

## Effects of lagoon creation and water control changes on birds at a former airfield at Orford Ness, Suffolk, UK: Part 1 – breeding pied avocets, common redshank and northern lapwing.

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### SUMMARY

A former military airfield at Orford Ness had naturally developed into a coastal grazing marsh, but limited water control and high evaporation caused it to be highly prone to drying out in summer. With the intention of attracting higher numbers of breeding waders, six large shallow pools and two deeper ponds were created by building low bunds linked by new ditches and water control points. To replace water losses to evapotranspiration, new sluices were built into the river walls to allow estuary water to be drawn into two new lagoons at high tide, and from there into the ditches and pools to maintain desired water levels. The number of breeding waders in the modified areas increased from an average of eight pairs in the two years prior to the works to 23 pairs in the year after the creation of pools. Pied avocet numbers increased from zero to five pairs, common redshank from five to 13 pairs, and northern lapwing from three to five pairs.

### BACKGROUND

Orford Ness, on the Suffolk coast of the UK (52°05'N, 1°33'E), is a highly designated nature conservation site (Site of Special Scientific Interest, Special Protection Area, Special Areas of Conservation, Ramsar), owned by The National Trust since 1993. Orford Ness is a 16 km long coastal spit and its most significant feature is the rare vegetated shingle habitat (405 ha). There are also UK Priority Habitat areas of coastal marsh (193 ha), saltmarsh (91 ha), saline lagoons (40 ha), mudflats, reedbeds and acid grassland (Warrington *et al.* 2013).

One area (Airfield Marsh) had been encouraged to develop into a coastal marsh by allowing winter flooding, through reduced use of the evacuation pumps. However, in most summers the site became very dry due to the high evapotranspiration and low rainfall on the Suffolk coast. This resulted in the marine clay soil baking hard (Figure 1), making it unsuitable for waders and wildfowl.

Management work was undertaken with the aim of improving the habitat for breeding and wintering birds and other wildlife (Warrington *et al.* 2014). Targeted breeding wader species were pied avocets *Recurvirostra avosetta*, common redshank *Tringa totanus* and northern lapwing *Vanellus vanellus*, which require a mosaic of habitats in close proximity, including plenty of invertebrate-rich shallow pools, damp mud and low vegetation, for feeding chicks. Avocet, in particular, had not been observed breeding in Airfield Marsh for at least 10 years prior to the works.

Firstly, a careful evaluation of the historic environment of the area was required, since Orford Ness is of international significance for its twentieth century buildings and structures associated with military developments (*e.g.* Cocroft & Alexander 2009). The areas targeted for intervention were those where a drained grass airfield was maintained for many years in the early part of the twentieth century, and had

subsequently been used for both grazing and arable agricultural production. All historic tracks, structures and buildings were identified and retained.

Secondly, Orford Ness is almost an island, connected to the town of Aldeburgh to the north only by a very narrow and unstable ridge of shingle. The site is a very challenging one for engineering operations (Mason *et al.* 2013).

Thirdly, most fringing coastal grazing marshes in the UK have freshwater available from inland sources and reasonable access to livestock from local farming enterprises. Neither were available at Orford Ness, where the only freshwater input is rainfall which is low in this area (mean < 600 mm/year). The site is unattractive to local graziers due to poor quality forage and high transport costs.

Finally, all of the marshes at Orford Ness are below mean high water and are protected from flooding by very old, clay walls. These marshes have been flooded with seawater on several occasions in the long history of the site.

Given these conditions, the habitat and water management manipulations had to be designed specifically for the site, estimated project costs were high, and outcomes were not predictable. Therefore, it was decided that only one of the embanked coastal marshes could be tackled in this project, and Airfield Marsh was selected as it had large areas of flat grassland, with existing perimeter ditches. Importantly, this marsh also had the best standard of flood protection plus recently refurbished evacuation pumps.

A water level management plan was developed, which identified the need to increase the range of habitats and diversify the site's topography. The plan was to create new shallow pools surrounded by damp mud, deeper pools to retain water, and earth bunds, ditches and sluices in order to deliver the necessary range of water levels and their control. In addition, extra water would be required in late spring through to mid-summer to top up the system as evapotranspiration increased.

Here, we report the effect of the work on water levels and numbers of breeding waders on Airfield Marsh. Numbers of birds at an adjacent site, Kings Marsh, where no shallow pools were created, are also reported.

