes of the mining companies and the public sector; financial support for carrying out specific conservation management programmes; and the creation of institutions permitting communication.

Promotion of research activities

The following activities are proposed in order to gather information about the dynamics of the natural resources in the wetlands required for the promotion of conservation and management programmes:

Identification of research needs in specific thematic areas

Promotion of specialization in the natural resources in the Andean region at local universities

Identification of sources of financing for research programmes in management techniques of the flamingo's habitat and bioenergy studies of the flamingo

Provide continuity to the project "Conservation of Flamingos in Northern Chile"

Incorporation of conservation practices for wetlands in the government's environmental management programmes

The government's environmental management is carried out primarily by the Regional Environment Commission (Comisión Regional de Medio Ambiente) (COREMA), which brings together regional and local authorities, representatives of public services in the environmental field and groups of high-level consultants forming a technical committee.

The following specific programmes are proposed:

Promotion through COREMA of the importance of conservation in the wetlands of the pre-puna and puna in order to obtain support for conservation management

Incorporation of considerations related to the conservation of Andean wetlands into the regional environmental strategy

Incorporation into development projects carried out near wetlands at the time of evaluation of environmental impact studies by the technical committee of COREMA of measures to mitigate potential impact

25. Current scientific research and facilities:

This area is occasionally studied as part of the research carried out under the project "The conservation of flamingos in Northern Chile" and during the project for selecting new Ramsar sites in northern Chile. These studies describe the nesting of the James's flamingos and population studies of other birdlife in the wetland and individual studies of the chemical and biological composition of the water in the lakes. There is no infrastructure available in this area.

26. Current conservation education:

There is no conservation education.

27. Current recreation and tourism:

These wetlands are occasionally visited by organized tours. The Ministry of Agriculture has no authority over the activities of these organized tours.

28. Jurisdiction:

Region II of Antofagasta
Ministerio de Agricultura
Secretaría Regional Ministerial de Agricultura
CONAF Región II

29. Management authority:

U.G. Patrimonio Silvestre
CONAF Región II
Antofagasta

30. Bibliographical references:

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