# MANAGING MEDITERRANEAN SALTWORKS AS PROTECTED AREAS: THE CASE OF SALINS GROUP IN EUROPE

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## EXTENDED ABSTRACT

It is at present, largely admitted that sea salt production actively protects the wetlands by creating real wildlife refuges for unique flora and fauna, recognized all over the world by many protected site designations. First, saltworks are almost always included in larger wetlands protected by the international Ramsar Convention. Moreover, in Europe, saltworks are all concerned by the Natura 2000 Network on the legal basis of both the Birds (1979) and Habitats (1992) Directives. Together, these legal instruments constitute the backbone of the EU's internal policy on biodiversity protection. According to the classification imposed by this policy, saltworks host more than half of the bird species targeted by the Birds Directive and almost all their habitats represent a priority interest.
Each European country had to define a national strategy to apply the requirements of this policy. In that way, the SALINS Group, which operates several saltworks on the Mediterranean coast, representing around 25,000 ha in France and 3,100 ha in Spain (and also 2,600 ha in Tunisia), have had to put in place different frameworks for the implementation of this European policy in the management of these locations in each country. The SALINS Group welcomed Natura 2000 and actively lobbied to be included in the network. An ecosystem manager was recruited to define and be in charge of the environmental strategy on the saltworks by the implication of the scientific partners and the SALINS staff, mainly in France which represents the major areas.
Within the framework of the Natura 2000 project, the SALINS Group decided to implement an environmental management plan dedicated to each of their French sites. Many examples are considered in order to illustrate actions with regard to the framework of the management plan for Aigues Mortes. In the field of nature conservation, islets have been built and restored to improve nesting conditions for colonial charadriiforms (gulls, terns and avocets). In the long term, these breeding sites are managed to avoid their colonisation by the aggressive Herring Gulls. Invasive plants like *Cortaderia selloana* are being controlled. Biological knowledge has been improved: more than 300 bird species, at least 300 plant species and 21 species of reptiles, amphibians and mammals have been identified by scientific partners. The SALINS Group staff participate in banding operations of chicks and monitoring of the medical and nesting birds status. Their naturalist skills are also improved by training on birds and plants. All this information has been recorded in a Geographical Information System and a Naturalist database. Access by the general public is managed in a controlled and limited way on the sites. The SALINS Group carried out panels presenting the saltworks biodiversity and it regularly takes part in environmental demonstrations like the World Wetlands Days to improve the image of the SALINS Group and the reputation of their sea salt brands.

**KEYWORDS**: Natura 2000 network, RAMSAR, Saltworks, SALINS Group, environmental management plan, biological knowledge improvement, enhancement of sea salt products

## 1. INTRODUCTION

By its favourable physical conditions, the Mediterranean basin has been a salt producing area since the dawn of humanity. Various products, lever of political power, salt plays a prominent role in the history of mankind as well as in the dressing of the landscape in this area (Leenhardt, 1939; Bergier, 1982; Boudet, 1995 and 1997; Petanidou, 1997). The principle of production consists of circulating sea water over ponds to increase its salt concentration by evaporation under the effect of the sun and the wind. During the movement, the NaCl concentration increases from 29 g/L to 280 g/L. Salt is then harvested once or more per year depending on the location.

In spite of their image as artificial mediums, the Mediterranean saltworks prove to be of a great biological richness (Sadoul et al., 1998). They shelter, in particular, more than 230 species of birds (Kayser, 2008) and represent fundamental wetlands for the conservation of the water birds, that is to say 100 species. This role is even more important in the middle of coastal zones threatened by urbanization and economic activities (Sadoul & Walmsley, 2000). The saltworks get favorable conditions for feeding, reproduction and resting of many species of water birds (Britton & Johnson, 1987, Castro, 1993; Zeno, 2006; Korovessis & Lekkas, 2006; Chokri, 2008). The importance of saline for feeding and reproduction of the Great Flamingo has long been recognised by the presence, on the saltworks of Salin de Giraud in France, the most important and reliable site of nesting in Europe (Johnson 1983 and 1997; Johnson & Cezilly, 2007). Saltworks are also strategic hosting zones for certain species of laro-limicolous (Stream and al., 1994; Sadoul, 1997) and for coastal migrating of wintering limicolous in the Mediterranean (Hortas, 1997; Masero, 2003). However, the saltworks also shelter a diversity of terrestrial and amphibious environments (Molinier & Tallon, 1965; Verhoeven, 1975; Molinier & Devaux, 1978; Tamisier, 1990; Pallu, 2006) which are rare or threatened on a European scale *(2). One can observe the presence of at least 300 species of plants, 21 species of mammals, reptiles and amphibians (Séjourné & Constantin, 2008; Séjourné, 2008).