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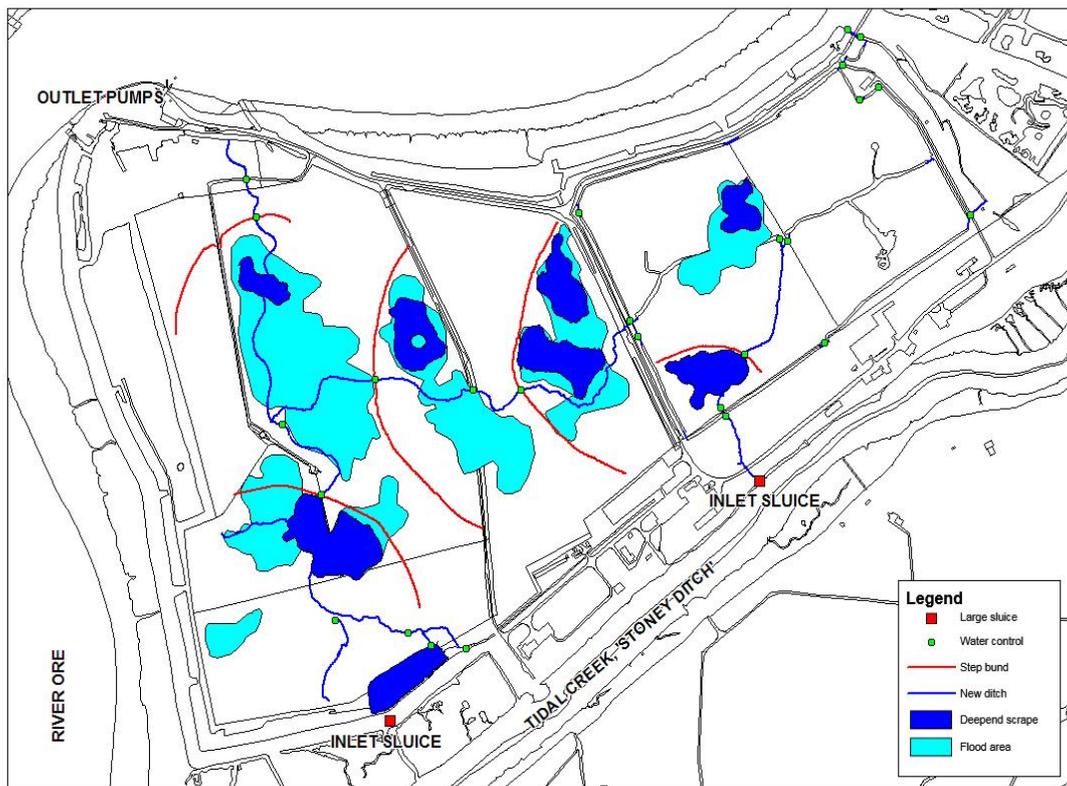
**Figure 1.** The Airfield Marsh is prone to drying out in most summers. This view is across the west side of the area, 30 June 2010.

**ACTION**

Airfield Marsh is an 80 ha coastal marsh, which was formerly a military airfield and has also been in agricultural use. It is surrounded by a clay river wall, and contains 11 ha of reedbed and 3 ha of dry grassland and tracks on shingle. Thus 66 ha was targeted for coastal marsh habitat improvements.

**Wetland habitat management:** From October 2011 to February 2012 large-scale earth-moving operations across the site produced six shallow pools (total 6 ha) and two deeper

storage lagoons (1.5 ha) in the Airfield Marsh, plus 2.6 km of new ditches. Topsoil was removed prior to pools being created and replaced afterwards. The pools were between 200 mm and 500 mm deep with gently sloping sides, and were designed to hold some water throughout summer in the deeper areas. The pools were linked by ditches and the water could be held back by a series of sluices set in low step bunds (500 mm high) (Figure 2). At high water levels in winter there is a very large area of additional shallow water, which can link the pools. In late spring, these shallow water areas were designed to draw down as evapotranspiration begins to exceed rainfall, providing



**Figure 2.** Airfield Marsh, where the new pools, flood areas, ditches, bunds and control points were created in autumn 2011. The large inlet sluices were located in the river walls to allow estuary water into two storage lagoons and from there into the network of ditches and pools.



**Figure 3.** Aerial photograph of the south-west of Airfield Marsh, showing the shallow water pools and water control structures (earth bunds, ditches, and water storage lagoon).

a significant area of wet mud and shallow water for wetland birds. Four and a half kilometres of new shallow and narrow ‘foot-drains’, 300 mm wide and 250 mm deep, installed across the grass areas added to the range of habitats provided by this project. There were numerous challenges in managing and delivering such operations on this remote coastal site with no road access. For example all materials, machinery and fuel had to be brought on site along a narrow 8 km rough track, and staff travelled on and off site daily by boat (Mason *et al.* 2013). The transport costs alone to bring the heavy earth-moving equipment onto and off the site were over £80,000.

