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Wetland Restoration in Spain
Αποκατάσταση Υγροτόπων στην Ισπανία

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Περίληψη

Η Ισπανία έχει χάσει 60% των υγροτόπων της σαν αποτέλεσμα των επί δεκαετίες ισχυόντων νόμων και πολιτικών αποξηράνσεων. Η καταστροφή των υγροτόπων διατηρήθηκε και κατά τις δεκαετίες του 80 και 90, ακόμη και σε Εθνικά Πάρκα και σε άλλες περιοχές προστασίας της φύσης που επηρεάζονταν από αρνητικές υδρολογικές αλλοιώσεις εκτός των ορίων τους. Η αποκατάσταση υγροτόπων στην Ισπανία είναι μια καινούργια πρακτική και τα περισσότερα προγράμματα αποκατάστασης ξεκινούν μετά το 1985. Από τότε, έχουν υπάρξει αρκετές δράσεις αποκατάστασης με ποικίλο βαθμό επιτυχίας. Στη πλειοψηφία τους βασίζονται σε δομικές παρεμβάσεις και συστήματα τεχνητής διαχείρισης παρά στην πραγματική επανόρθωση των φυσικών διεργασιών και λειτουργιών. Αν και αυτή η τακτική φαίνεται συχνά η μοναδική δυνατότητα σε τεχνητούς υγροτόπους ή σε υγροτόπους με μακρά ιστορία ανθρωπογενών παρεμβάσεων, δεν αποτελεί τον γενικό κανόνα. Τα γνωστά σχήματα των προγραμμάτων αποκατάστασης, εκβαθύνσεις, κατασκευές φραγμάτων ή μεταφορές νερού από αλλού για τη δημιουργία μόνιμα κατακλυστέων περιοχών, δεν λαμβάνουν υπόψη θέματα όπως η αρχική μορφολογία και ιζηματογένεση ή το υδρολογικό δυναμικό. Έχουμε παραδείγματα από απόπειρες αποκατάστασης εντελώς εξαφανισμένων υγροτόπων. □λλα προγράμματα εστιάζουν στην επανόρθωση των αλλοιωθέντων χαρακτηριστικών ή ιδιοτήτων υφισταμένων υγροτόπων (ποσότητα/ ποιότητα νερού), ή στην ανασύσταση μικρότερων τμημάτων αυτών ή κάποιων συγκεκριμένων φυσικών τους χαρακτήρων. Σε άλλες περιπτώσεις, είναι αμφισβητήσιμο κατά πόσον πρόκειται για πραγματική αποκατάσταση ή για απλή διαχείριση με στόχο την βελτίωση κάποιας συγκεκριμένης λειτουργίας (π.χ βιότοποι υδρόβιας ορνιθοπανίδας) ή για κοινωνική χρήση (προσέλκυση επισκεπτών, περιβαλλοντική εκπαίδευση, οικοτουρισμό κ.λ.π.). Τα προγράμματα αποκατάστασης δεν συμβαδίζουν πάντα με κατάλληλα προγράμματα παρακολούθησης, παρόλο που όλο και μεγαλύτερος αριθμός διαχειριστών αντιλαμβάνονται ότι αυτό είναι το θεμελιώδες ζήτημα σε ένα πρόγραμμα αποκατάστασης. Είμαστε μπροστά σε μια καινούργια εποχή για την αποκατάσταση υγροτόπων στην Ισπανία, καθώς η υπόθεση αυτή γίνεται όλο και πιο αποδεκτή και επιθυμητή από το κοινό. Ωστόσο, η κατάσταση διαφέρει πολύ ανάμεσα στις

διάφορες περιφέρειες,καθώς εξαρτάται από τις αξίες γης και τις πιέσεις που προκαλούνται από τις μεταβολές στη χρήση γης των πρώην υγροτοπικών περιοχών. Απαιτούνται ευφάνταστα μέσα για να ξαναδημιουργήσουμε υγροτόπους και θα αποδειχτεί από την οικονομική και κοινωνική σκοπιά ότι αυτό είναι συγχρόνως και κερδοφόρο και αναγκαίο.