For a long time, many actions of knowledge and nature conservation have been undertaken by saltworks managers (Penanidou, 1989; Castritsi-Catharios, 1992; Sadoul and al., 1998).

In the case of SALINS group in France, islets of nesting, intended for colonial laro-limicolous breeders, have been created since 1979 on several saltworks. Amongst the most significant operations, the “Flamingo island” built in 1970 on the saltworks of Salin de Giraud remains at present a remarkable case. Installed in partnership with the Biological station of Tour du Valat to host the Great flamingo which ceased to breed in France at the beginning of the Sixties, this small island, restored regularly, became the single zone of reproduction of the Great flamingo in France for 38 years with an average of 11,000 breeding pairs each year. This action has allowed for the undertaking of a great research programme since 1977: the annual banding of approximately 800 chicks permits collecting data to study all the aspects of the reproductive biology of these birds (Béchet and al., 2009). It constitutes the oldest program and one of the oldest data files for a terrestrial species of bird. The SALINS Group have supported the undertaking of this operation by providing human and material means. In the same way in 2008, it took part in the financing of the re-installation of the observation tower near to the nesting flamingo island.

This example emphasizes the ecological importance of Mediterranean saltworks which are now universally recognized by various labels and protective agreements. The saltworks are in general included in wetlands of international importance according to the Ramsar convention (1971) *(1). Moreover, in Europe, they are all now integrated into the Natura 2000 network *(2) of which the aim is European biodiversity preservation.

The objective of this document is to explain how the SALINS Group have integrated these policies of nature protection in the current management of their saltworks operations.

## 2. ALL THE SALTWORKS MANAGED BY THE SALINS GROUP ARE CONCERNED BY NATURE PROTECTION INTERNATIONAL ENGAGEMENTS

The SALINS Group manages ten saltworks mainly on the Mediterranean coastline and representing approximately 25,000 ha in France (*Compagnie des Salins du Midi et des Salines de l'Est*), 3,100 ha in Spain (*Union Salinera de Espana*) and 2,600 ha in Tunisia (*Cotusal*).

