Management of Avocet breeding islands

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Avocet *Recurvirostra avosetta* is a sedentary species in the saltpans of Cabo de Gata, although numbers present increase during spring and summer. Nesting occurs on the dikes and islands placed at the different pools of the saltpans. The two major islands (A1 and L), hold the largest breeding numbers of Avocet. Massive influxes of water to the saltpans in May each year consequent upon the salt production process, frequently flood the islands, resulting in partial destruction of Avocet colonies. In 1993 a European Community project allowed the management of the two main breeding islands. Most of the surface of island A1 was raised using mud excavated by hand from a natural deposit area elsewhere on the island. Island L, mostly eroded by water, was losing its surface. The proximity to the shore enabled the use of heavy machinery to enlarge (from 200 to 870 m^2) and raise the island. Due to natural sedimentation changes, in the three years following management intervention, island A1 has recovered an equal amount of sediment to that removed. Island L has resisted three winters without experiencing erosion of any importance except in the clay banks of the perimeters, removed by water. The Avocet breeding population nesting on the islands increased by 23% in 1993, 57% in 1994 and 74% in 1995 from a maximum of 110 pairs in 1991. Management of the islands resulted in a reduction of clutches failing to hatch as a result of flooding, increasing breeding success. We estimated that the proportion of potential chicks that fledged prior to management was 23% on island A1 and 25% on island L. After intervention, the breeding success increased to 42% for island A1 and 45% for island L.

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INTRODUCTION

The saltpans of Cabo de Gata, which are listed as a wetland of international importance under the Ramsar Convention, are located on the southeast coast of the Iberian Peninsula. Their surface area is 300 ha, with an average depth of 35 cm and an annual salt production of 30 000 metric tons.

The production of salt involves the precipitation of salts (carbonates, sulphates and chlorides) as the water moves from one pool to another: evaporating pools, heating areas and crystallisation pool. The cycle commences in February and is concluded in October with the collection of salt (NaCl). Each pool has specific characteristics of surface area, depth, granulation and chemical make-up of the substratum and of conductivity which determine the microfauna of the invertebrates found in the water and mud (*unpubl. data*). Waders use the saltpans both as staging area, as wintering habitat and as nesting area (Castro 1993).

The wader best adapted to this hypersaline environment is the Avocet *Recurvirostra avosetta*, which is a sedentary species in the saltpans of Cabo de Gata, although its numbers increase during spring and summer. Nesting occurs on dikes and islands placed at the different pools of the saltpans. The two major islands, called A1 and L are most important for breeding Avocets Castro *et al.* 1995).

There is a massive influx of water to the saltpans in May each year, as a consequence of the salt production process. This results in frequent flooding of the small islands and thus in partial destruction of Avocet colonies (Table 1).

Although there has been a long tradition in Great Britain of habitat management to improve the breeding habitat of Avocet and other waders (Hill 1988; Hill 1989; Cadbury *et al.* 1989; Burges & Hirons 1992) very little has been done in the Mediterranean saltpan habitat (Goutner 1985; Martinez Vilalta 1991; Castro 1993; Arroyo *et al.* 1994; Castro *et al.* 1995; Perez Hurtado *et al.* in press).

In 1987 the Andalusian Environmental Agency and the company owning the saltwork signed an agreement on the shared management of the resources of the saltpans ecosystem. In January 1993 a MEDSPA (Mediterranean Specific Action) Community Project, was carried out on the two major islands with the aim of avoiding future flooding.

Figure 1. General plan of Cabo de Gata saltpans. Islands A1, A2 and L in the third evaporation pool.

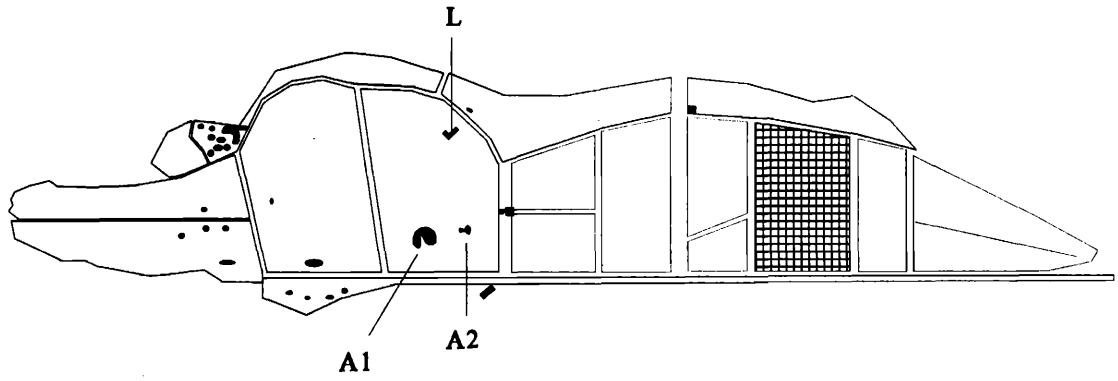

Table 1. Number of nests before and after intervention at the islands in January 1993. We only consider nests with a minimum of one egg. (N) constructed nests, (Dn) percentages of destroyed nests by flooding, (Ab) percentages of nests destroyed by other causes.