SUMMARY

After several decades of active wetland drainage laws and policies, Spain has lost more that 60% of its wetland area. The processes leading to wetland destruction have continued to operate until the 80s and 90s, even in National Parks and other nature protection areas affected by negative hydrological influences coming from outside their boundaries. In contrast, wetland restoration in Spain is relatively new, most restoration projects starting after 1985. Since then, there have been a number of restoration activities going on with differing success. Most of these are based on structural interventions and artificial control systems, rather than in the true rehabilitation of all the damaged processes and functions. While this is usually the sole option in man-made or artificialised wetlands, with a long history of traditional management, it is not a general rule. Scraping, damming or bringing water from elsewhere to create a permanently flooded area, a common feature of restoration projects, ignore relevant aspects like the original morphology and sediments, or the hydrological dynamics. Of the examples reviewed, some pursue the restoration of completely lost wetlands. Other projects focus on the restoration of altered characteristics or attributes of existing wetlands (water quantity and/or quality), of smaller sections of these, or of particular physical features. In other cases, it is arguable wether they represent proper restoration, or simple management for the recovery of some particular wetland function (waterfowl habitat) or social utility (e. g. visitor management, environmental education, ecotourism..). Not all restoration projects and management activities are coupled with a proper monitoring programme, but a growing number of managers are aware that this is a key element of a restoration project. We are facing a new era for wetland restoration in Spain, as this issue is becoming increasingly acceptable and demanded by the public. The situation, however, differs greatly among regions, depending on land prices and pressures leading to changes in human uses of former wetland areas. Imaginative ways are needed to turn back as much land as possible to wetland, and it shall be demonstrated from the economic and social point of view that this is profitable and necessary.

Background

Spain has a long history of wetland destruction, intensified in the recent past. A 60% of the surface area of natural wetlands and lakes disappeared during the last 40 years: 114.000 ha remain of a former total of 280.000 (Source: 1990 National Wetland Inventory; CASADO & MONTES, 1995). Active policies promoting wetland reclamation (incentives for wetland drainage) were in force from the late XIXth century and especially since 1918. A recent shift to regulations promoting delineation, inventory and protection of wetlands is illustrated by the 1985 Water Act and the 1989 Nature Conservation Act.

The traditional (site based) approach to wetland protection has proven unsuccessful in preventing further degradation caused by watershed influences. The processes leading to wetland destruction have continued to operate until the 80s and 90s, even in protected areas and National Parks, affected by negative hydrological influences coming from outside their boundaries. In contrast, wetland restoration in Spain is very recent as a philosophy, public policy, science and practice, most restoration projects starting after 1985. The first large scale project was the hydraulic rehabilitation of Daimiel National Park, where the water table dropped dramatically due to irrigation schemes promoted by the Spanish government. Since then, there have been a number of small projects almost everywhere in the country, but not many large ones. In this presentation we will present and discuss some examples.

Concepts and definitions

Managers and researchers refer to the actions performed to restore a whole wetland, a part of it, a particular function or a biological feature, as restoration, recovery or rehabilitation. Some of these, in fact should be considered simply management.

We will use these terms in the following sense:

Restoration: action taken to return the system to its original state (structure and function)
Recovery: action taken to return the wetland to its previous ecological role (functional value)
Rehabilitation: action taken to give the site at least some social utility (irrespective of the original state)
Management: action taken to guide the system towards some desired state (irrespective of the original state)

Processes involved in wetland deterioration and restoration

Large-scale water extraction and pollution originated in watersheds have caused severe damage to wetlands. As a result, restoration of wetland functions, even inside legally protected and well-preserved wetlands (National Parks and nature reserves) is difficult when the natural mechanisms involved have been altered by man□s activities outside. Deterioration of wetland structure results also from the acceleration of natural succession (siltage, encroachment by vegetation) or from hydraulic disruption, due to land use changes in and around wetlands. The abandonment of traditional activities causes degradation of man-made wetlands, like traditional salinas. At the same time, the transformations related to these activities (dykes and other artificial control structures) make the reversion to the natural conditions difficult.

Hydraulic works (dam construction, river channelization...), mining (gravel pits) and other infrastructures (irrigation ponds, ornamental waters, sewage lagoons, settling ponds of pig farms) have created new or potentially restorable wetland habitat.