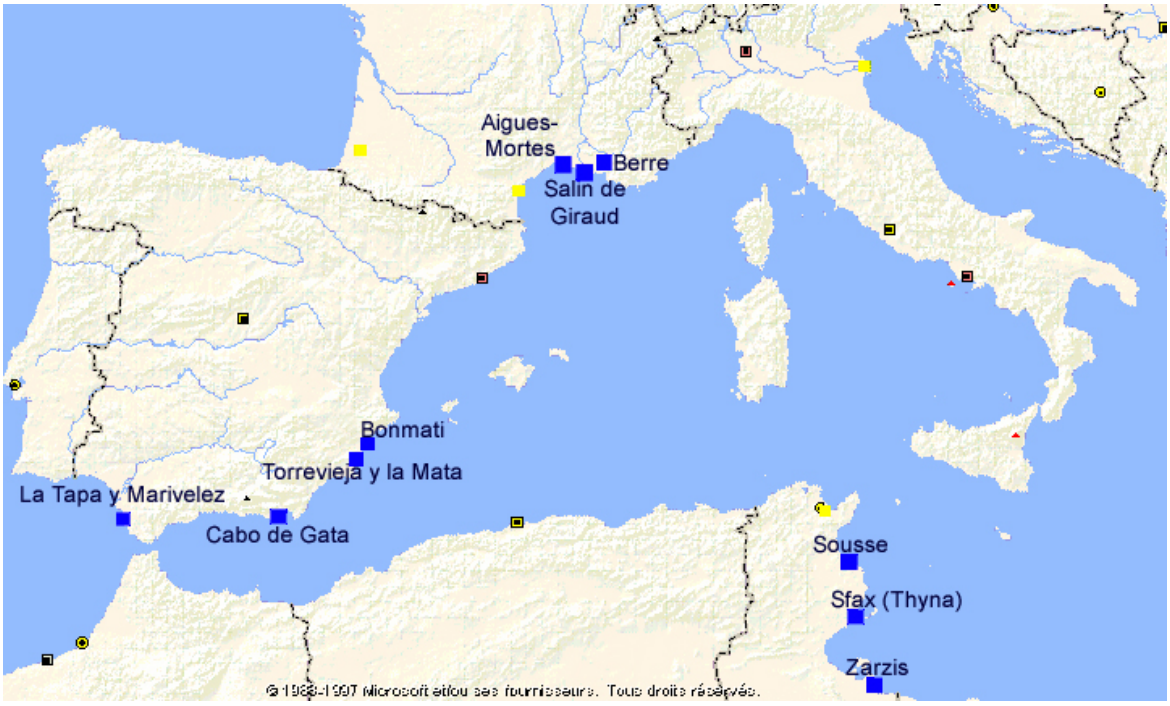


**Figure 1.** Mediterranean saltworks managed by SALINS Group (dark squares)

In a general way, the saltworks are included in the List of Wetlands of International Importance according to the Convention on Wetlands *[(1)], signed in Ramsar, Iran, in 1971, which is the only intergovernmental treaty of worldwide scope which is devoted to a particular ecosystem. The Convention's mission is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.
The text of the Convention (Article 2.2) stipulates that: "*Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included*". On this last point, a specific criterion (Criterion 6) specifies that "*A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird*".

Therefore the majority of the main saltworks managed by the SALINS Group were included in Ramsar sites (Table 1). They regularly support more than 1% of the individuals in the population of Great Flamingo, certain species of colonial breeders laro-limicolous and wintering limicolous of the bio-geographic Mediterranean area (Sadoul, 1996 and 2008; Delany & Scott, 2006; Béchet and al., 2007 and 2008; Chokri; 2008; Séjourné & Constantin, 2008).

**Table 1:** Natura 2000 sites and Ramsar sites locations related to saltworks managed by the SALINS Group

| Saltworks | Surface of the saltworks | NATURA 2000 SITES | | RAMSAR SITES |
|---|---|---|---|---|
| | | Habitats Directive | Birds Directive | |
| Salin de Giraud (France) | 11352 ha | ZSC Camargue | ZPS Camargue | La Camargue |
| Aigues-Mortes (France) | 10800 ha | ZSC Camargue gardoise | ZPS Camargue gardoise laguno-marine | La Petite Camargue et l'étang de l'Or |
| Berre (France) | 457 ha | ZSC Marsh and wetlands of the pond of Berre | ZPS Saltworks of the pond of Berre | - |
| Torrevieja y la Mata (Spain) | 2100 ha | ZEC Lagunas de La Mata y Torrevieja | ZEPA Lagunas de La Mata y Torrevieja | Lagunas de La Mata y Torrevieja |
| Bonmati (Spain) | 207 ha | ZEC Salinas de Santa Pola | ZEPA Salinas de Santa Pola | Salinas de Santa Pola |
| Cabo de Gata (Spain) | 399 ha | ZEC Cabo de Gata - Nijar | ZEPA Cabo de Gata - Nijar | Salinas de Cabo de Gata |
| La Tapa y Marivelez (Spain) | 395 ha | ZEC Bahia de Cadiz | ZEPA Bahia de Cadiz | Bahia de Cadiz |
| Sfax (Tunisia) | 1700 ha | *Not concerned* | | Saltworks of Thyna |
| Sousse (Tunisia) | 913 ha | *Not concerned* | | - |
| SALINS Group Total | 28323 ha | including 25710 ha in Natura 2000 sites | | including 26953 ha in Ramsar sites |

Caption:
Habitats Directive:
Birds Directive:

In France:
ZSC: Zone Spéciale de Conservation
ZPS: Zone de Protection Spéciale

In Spain:
ZEC: Zona Especiale de Conservación
ZEPA: Zona de Especial Protección para Aves

Moreover, in Europe in a general way, the saltworks are integrated into the Natura 2000 network. With the double objective of preserving biological diversity and developing the territories, Europe launched, in 1992, the realisation of an ambitious network of ecological sites called Natura 2000 *[(2)]. The grid of these sites extends to the whole of Europe in order to make this initiative coherent by safeguarding the species and the natural habitats. The two most important texts establishing the lawful base of this network are the "Birds" Directive (1979) *[(3)] and "Habitats" Directive (1992) *[(4)]. The sites designated under these two directives form the Natura 2000 network. The "Birds" Directive proposes the long-term conservation of the species of wild birds of the Union by targeting 181 threatened species which require special attention. More than 3000 sites were classified by the members of the European Union as Special Protection Zones (ZPS). The "Habitats" Directive establishes a framework for the Community actions of the conservation of species and their habitats. This directive lists more than 200 types of natural habitats, 200 animal species and 500 plant species being of Community interest and requiring protection. The Special Conservation Zones (ZSC), currently more than 20,000 sites covering nearly 12% of the European territory, allow for the protection of these threatened habitats and species.

Wherefore the saltworks managed by the SALINS Group in Europe have all been integrated into the Natura 2000 network pursuing the two directives (Table 1). They

shelter more than half of the birds species targeted by the “Birds” Directive (Kayser, 2008; Séjourné & Constantin, 2008). The ponds used for the production of salt are considered as coastal lagoons which represent a priority interest for the “Habitats” Directive which is also the case for nearly all of the hosted habitats associated with these lagoons.

## 3. SPANISH AND FRENCH STRATEGIES IMPLEMENTED TO APPLY THE EUROPEAN POLICY FOR BIODIVERSITY CONSERVATION

At state level, each member of the European Union has chosen an implementation strategy for the various protection policies.

**In Spain:**

For the saltworks managed in Spain, which are all located in Natural Parks, the tools used to apply the policy are specific legal instruments of planning introduced in 1989: at territorial level, the Plan for Organizing Natural Resources (“Plan de Ordenación de los Recursos Naturales” - PORN) defines the framework for the management of natural areas, and, at natural protected area level, the Land Use Management Plan (“Plan Rector de Uso y Gestion” - PRUG) defines the objectives and the practical arrangements.

Taking the Natura 2000 network implementation into account, these legal instruments directly integrate the objectives of the two European Directives (Table 1).

These documents constantly consider that the continuation of salt production provides effective guarantees for the maintenance of ecological and cultural values supported by saltworks. In the PRUG, a particular attention is paid to the hydraulic aspects related to salt production: “*without carrying damage to the salt activity, the level of water will be managed in order to develop and/or maintain related birds populations”.*

Subventions can be given to the managers of the areas to implement the actions defined in this plan but the Natural Parks are particularly involved in the application by operating themselves conservation programs and knowledge actions.

In the case of Cabo de Gata saltworks, these have also been undertaken since 1987 by an agreement signed between the local authority and the salt manager for the “*protection of existing natural resources in the saltworks*” (Castro Nogueira, 1993).

More recently, on the Torrevieja y la Mata saltworks, shelters have been installed by the staff to protect the individual nests of Audouin's Gull (*Larus audouinii*), species in danger of extinction on a worldwide scale.

**In France:**

In the Environment Code, a section dedicated to the Natura 2000 sites specifies the general framework of the designation and management of these sites (art L. 414.1 to L. 414.7 of the Environment Code).

The designation procedure for the Natura 2000 sites are based on the scientific guarantees brought by inventories of the habitats and species validated by the National Museum of Natural History (MNHN). Today in France, all the Natura 2000 sites cover 6.8 millions hectares, almost 12.4% of the territory.

To implement the Natura 2000 network, authorities have introduced a couple of new dedicated tools for each site: the “Steering Committee” and the “Objectives Document”.