To prevent the drawdown zones becoming hard-baked mud, additional water input was required. This was provided from two embanked lagoons on the south side of Airfield Marsh, each with a capacity of 9,900 m<sup>3</sup>, which were filled with brackish estuary water via two tidal inlet sluices in the river wall. All water on the marshes at Orford Ness is brackish to saline, as there is saltwater intrusion through leaks in the river walls and the soils have high salt content due to their salt marsh origin and occasional flood events. Because the only freshwater input is rainfall, topping up the pools using brackish estuary water was judged to be a pragmatic approach to keeping the wetland areas wet.

Post-works, a flock of hardy rare breed sheep, managed by the National Trust staff, were introduced to the Airfield Marsh from April to October, to assist with the vegetation management alongside taking some late summer hay-crops.

In November 2011 two new deep saline lagoons totalling 1.5 ha were also created on Kings Marsh, a 48 ha area of wet grassland with approximately 10 ha saline lagoons next to, but hydrologically separate from, Airfield Marsh on Orford Ness. No shallow pools were created at this site, which had been favoured by avocets over Airfield Marsh prior to the management work taking place.

**Monitoring:** Water salinity was measured at 10 points at key locations in the water control system each month between

April and August using a refractometer. Bird counts were carried out for three hours each week starting in January 2010. The site, including both Airfield Marsh and Kings Marsh, was divided into survey zones and the amount of time spent surveying each zone was proportional to its area. Data on all bird species present were collected, but here we only report on the three targeted wader species.

## CONSEQUENCES

**Water levels:** The engineering work was completed by February 2012 and water was brought into the marshes via the inlet sluices on 2 April to test the network. Three of the five months from April to August 2012 had over twice the average monthly rainfall, and two months were approximately average. This high rainfall in summer 2012 meant that no additional water was drawn into the network in this year, as the pools remained full and the flood areas filled and dried out several times. However, summer 2013 was dry, with four summer months having 50-70% average rainfall and the other having average rainfall (UK Met Office). Thus in summer 2013 estuary water was brought into the site to keep the target areas of the marshes wet. No changes in the average summer salinity of the marshes were detected after the management (Table 1).

**Table 1.** Mean summer salinity of water in Airfield Marsh. Engineering work was conducted in October 2011 to February 2012.

Year	Mean salinity (s.d) (parts per thousand)
2010	17 (2)
2011	16 (1)
2012	15 (1)
2013	17 (2)

**Table 2.** The number of breeding pairs of three species of waders on Airfield Marsh and Kings Marsh, Orford Ness, before (2010, 2011) and after (2012, 2013) the wetland improvement works on Airfield Marsh.

Year	Avocet		Redshank		Lapwing	
	Airfield	Kings	Airfield	Kings	Airfield	Kings
2010	0	31	5	7	2	3
2011	0	26	5	7	4	4
2012	2	15	8	6	5	3
2013	5	49	13	6	5	6

**Breeding waders:** There was an increase in the number of breeding pairs of waders on the 66 ha area of the Airfield Marsh targeted by the wetland improvement works if the post-works years are compared to the pre-works years (Table 2). The total number of breeding waders increased from an average of eight pairs in the two years prior to the works, to 23 pairs the year after the works were completed. Numbers of pied avocet ( $\chi^2 = 7.00$ , d.f. = 1,  $p < 0.01$ ) and common redshank ( $\chi^2 = 3.90$ , d.f. = 1,  $p < 0.05$ ) increased significantly, and numbers of northern lapwing showed a non-significant increase ( $\chi^2 = 1.00$ , d.f. = 1,  $p > 0.05$ ) (Table 2).

In addition, the number of breeding waders on Airfield Marsh can be compared to those on the adjacent Kings Marsh. Prior to the recent management work, avocets favoured the lagoons on Kings Marsh, and this pattern continued after the intervention, even though the wet summer of 2012 was a notably poor year for them. Counts of breeding pairs suggest that the improvements to the wetland habitats on Airfield Marsh have not simply moved wader pairs from Kings Marsh, but that extra birds began to use the site (Table 2).

## DISCUSSION

The manipulation of the topography and the water features undertaken to improve the Airfield Marsh for birdlife were typical of those carried out on other marsh and coastal sites in the UK (e.g. Badley & Allcorn 2006); however, the site was far from typical (see introduction). The increases in breeding waders evident soon after the intervention was completed is encouraging, although it is not possible to attribute this increase to specific aspects of the habitat creation or ongoing habitat management, as the bird response could be due to any or all of the actions.

After all of the works were completed, vegetation regrowth was very rapid, presumably helped by the wet summer of 2012 and the fact that topsoil had been scraped away before the topographic changes, and then replaced afterwards. The rhizomes and roots of the co-dominant sea couch *Elytrigia atherica* and false oat-grass *Arrhenatherum elatius* plus the seed bank would have been retained in the topsoil, likely facilitating re-vegetation.

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