The scale and scope of the restoration projects thus vary greatly, depending on the processes leading to the present state of the wetland, the constraints imposed by its previous use or management, the aims of the project, and the resources available. In a simple classification, we can consider the following situations, in a gradient ranging from the restoration of completely lost, natural wetlands, to the creation of totally artificial new ones. We will deal in more detail with the two first cases, giving examples of Spanish restoration projects:

- Integral restoration of lost wetlands
- Restoration of altered characteristics or functions of the wetland (water regime, water quality, structural features...)
- Rehabilitation/management for waterbirds or other target species
- Wetland rehabilitation or creation for some social utility (recreation, education, birdwatching...)
- Artificial wetland creation

Integral restoration of lost wetlands

We have some examples of wetlands completely lost in the recent past, that have been at least partially restored by turning some of the original surface back to wetland. This is the case in the □Raco de l□Olla□ in the Albufera de Valencia, La Nava lagoon in Palencia and the Lagoon of Ivars in Lleida. Some of these are in fact drained/ploughed or filled basins belonging to a larger wetland complex, which have been restored to increase the wetland surface or to gain habitat diversity within the complex.

The common feature of these projects, whatever the surface involved, is that they have a global approach to wetland restoration, from the reconstruction of the wetland basin to the recovery of the original hydrological regime and water chemistry. However, the return to a pristine situation is usually difficult, due to natural sucession and to drastic changes in the physical and ecological features of the site. Natural mechanisms do no longer operate in most cases, leading to a man-managed scenario that tries to mimic the former structure and function of the wetland.

In most cases we see the restoration of only a small proportion of what used to be the original wetland. In other cases, only the initial stages of the restoration process are reached. One of the major problems for lost wetland restoration is that most of them have been transformed to irrigated agricultural land, which is very expensive in Spain. In some areas, irrigated agricultural land can reach a price of 40.000 ECU/ha.

La Nava Lake (60 Ha restored of former 3.500-5.000; planned restoration: 500 Ha): The Laguna de la Nava used to be an endorrheic lagoon covering an area between 3.500 ha and 5.000 ha., with a maximum depth of only 2m and an average of 1,5m. The first attempts to drain the lagoon occurred in the XVth century, but it was mainly in the XIXth when most of the lake was drained. The last remnants were drained as late as 1951, like many other wetlands in Spain. This area had large numbers of wintering ducks and bean geese, it was also a stopover place for cranes and there were some large breeding colonies of purple heron and other waterbirds. In 1990, a group of concerned people from a local NGO managed to flood again an area of 60 ha of the former lagoon. Later the same year, they managed to convince the regional government to get involved, they applied for ACMA funds and managed to involve water authorities as well who provided 0,5 Hm^3 per year of clean water for the wetland. The local government took also part and gave away 60 ha of land to be restored as a wetland. The initial plan aims to restore some 500 ha, but the project is still far away from this objective. There has been a good recovery of the vegetation as well as wildfowl with over 15.000 wintering ducks and 3.000 geese.

Raco de l'Olla (24 Ha within a lake area of 3.000: L'Albufera): The area covered by the old racetrack of el Saler was recovered by the municipality of Valencia. This institution and the regional environmental board launched a restoration project. Two large lagoons were excavated and a treatment pool in order to increase water quality. Remaining areas with natural vegetation were left and an effort was made so that areas of salt marsh did not receive freshwater in excess. A number of islands for breeding birds were built and different management systems for the island cover were established. Water management is done through a system of pumps and sluices that allows a specific control of water levels for each lagoon. The whole area covers about 24 ha. and the volume of excavated sand was 197.392 cubic metres. The total budget for this operation was 137.327.132 pesetas, the main cost being the excavation and transport of sand. After a few years of operation, the result as far as the use of the area by waterfowl has been spectacular with numbers of terns, gulls, avocets and black-winged stilts going up as more and better nesting habitat is being provided.

Lagoon of Ivars (150 Ha): This was also an endorrheic lagoon with a high concentration of salt until 1884 when the water brought by an irrigation canal was used to keep a permanent water level. The ecology of the lake changed and it was quickly colonized by reedbeds and waterbirds. The maximum depth was 3 m and over 90% of the bottom was covered by submerged macrophytes. Wintering birds were not very abundant because of hunting pressure and the size of the lake, around 150 ha. In 1951 the lake was drained in order to obtain more land for agriculture. Compared to La Nava where the idea came from an NGO, in Ivars it was the local people who in 1991 asked the regional government for a restoration project. It was agreed that the lake would be primarily for conservation and ecotourism, with minimum recreational activities such as fishing or boating. In 1993 an agreement was signed between municipalities, regional government departments and county authorities in order to promote the restoration of the lake. A plan was passed in 1995 in order to avoid urban development near the lake and a restoration project was prepared. This plan

caused some confussion among landowners of the surrounding properties that did not understand certain regulations. The same year a couple of properties were purchased by the Department of the Environment. Since then the project is blocked because of a lack of resources for the purchase of land, which is very expensive in the area.