The first one is a body of dialogue and debate, set up by the local authority; it gathers all the partners: structures of the State, local government agencies, local communities, owners, farmers, hunters, fishermen, users, associations…,

The last one is a management plan, on the model widely used in the naturally protected areas, which contains two parts. In the first part, the social-economical and the ecological aspects are assessed. These elements permit, in the second part, to define the objectives of the site which will contribute to maintaining or improving the state of the conservation of natural habitats and species for which this site was designated.

Within this framework, the dialogue with the users of the territory is essential: it makes it possible to take specificities and local problems into account.

Up to now the Steering Committee has been deprived of any legal ability, a territorial community or a group of territorial communities is designated to ensure the administrative, technical and financial tasks related to the development of the Objectives Document. This territorial community can take the responsibility for these tasks by delegating operations to a third party organisation or structure which one calls the “Natura 2000 operator”.
Within the European network of Natura 2000, France has made the choice of a contractual and voluntary management for the implementation of the sites: users may invest themselves in their management by signing a “*Natura 2000 Contract*” or a “*Natura 2000 Charter*” for a period of 5 or 10 years.
The Natura 2000 Contract is comprised of many engagements, conform to the orientations laid out in the Objectives Document, on the conservation and, if necessary, the restoration of the natural habitats which justify the creation of the Natura 2000 site. The contract defines the nature and the methods of the state financial aid and the services required in return from the recipient.
Much more simple to carry out, the Natura 2000 Charter of a site is a tool for the adhesion to the objectives of conservation as defined in the Objectives Document. Signing the Natura 2000 Charter does not imply the payment of a financial counterpart. However, it opens the right for the partial exemption of the real estate tax on rural properties and also makes it possible to obtain certain government aids.
This contractual policy is always submitted to applicable laws and regulations. The public authority can intervene to regulate the access to certain zones or limit the practice of certain activities (sporting, industrial, etc).
The projects liable to significantly affect the natural habitats and the species present on a site Natura 2000 must be subject to an assessment of their incidences. The Environment Code specifies that “*the programs or projects of activities, works and installations subjected to authorisation or administrative approval, and whose realisation is likely to affect significantly a Natura 2000 site, are the subject of an assessment of their incidences taking into consideration objectives of conservation of the site. The activities, works and installations listed in the Natura 2000 Contracts are exempted of this assessment procedure*”.
Moreover, following the new law n°2008-757 of 1 August 2008 on environmental responsibility pursuant to the pollutant-payer principle, it is henceforth specified that deteriorations affecting the species and the habitats aimed by the Birds and Habitats Directives (Natura 2000) constitute damages to the environment. According to this new law, these habitats and species, if they are deteriorated, will have to be the subject of compulsory repairing agreements.
Within the application of the network Natura 2000 in France, the SALINS Group have chosen to take an active part. To be able to ensure this position, it initially created a job as manager of natural spaces. The SALINS actively took part in the designation procedure of the Natura 2000 sites by systematically transmitting opinions. They have been registered on the list of the members of each of the Steering Committees set up for the three French sites that include saltworks.
At present, the progress report for the application differs according to the sites: the Objectives Document applying to Aigues-Mortes saltworks was validated in December 2007, that of the Salin de Giraud is under development and that of Berre has not yet been initiated.
The SALINS Group have taken an active part in the realization of the Objectives Document applying to the Aigues-Mortes saltworks to auto-regulate themselves concerning the coherency of management measures with the requirements of the salt production. Many actions registered in the Objectives Document have already been implemented on a daily basis in the Aigues-Mortes saltworks. Even if the Objectives Document for the two other sites have not yet been finalized, naturalists management measures have already been implemented there.

## 4. THE AIGUES-MORTES SALTWORKS ENVIRONMENTAL MANAGEMENT PLAN

To take the implementation of the Objectives Document of the Natura 2000 Site "Petite Camargue" into account, SALINS have chosen to realize, in a voluntary way, an environmental management plan for the Aigues-Mortes saltworks.

Such a management document is comparable to that commonly used for Natural reserves in France (Chiffaut, 2006).

This management plan, a basic document drawn up for a 5-year duration, is composed of two sections.