Island		A1			L			A2	
Year	N	%Dn	%Ab	N	%Dn	%Ab	N	%Dn	%Ab
Before intervention									
1982	77	9	0	0	0	0	0	0	0
1984	42	47.6	0	0	0	0	4	100	0
1991	64	84.3	?	36	58.3	?	10	100	0
1992	59	13.5	?	34	20.6	?	9	22.2	0
After intervention									
1993	71	0	?	53	0	?	11	0	0
1994	117	0.8	12.8	43	6.9	11.6	13	76.9	0
1995	116	0.8	16.3	54	0	1.8	14	57.1	0

METHODOLOGY OF INTERVENTION AND HABITAT MANAGEMENT

Island A1 has been formed by natural accumulation of sediment and is found in the third evaporating pool (Figure 1). It had a surface area of 3 500 m^2, half of which is covered by the shrub *Arthrocnemum* which is approximately 0.5 m high (Figure 2). The island supports the biggest colony of Avocets. As work with heavy machinery was a not possible option due to the considerable distance from the shore (>70 m) the management project was carried out manually by four workers using shovels and wheelbarrows and took a total of 160 workdays to complete.

The strategy was to excavate the mud in that part of the island which had regularly been flooded during the breeding season, causing the total destruction of nests. With the mud extracted from this area (which was determined by a previous study to be the area of maximum accumulation of lime deposit) a wall of an average height of 50 cm was built around the entire island and with the remaining mud the surface level of the northern zone was built up to an average height of 50 cm above the water level of the pond. The restored island had a total area of 2 700 m^2 with two distinct parts according to the presence of halophytic vegetation.

Island L has been built from a peninsula also located on a shore of the third evaporating pool and had a surface of 200 m^2 (Figure 3). Nesting attempts by the Greater Flamingo *Phoenicopterus ruber roseus* in the 1980s destroyed the halophytic shrub which had consolidated the substratum, with the result that easterly and westerly winds gradually eroded the peninsula so reducing the total surface usable by breeding waders.

The management strategy employed differed greatly from island A1. Very low levels of sedimentation were found in the area around the island and the proximity to the shore

gave predators such as Wild Boars *Sus scrofa* and Red Foxes *Vulpes vulpes* access to the birds due to the low water levels. The proximity to the shore (<20 m) enabled the use of heavy machinery to enlarge and increase the height of the island, and the area around the entire island was excavated to a depth of one metre.

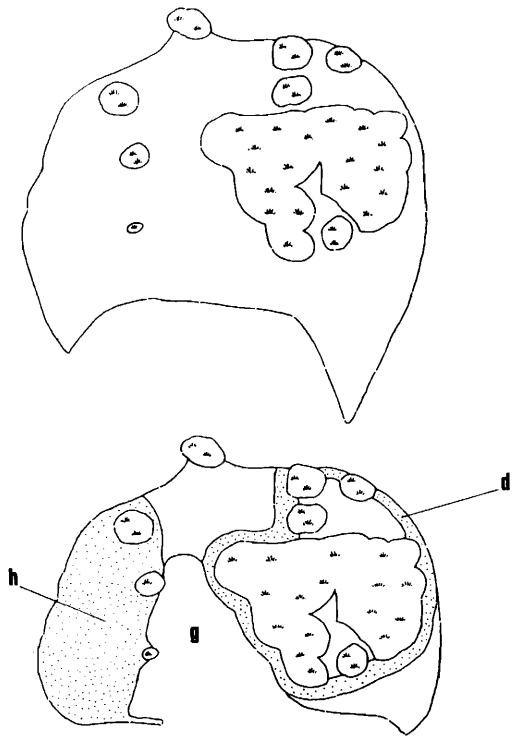

Figure 2. Island A1 before intervention (upper) and after intervention (lower). Mud extracting area (g). Mud perimeter wall (d). Built up northern zone (h).

The management was undertaken using a tracked digger which gained access to the island by a path built for the occasion and took place in three stages:

1. The positioning of a base layer that consisted of blocks of limestone measuring 30 cm in diameter and which were transported by the digger to the island. The blocks were put in place manually, ensuring that 10 cm protruded above the water level.
2. The positioning of an intermediary layer made up of boulders brought from a nearby dry river bed using a power shovel. The boulders were placed manually among and on top of the limestone blocks. The boulders chosen were without sharp edges in order to facilitate the establishment of breeding birds there.
3. The top level, which covers the island, was made up of lime extracted from the surroundings and was spread by hand. While this material was being spread the perimeter was built with a 45º slope to form beaches to facilitate the waders' access to the island.