Laguna de Salinas (80 Ha lake within a steppe and wetland area of 32.682: Villafafila): A somehow similar project took place in 1988 in Villafafila lagoon in Zamora. This is a system of endorrheic lagoons, one of which was drained in 1971 by the ministry of Agriculture. The same ministry stopped the drainage scheme one year later but an 80 ha. lagoon, Laguna de las Salinas was already completely drained. In 1988 it was restored by blocking drainage channels. Some embankments were built to keep water and sedimentation pools in order to slow down a severe filling up process (PALACIOS & RODRIGUEZ, 1989).

Restoration of altered characteristics of existing wetlands

Restoration projects in existing wetlands can also vary greatly depending on wether an attribute or characteristic of the whole wetland is to be restored, or just a particular feature or section of it. The size or geographical scale of the intervention varies also greatly.

Projects relate either to water quantity or distribution (with examples in Daimiel and Donana National Parks, and in other major wetlands), or to water quality (e. g. the lagoons of El Rincon in Cordoba and La Encanyissada in the Ebro Delta). Other projects have sought to restore a natural wetland from a man-made one (e. g. a rice field converted into a freshwater wetland), by leaving secondary succession work under adequate hydrological management, after removing the agricultural use.

Donana National Park (57.200 Ha): The major Spanish wetland and one of the European hotspots of vertebrate diversity, with 25.000 ha of marshes remaining of the 150.000 existing by 1900. The marshes collect un to 500.000 birds, including 100.000 geese. The DNP was created in 1969 and large buffer areas (Natural Park) were declared later, but an ample surrounding district with intensive irrigated agriculture, mining and tourism activities represents direct and indirect threats. Examples are the 1998 Aznalcollar incident (a mining-waste flash-flood through one of the inflow rivers) and the predicted groundwater level decreases due to aquifer depletion. In 1960, technical development allowed the reclamation of 75% of the former marshes for agriculture, and the subsequent colonisation of the area. At the same time, inflow rivers were channelised, reducing the inpunt of surface water by 2/3. Increased siltation and the destruction of the Guadalquivir river main levee, caused rapid drainage of the marshes, resulting in a extreme dryness during the 80s. This forced the drafting of a DNP Hydric Regeneraton Plan that had the objectives of ensuring an adequate water supply to the Park, both in quantity and quality, recovering the the stability of the levee, and restoring the functioning of the inflow rivers and creeks (CASAS & URDIALES, 1995). A Sustainable Development Plan for the Donana District was devised to counteract additional threats to the hydrological system, like the groundwater-based irrigation plans and the development of mass tourism. The Aznalcollar incident brought a toxic flood close to the NP, in what represents the peak in the deterioration process of the Guadalquivir marshes. This forced the Ministry for the Environment to launch a plan for the integral restoration of the watersheds feeding the marshes, the Donana 2005 Project. This plan includes actions in eight areas, to secure the quantity and quality of the water flowing into the NP (URDIALES, 1999).

Las Tablas de Daimiel National Park (1.928 Ha). It is the remnant of a floodplain of 8.600 ha around the confluence of two small rivers of central Spain. The wetland represents the natural discharge of a Tertiary aquifer 100 m thick and extending over an area of 5.000 Km2. It is a Ramsar site valued not only for birds, but also due to its great botanical value (communities of fresh and brackish waters of high diversity and structural complexity). Although direct attempts to drain the wetland were stopped by its declaration as NP in the 60s,