The first section presents the socio-economic and cultural context, the natural heritage and educational interest of the site. These elements make it possible to find out the value of the site and the conservation stakes.

The second section lays out the general orientations, the long-term objectives, the actions of the plan and the management operations in accordance with the Objectives Document.

The management plan was carried out in constant dialogue with the saltworks staff and the scientific experts working in various fields (Tour du Valat, Association of the Friends of the Vigueirat Marshes with N. Sadoul, Mediterranean Botanical Academy).

It was validated by the Natura 2000 Steering Committee in December 2008. The Scientific and Technical Committee of the Natura 2000 operator (Syndicat Mixte Camargue Gardoise) must now be consulted for opinion.

The broad objectives of the management plan are presented in Table 2 see below:

**Table 2.** The broad objectives of the Aigues-Mortes saltworks environmental management plan

| Orientation: **"To maintain salt activity and to develop the biological richness of the site"** | |
|---|---|
| Long-term Objectives | Objectives of the management plan |
| A. To preserve the salt activity, the habitats and fauna and flora of the saltworks | A.1. To preserve the salt lagoons as well as the related fauna and flora |
| | A.2. To preserve the terrestrial and amphibious environments related to salt lagoons |
| | A.3. To maintain marshes and reed beds in freshwater zones |
| | A.4. To maintain or improve the consideration of the patrimonial interest in the habitats and species used by the public (game, leisure fishing and access to seashore) and others commercial activities (fishing, *Artemia*) |
| | A.5. To limit the recession by the shoreline |
| B. To improve biological knowledge | B.1. To improve the knowledge of the natural heritage |
| | B.2. To participate in specific scientific research programmes |
| | B.3. To feed and organize the naturalist database |
| C. To emphasize the ecological role of Mediterranean saltworks | C.1. To adapt the current programmes for visitors' access to the saltworks with the preservation of the site |
| | C.2. To reinforce the external means of communication |

## 5. EXAMPLES OF NATURE CONSERVATION ACTIONS UNDERTAKEN ACCORDING TO THE AIGUES-MORTES ENVIRONMENTAL MANAGEMENT PLAN

### 5.1. Objective: “To preserve the salt activity, the habitats and the fauna and flora of the saltworks”

Within the framework of the **A.1** objective "To preserve the salt lagoons as well as the related fauna and flora" (Table 2), actions are designed to support the conditions of reception of colonial laro-limicolous breeders in a way compatible with the requirements of salt production.

Indeed, the site is of major importance for the conservation of these birds, hosting sometimes up to 100% of breeders in France for the Slender-billed Gull, Mediterranean Gull, Sandwich Tern and Gull-billed Tern (Sadoul, 1996 and 1997). The recent trend emphasizing an important population fall for these species all along the Mediterranean coastline (Isenmann P. and al., 2004), it appears essential to set up actions on the saltworks.

To maintain favorable breeding conditions for these species, it is necessary to create and regularly restore small nesting islets (Sadoul & Walmsley, 2000) whose characteristics are variable according to the concerned species (Pérennou and al., 1996). In the long term, it appears necessary to set up a specific management for limiting the disturbance of the Yellow-legged Herring Gull, expanding species on the Mediterranean coastline since the years 1950 and which compete with the others limicolous species of patrimonial interest (Sadoul & Walmsley, 2000).

Since 2006, fourteen small islets have been restored and four islets were created on the salworks. These actions already show very satisfactory results with a considerable growth in the population, that is to say more than 2000 couples observed in 2008, thanks to the creation of new islets (Sadoul and al., 2008).

Slender-billed Gull colony on an islet created in 2006 from calcium sulphate deposit © S. Tollari

Two methods to limit the reproduction of the Herring Gulls have both been tested since the winter of 2006-2007. These experiments aim, in the long run, to completely free these islets from Herring Gulls in order to allow for the return on these sites of small colonial laro-limicolous.