The 20 m long path which allowed access to the island, was dismantled using the same machinery once the work was finished.

To monitor the management effects on the islands, we visited them during the breeding season (April to July) three times in 1993, 16 times in 1994 and 17 times in 1995.

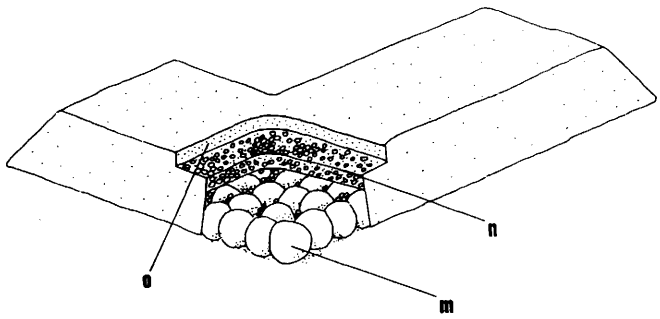

Figure 3. Island L. Limestone blocks form the basal layer (m). Boulders form the intermediary layer and lime forms the top layer (o).

RESULTS

Due to the natural sedimentation changes, in the three years following the management, island A1 has recovered an equal amount of sediment to that removed. This new sediment now available for use in future management.

Island L has resisted three winters without experiencing erosion of any importance except in the clay banks of the perimeter, removed by the water. Thus the beaches surrounding the island are now formed by boulders, also used for breeding by Avocets.

The Avocet breeding population on the islands (Table 1) increased by 23% in 1993, 57% in 1994 and 74% in 1995 compared to the previous maximum number of 110 pairs in 1991.

Predation was not recorded in the period 1982-84 on the islands (Castro 1993), although there was loss of nests from flooding. We do not know the breeding success of the Avocet colonies for the period 1991-1993.

The hatching success of birds on A1 was 86% in 1994. One nest placed next to the water and not on the raised surface was flooded. Ten nests were abandoned for unknown causes, and five were covered by windblown sand (13%). Island L had a hatching success of 81% with 12% of nests abandoned for unknown causes. The flooded nests on island L (7%), were those on the breakwater boulders surrounding the island. In most years, the small island A2 (with a low surface and area of 50 m^2) had high clutch failure rates due to flooding (Table 1).

An estimated 53% of chicks fledged in 1994 (n=24). The hatching success in 1995 for island A1 was 83%, with 9% recorded loss of nests from predation, 8% abandonment due to unknown causes and only one nest flooded. A total of 98% of chicks on Island L fledged as only one nest was lost to predation.

Herring Gull *Larus cachinnans michalis* was the only nest predator and Peregrine Falcon *Falco peregrinus* caught three adults.

In recent years, Little Tern *Sterna albifrons*, Common Tern *Sterna hirundo* and Kentish Plover *Charadrius alexandrinus* have bred on the islands.

Little Terns are present in spring and summer and has bred in the saltpans since 1991 (López Martos 1995). We have been monitoring the breeding colony from 1992 when 12 pairs were recorded). In 1993 the colony increased to 23 pairs, to 35 in 1994 and to 78 pairs in 1995. Little Tern breed on island L and at sites free of vegetation on island A1.

The first pair of Common Tern bred on island L in 1994. Two of them bred on island L and one more on island A1 in 1995. Kentish Plover is a common breeding species on sandy beaches and the saltpan dikes. From 1993, a few pairs have also occupied the management islands.

DISCUSSION

Although we have not recorded a clear-cut increase of the different seasonal populations from 1982 to 1995, the breeding population is certainly increasing.

It is probable that until the management of the islands occurred in 1993, the potential breeding population of Avocet could not completely occupy the full potential of this area. Waves and wind resulted in flooding of the island and chilling of chicks from spray, thus reducing the potential recruitment to the colony. This effect was worsened since only a small proportion of the potential population bred before the main flooding periods (which submerged the islands for a considerable period).

Management of the islands has resulted in fewer clutch failures from flooding and the necessary conditions to allow successful breeding. This has increasing overall breeding success rates. We estimate that the proportion of fledged chicks before management of island A1 was 23% (25% for island L). After intervention, the breeding success increased to 42% for island A1 (45% for island L).

Several factors have to be undertaken to increase Avocet breeding success:

1. Islands must be built as close to feeding areas as possible. If adults birds do not have to leave the area to feed, an attack from a predator can be defended by both incubating and feeding birds.
2. Areas with emergent aquatic plants (*e.g. Phragmites australis*) around the saltpans are used by the chicks both to protect themselves and for resting.

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