irrigated land around it has increased from 30.000 Ha in 1974 to more than 125.000 in 1987. This, coupled with drought, led to the aquifer no longer discharging into the wetland in the summer of 1984 and to a spontaneous fire burning 1/3 of the NP in 1986. As a response, a □Hydric Regeneration Plan□ has been developed. Technical and feasibility studies established that 18 Hm^3 - from an external source- were needed, in addition to the natural inputs. These studies recognized that the best option was to allow the overexploited aquifer to recover by limiting water extraction, this being the long-term solution. But this has an evident socio-economic impact and needs a broader territorial context than that of the NP. An urgent mechanism was needed to restore the function of the site. Several actions were planned (dam construction, elimination of drainage channels, pumping from wells to provide freshwater spots), with a budget of 1.000 million pesetas. Among those performed, the derivation of water from the Tagus-Segura transfer scheme in 1998, has been till now the only action with some success. But from 1990 the situation deteriorated again, due to low water supply from the scheme, leading to ecological changes: eutrophication (and consequent decrease in submerged plant diversity), salinisation, reed expansion, and loss of habitat and bird species diversity. In recent years, at the same time overexploitation is legally declared, agri-environmental subsidies are being paid to farmers as a compensation for the reduction of irrigated areas and water consumption (SANCHEZ, 1995).,

El Rincon Lagoon (7,4 Ha): Eutrophication is one of the main problems in many wetlands. One of the first restoration projects in Spain involving eutrophy control, took place in 1986 at the Laguna del Rincon in Cordoba. This small lagoon was one of the very few locations where in the 80□s, white-headed ducks (Oxyura leucocephala) were breeding successfully. Suddenly in 1986 they stopped raising ducklings for some reason and many of the submerged macrophytes disappeared. A high density of green algae was identified and carp were believed to cause the suspension of rich sediment, causing eutrophy. In late september, when the lagoon had a very low water level it was dryed up with the use of pumps and 5.000 cubic metres of water were removed. All the carp and american crayfish were taken away and the sediment was left dry for a few days so that organic matter could mineralize. By the end of the year, the lagoon recovered its water and next spring macrophytes came up and white-headed ducks bred again successfully. This was a fairly cheap operation since the lagoon was small and only 5.000 cubic metres of water had to be pumped out, using firemen trucks (TORRES et al, 1988).

Encanyissada Lagoon (550 Ha of 7.736 of whole protected wetland: Ebro Delta Natural Park): Only a few years later, there was another project that took place at a much larger scale in the Ebro delta (Catalonia). In 1976 the Encanyissada lagoon, covering 550 ha and with an average depth of only 80 cm, used to have good numbers of ducks and wintering coot because of the abundance of submerged macrophytes. At that time there were 424 ha. covered by Potamogeton pectinatus, Najas marina and Ruppia maritima. Suddenly in 1978 macrophytes disappeared completely from the lagoon and there was a huge development of phytoplankton. This lagoon used to receive drainage water from surrounding ricefields from April to October, bringing in high loads of nutrients, mainly nitrogen. In 1992 a circumvalation canal was constructed that allowed the regulation of freshwater flow into the lagoon (MENENDEZ et al., 1995). Very quickly a decrease in ammonium was observed and although nitrate, nitrite and soluble phosphorus did not change, total phytoplankton chlorophyll decreased in 1994 compared to 1992. Because of this, a colonization and growth of rooted macrophytes was observed, mainly Ruppia cirrhosa, Potamogeton pectinatus, Najas marina, Myriophyllum spicatum and Ceratophyllum demersum. In 1997, the area covered by submerged macrophytes was similar to that of 22 years before. A good indicator to show this success story is the wintering population of coot which is counted every year in january.

Mar Menor Lagoon (13.500 Ha): At an even larger scale the restoration of water quality can be reached through wastewater collection and treatement systems, imposed by EC Directives to coastal and inland areas sensitive to urban or agricultural pollution. The Mar Menor lagoon in Murcia (SE Spain) is a good example of how changes in water quality could be reversed by the development

of this kind of infrastructure, leading to ecological benefits not primarily pursued by it. Since the 80s, the changes in wintering waterbird populations monitored in the lagoon are attributed to the increased use of fertilisers in the surrounding farmland and to the discharge of sewage into the lagoon or its watershed (HERNANDEZ & ROBLEDANO, 1994). A global project for the collection, treatment and re-use of wastewater in the lagoon/s district (with a summer population of 250.000 people) is nearly finished and bird populations are expected to respond to it. The creation of artificial wetlands for tertiary treatment has been proposed inside this scheme as a way to reduce treatment costs while increasing waterbird habitat (ESTEVE & VIDAL-ABARCA, 1998).