One of the principal criteria sought by the Herring Gulls to select its nesting site is its inaccessibility to the terrestrial predation. The site is all the more attractive as this condition is constant year after year. Consequently, the loss of the insulation of the islet must involve a progressive abandonment by the early breeders. It is the objective targeted by the first method of temporarily installing a footbridge, connecting the islet to a dyke, in order to allow the passage of predators. Two sites were thus arranged during the autumn of 2006 and were the subject of a particular follow-up: an infra-red camera was installed on each of the two islets at the end of the footbridge in order to identify the predators and to count the intrusions.

The use of the footbridges has produced positive results with a clear fall in the frequentation of the islets by Herring Gulls.

14 islets restored in 2006 ©G. Rey and G. Santantonio

Anti-Herring Gulls footbridge

Slender-billed Gull ©P. Aguilar

The second method aims to scare the colonies of Gulls at the time of their installation from January to March in order to limit the numbers of nesting couples and in April to poison the couples which have settled. It is expected that the combination of these two methods on the same colony will involve a fast and continuous decrease in the gull's breeding. However, this effect will only be assessed over the years to come. This method has still not been tested but seems promising. In the event of success, it would have the advantage of rapidly freeing the sites, decreasing the breeding population, while limiting the dispersion of the birds onto other sites. Periodic 'frights' are carried out by the installation of an inflatable automatic device called the Scarey-Man ®.

Yellow-legged Herring Gull © P. Aguilar

Automatic scarecrow (Scarey-Man ®) © S. Séjourné

The results show that the management of Herring Gulls colonies by startling and poisoning involves a fast decrease of population as expected. This effort and its medium-term impact must be continued (Sadoul et al., 2008).

Over the two next years, it has been planned to create and restore other islets on the saltworks for an total amount of €10,700: 4 large islets, 3 series of small islets (28 islets on the whole) dedicated in a specific way to avocets and stilts, 3 anti-gull footbridges, 14 islets annually restored by light clearing of undergrowth and other arrangements to protect the islets from water and to manage their access. The majority of these actions

will be carried out by the Aigues-Mortes saltworks staff and will be granted a Natura 2000 contract. It is also programmed to maintain 'startlings', coupled with the eradication, to limit the reproduction of the Herring Gulls.

The objective A2: **"To preserve the terrestrial and amphibious environments related to salt lagoons**" and objective A3: **"To maintain marshes and reed beds in freshwater zones** (Table 2) need the implementation of several actions of management including the elimination of invasive plants. The invading species have for 20 years been an important subject in ecology because of their progressive extension, the increasing damage they produce on the environment and the lack of knowledge of their operating cycle (Callaway & Maron, 2006). The presence of invasive species on the natural environments in the Camargue has already been identified (Costa, 2005). Many habitats related to salt ponds, within approximately 1,200 ha, are of main ecological interest according to the Habitats Directive (Pallu, 2006) and are threatened by invasive plants.
Four invasive species have been detected and located on the Aigues-Mortes saltworks: the Pampas Grass (*Cortaderia selloana*), the Groundsel-tree (*Baccharis hamilifolia*), the Desert false-indigo (*Amorpha fruticosa*) and the Water-primrose (*Ludwigia sp.)* (Pallu, 2006).

*Cortaderia selloana* © S. Séjourné

*Baccharis halimifolia* © S. Séjourné

It is important to set up preventive, eradication and control actions of these species to preserve the biodiversity (Hulme, 2006). These species are systematically detected and charted on the saltworks. The salt staff who circulate daily on the site are implied in the early detection of these species in order to limit the interventions. In 2006, tests of elimination of these species were carried out on the saltworks. Using a mechanical shovel, 50 seedlings of *Cortaderia selloana* were cleared then evacuated in order to be destroyed in accordance with the recommendations (Costa, 2005). In addition, 30 seedlings of *Baccharis halimifolia* were cut at ground level and for certain feet, the stumps were treated with specific phytocides (Costa, 2005). In 2007, the on-site observations show that the operation was profitable for the treated stumps while the simply cut seedlings presented suckers.

Therefore, it is now planned to continue these actions of elimination and control of the invading species on the Aigues-Mortes saltworks within the framework of a Natura 2000 contract.

### 5.2. Objective B: "To improve biological knowledge" (Table 2)

Due to the numerous ecological factors that control the biological richness of saltworks, the improvement of biological knowledge is an essential component of the environmental management.