In many other sites, small-scale interventions have been devised to restore structural elements like islands, gentle-sloping banks, patches of vegetation, etc. There are good examples in Cabo de Gata Saltpans, Salinas de San Pedro del Pinatar in Murcia, Laguna de Fuentedepiedra in Malaga and Villafafila lagoon in Zamora (see descriptions in MONTES et al., 1995). Some of these interventions aim at restoring pre-existing features or elements. In other cases these are totally artificial structures, built deliberately to create safe breeding habitat or resting places for waterbirds, or accidentally, for instance during dredging operations.

Discussion

There are a good number of restoration projects that have taken place, are under way or planned all over Spain. It is difficult to generalize, but very often some of this actions do not have a proper restoration plan. Most are based on structural interventions and artificial control systems, rather than in the true rehabilitation of all the damaged functions. While this is usually the sole option in man-made or artificialised wetlands, with a long history of traditional management, this is not a general rule. Scraping, damming or bringing water from elsewhere to create a permanently flooded area, is a rather common and easy-to-perform solution that ignores relevant aspects like the original morphology and sediments, or the hydrological dynamics (CASADO et al., 1992). Some big projects are mere engineering solutions that reflect the failure to perform an integral restoration. This is the case of the Daimiel NP, affected by illegal groundwater extraction for irrigation, that has become a reservoir fed from wells and from an irrigation channel.

Some projects performed inside Nature Protection areas have been reviewed in specific workshops (see MONTES et al., 1995), but there is a lack of published information on many other, except for very general, non specialized magazine articles. It is also hard to find detailed information on associated costs and results. In most places there are good data on bird species and numbers that have colonized the area, but not much else. Another important side of this issue that is not always considered is the perception of local people regarding restoration processes. We know about many restoration projects but we do not know what do local people think about that.

Large restoration projects are difficult to implement in Spain because of the pattern of property of the land. Many of our wetlands were drained by government and kept by the church or by aristocracy. At some stage these drained wetlands were given away or sold to local people in very small plots, sometimes of only 0,5 ha or even less. This distribution of the land in wetlands makes it very difficult to purchase it. There are examples where in a plot of only 40 ha, there can be over 50 landowners. The complexity of negotiation and the price of land make this a very hard job both for governments or NGOs to face the purchase and restoration of a major wetland. Taking into account these socio-economic aspects is crucial for the success of restoration activities.

A sound scientific and technical background is also needed. In many of the cases reviewed, it is arguable if they represent proper restoration, or management aiming at the recovery of some particular wetland function (waterfowl habitat) or social utility (e. g. visitor management, environmental education, ecotourism..). There is a confussion between ecological restoration or recovery projects, and

pure rehabilitation or management actions (control of water levels, introduction of grazing or mowing regimes, construction of breeding structures).

Management activities have often changed completely the type of vegetation of the wetland and as a consequence, the whole wildlife and especially bird populations. In some areas, management oriented towards increasing the numbers of some species of birds has had negative effects upon other wildlife and certain types of vegetation. Unfortunately, not all restoration projects and management activities are coupled with a proper monitoring programme, taking into account all these effects and the response of non-target species and communities. A growing number of managers, however, are aware that this is a key element of a restoration project.

In some wetlands the introduction of such management practices has been called □restoration□, and the numerical response of waterbirds used as a simple indicator of success. This response reflects only the success of coarse-grained habitat management, or even just the ban on hunting, but is meaningless with regard to ecological restoration. Some restoration projects do not have clear objectives and proper monitoring systems that should provide vital information for future projects.

Imaginative ways are needed to turn back as much land as possible to wetland, and it shall be demonstrated rom the economic and social point of view that this is profitable and necessary. We are facing a new era for wetland restoration in Spain, as this issue is becoming increasingly acceptable and demanded by the public. The situation, however, differs greatly among regions, depending on land prices and pressures leading to changes in human uses of former wetland areas.

Spain has a very important area of lost endorrheic and steppic wetlands in areas where the price of land is still low, and where pressures leading to land use changes are lower at present. On the other hand, there is a very important land area covered by rice fields in the Ebro Delta, Albufera de Valencia and Marismas del Guadalquivir, among others, that may be forced to a change of crop or land use in the near future. The same applies to some types of coastal wetlands, in particular to derelict saltpans of Southern and Eastern Spain, gradually transformed for intensive fish-farming, housing or industry.

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Σύλογος Προστασίας Θαλάσσιας Χελώνας

Ινστιτούτο Θαλάσσιας Βιολογίας Κρήτης