Complete species inventories already exist mainly for birds. Since 2007, flora inventories have been undertaken in partnership with the Mediterranean Botanical Academy, allowing to supplement the existing data with 84 newly identified taxons (43.5 % increase). Among these species, 20 are of patrimonial interest and specimens of a Maresia species (*Malcolmia nana)*, considered extinct in France since the Seventies, were found on the site in 2007.

The existing follow-ups, focused on birds, have been maintained (Tour du Valat, Association of the Friends of the Vigueirat Marshes, National Office of hunting and wild fauna, Nature Protection Society) and new follow-ups will be set up, in particular concerning the protected flora, in partnership with scientific experts. In addition, the monitoring of the sanitary status of birds by the staff is essential regarding the arising risks of animal diseases such as Avian flu.

The studies on the life cycle of the populations, mainly for birds, are favoured on the saltworks. The SALINS Group place both technical and human means at the disposal of the partners to carry out the banding operations and for the on-site reading of these rings. For example, 404 Slender-billed Gull chicks were involved in a banding operation in the summer of 2008. The studies undertaken on this species, which represents a model for knowledge improvement on colonial laro-limicolous, by a continuous follow-up and the banding of chicks, would bring about in the long run, a lot of information about its biology (dispersion, breeding parameters, demography).

All of this naturalist and ecological information is organized and managed in a specific database and a Geographical Information System (David, 2006).

The naturalist training of the salt staff implied in the follow-ups and the actions of conservation is essential. Specific training on the recognition of the principal water birds was carried out in 2007 in partnership with "Association of the Friends of the Vigueirat Marshes" and training on the recognition of habitats and flora is programmed for 2009.

### 5.3. Objective C: "To emphasize the ecological role of Mediterranean saltworks" (Table 2)

The development of the ecological role of Mediterranean saline and actions of nature conservation undertaken by the SALINS group must be beneficial for salt production.

The general public is hosted regularly on part of the site via a small train and a salt eco-museum provides them with explanations about salt and the environment.

It is essential to adapt the current general public access programmes (Objective C1, Table 2). The educational activities and visual aids on salt, fauna and flora will be diversified with specific focus on the recent results of preservation actions carried out on the saltworks. Within this framework, 16 new panels presenting the saline ecosystem and environmental engagements of the SALINS Group were made in 2008.

It is also necessary to reinforce the means of external communication (Objective C2, Table 2) by taking part in environmental demonstrations and by developing press releases relating to the saltworks environmental events and news. Within this framework, SALINS Group participates in the annual Wetlands World Days by the realisation of conferences and exceptional open-door demonstrations intended for the general public.

Small train and salt eco-museum

## 6. CONCLUSIONS

In accordance with the reciprocal dependence between sea salt production and biological richness of saltworks, a critical link connects the economic viability and the conservation objectives. Many Mediterranean saltworks have already been closed (Sadoul and al., 1998; Paracuellos and al.; 2002) introducing progressive changes mainly to waterfowls; on the inactive saltworks, one observes a reduction in the population of the Great flamingo and of some coastal limicolous (Paracuellos and al., 2002). Indeed, the saltworks are strategic zones for the feeding of the flamingos via the presence of *Artemias sp* (Britton & Johnson, 1987). Moreover, at a time of dry climatic conditions, the salt-water marshes become refuges zones for its feed (Béchet and al., 2009). In the long term, this progressive disappearance of Mediterranean saltworks could bring into question the conservation of certain species. Therefore it is essential for salt-workers to enhance reliable tools and practices dedicated to efficient nature conservation management. In this context, the actions implemented on the Aigues-Mortes saltworks within the framework of an environmental management plan illustrate the commitment and the professionalism of the SALINS Group to nature conservation. This will be continued with long term objectives for the SALINS Group to carry out actions of knowledge and nature protection on all their exploited sites within the framework of environmental management plans.

## 7. REFERENCES


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**Endnotes:**

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* (3) Council Directive **79/409/EEC** of 2 April 1979 on the conservation of wild birds;
* (4) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora;