THE IMPORTANCE OF COASTAL HABITATS FOR EUROPEAN WADER POPULATIONS

RIVON-COMMUNICATION NR. 272

by J. Rooth

Introduction

Concern about a possible reduction in the numbers of certain kinds of waders and the threat to their habitat (see also Proceedings of the 1962 MAR Conference and Proceedings of the First European Meeting on Wildfowl Conservation in 1964) has prompted the International Wildfowl Research Bureau to set up a Wader Working Group (Annual Meetings at Aarhuus in 1964 and at Kampen in 1965). This Working Group will co-ordinate, intensify and initiate research into *Limicolae* at an international level.

Significance of the habitat

In view of the foregoing, it will be appropriate to consider the significance of the habitat and to deal at the same time with the threat to the habitat and the consequences thereof to the waders.

Lack of information is one of the reasons why the following can be no more than a sketch of the situation in a restricted area. Furthermore, I intend to confine my discussion to those species which migrate in large concentrations (more than 10,000) mainly along the sea coasts and loaf or winter in the coastal area: birds such as *Calidris canutus, Calidris alpina, Haematopus ostralegus, Recurvirostra avosetta, Limosa lapponica, Numenius arquata, etc.*

Large concentrations of these species, numbering several tens of thousands and sometimes more than 100,000 in a relatively confined area are mainly found in the more or less saline coastal waters with mud and sand flats.

Such coastal areas, inland seas, bays and estuaries are all characterized by the abundance of food they provide. This is due to an open connection with the sea (or ocean) where the water contains much anorganic and organic matter in suspension. In the shallow coastal waters where the velocity of the currents drops and where the tides, of course, also play an important part, the suspended matter will settle. Such areas are thus fed continuously from outside with nitrogen, phosphorus and other foodstuffs as well as with instantly available foods. The shallow water admits sufficient light to create the conditions for a plentiful growth of phytoplankton. Zooplankton follows automatically and, where there is much plankton, there is an abundant invertebrate and vertebrate fauna.

Food

As regards the Dutch Wadden Sea, this great fertility and production of biomass was analysed recently in a fascinating manner by Verwey (1965). I should like to give a few examples.

The most important consumers and converters of plankton are the Mollusca.

Reprinted from:
Proceedings 2nd European Meeting on Wildfowl Conservation, Noordwijk 1966, 1967.
P. 193-200.

Species such as *Mytilus edulis* and *Cardium edule* retain in principle everything from the water they pump through. They occur in an average density of 70–80 specimens per square metre. *Mytilus* alone produces 3,000 million kg of dry matter per annum in the 1,560 square kilometres of the Western Wadden Sea. 360 million kg (12%) of this matter is organic and 240 million kg of it is calcium.
The material deposited on the bottom is a source of food for such creatures as Polychaeta, Crustacea and Mollusca, which in turn convert them and pass them on to other organisms, which may achieve an average density of 10,000 specimens per square metre (v. d. Baan, c.s. 1958 and Rooth 1964). As the total area of the Dutch Wadden Sea is about 2,800 square kilometres, the number of invertebrates present is clearly astronomical. Whereas the number of different species is generally restricted by the higher or lower salt content of the water, the species that can occur in these habitats are present in extremely large numbers. Polychaeta, for instance, occur all over the Wadden Sea in millions of millions. This is most important for many Waders, which from time to time confine themselves to one type of food, and it permits their presence in large numbers.

Birds

On 23rd August 1963, the bird population of the entire Dutch Wadden Sea was as follows:

Haematopus ostralegus	163,000
Numenius arquata	45,000
Limosa lapponica	23,000
Calidris canutus	132,000
Calidris alpina	98,000
Recurvirostra avosetta	over 10,000

So we arrive at a figure of 500,0000 waders, to which should be added about 200,000 gulls and over 50,000 ducks, in all more than 750,000 birds (Rooth, 1966).

Food ratios

The ratios between these large numbers of birds and their prey are also being investigated (see Rooth 1964). I shall mention some examples.
Hulscher (personal communication) found that *Cardium edule* was the staple food of *Haematopus ostralegus,* which consumes 238 millilitres of cockle meat every 24 hours.
From regular counts (including those made by Mörzer Bruyns and Braaksma, 1954, and by Rooth, 1960) and random checks, he estimates the average number of oyster-catchers in the entire Wadden Sea throughout the year at 98,000.
They consume per annum 8,500 million millilitres. If they ate exclusively one-year-old cockles, which, when 23 mm long, provide 0.72 millilitres of meat, the annual consumption would be 12,000 million cockles (10-mm. cockles : 100,000 million; 30-mm cockles . 4,700 million).

With a density of 80 cockles per square metre on the 1,120 square kilometres of sand and mud banks in the Wadden Sea that are exposed at low tide, the total cockle population amounts to about 90,000 million. If exclusively one-year-old cockles (12,000 million) are consumed, the predation percentage would be 13! After severe winters, when cockles are badly hit, the birds temporarily and locally change over to *Macoma balthica.* If 80,000 birds feed for three months on *Macoma,* they will consume about 5,000 million out of an estimated total *Macoma* population in the Wadden Sea of 50,000 million (10% predation).

From my own research into the diet of *Calidris canutus,* I know that when they eat exclusively *Cardium edule,* one bird will consume about 600 a-few-months-old specimens every 24 hours. They also eat *Hydrobia,* so at the rate of 1,000 *Hydrobia* + 100 one-year-old *Lamellibranchiata* (*Cardium and Macoma*) every 24 hours, the average *Calidris canutus* population of 80,000 will consume in one year 30,000 million *Hydrobia* and 3,000 million young *Lamellibranchiata.*

If we convert Verwey's data (1965) to apply to the entire Dutch Wadden area, the following five species of wader will be there throughout the year in the following approximate numbers:

Haematopus ostralegus	80,000
Numenius arquata	16,000
Calidris canutus	80,000
Limosa lapponica	40,000
Tringa totanus	1,000

The food consumption of these five species alone in the course of one year lies somewhere around 6,000 million one-year-old and perhaps another 2,0400 million younger cockles (*Cardium*), 5,000 million *Macoma,* 70,000 million *Hydrobia,* 1,000 million *Littorina,* a few thousand million *Polychaeta* and 200 million *Carcinus maenas.*

Although the figures involved are exceptionally large and are, of course, only approximations, the predation of one-prey specialists or of various species of birds combined on such prey as *Mytilus, Cardium* and *Macoma* appear to be somewhere between 10 and 20%. After severe winters these predation percentages will undoubtedly be higher.

The foregoing is, however, a brief and incomplete sketch of the significance of a habitat such as the Wadden Sea.

Feeding areas

Since the number of such rich feeding areas and their extent are not very large and since both the number and extent of various of those areas in Western Europe are being reduced, it may mean that the food problem of these Northern breeding populations is going to be limiting factor, if it has not already become one.

Moreover, the elimination of such areas, seen as links in a chain of 'stepping-stones' during migration, may take a heavy toll.

We shall now investigate where those feeding areas are situated and to what dangers they are exposed.

The MAR Wetland List (Olney, 1965) has ennabled us to make a comparison between the various West European coastal areas that are of importance to migrating, loafing or wintering waders. This was done recently by Mörzer Bruyns (1965). I shall confine myself at present to those areas which as regards extent and number of birds are the most important. When known, the maximum number of birds present will be mentioned.

In *Norway* and *Sweden* there are many important marshlands, Orrevatn (1,500 hectares), Öland (Södviken: 800 hectares) and the Southern point of Skane (1,000 hectares) being the most important ones for the waders.

Denmark: the fjords of North and West Jutland (1,500 hectares) and the Danish Wadden Sea (60,000 hectares) provide for probably tens of thousands of waders.

In *West Germany* the Wadden Sea (325,000 hectares) is particularly important, waders there numbering between 500,000 and 750,000.

Netherlands: the most important areas are the Wadden Sea (280,000 hectares) with from 500,000 to 600,000 waders (Rooth, 1966) and the Delta area which – together with the Western Scheldt – can accommodate about 250,000 waders in a total area of some 120,000 hectares (W. Wolff, personal communication).

Belgium: in the Zwin, which covers 150 hectares, large concentrations (hundreds of birds) do not occur, but it is important as a stopping-place for migratory birds (Lippens, 1963).

In *Britain* it is particularly the Wash and surrounding area (10,000 hectares) with 150,000 waders that is important; also such areas as the Norfolk Broads (5,000 hectares) and the North Norfolk Marshes (1,000 hectares).

In *Ireland* it is the Slobs and Harbour, Co. Wexford, (3,000 hectares) and the Inishka Islands, Co. Mayo, (400 hectares) that are important for wintering and migrating waders.

In *France,* on the West coast, it is the Bay of Veys (34,000 hectares) in the North with as many as 200,000 waders when migration is at its peak, and the Bay of l'Aiguillon in the South (100,000 hectares) with 100,000 wintering waders (Spitz, 1964) that are important. Between these two areas the Bay of Mont St. Michel (30,000 hectares), the Gulf of Morbihan (5,000 hectares) and the Bay of Bourneuf (700 hectares) are the principal stopping-places (Etchecopar, 1962).

In *Portugal* it is particularly the Tagus estuary (30,000 hectares) and the Sado estuary (20,000 hectares) that are important for their migrating and wintering waders.

In *Spain* the Marismas of the Guadalquivir (250,000 hectares) with tens of thousands of waders constitute the most important area.
The (maximum) numbers of birds in these most important areas are aften unknown, and in the areas where more detailed inventories have been taken the figures obtained are often but 'snapshots'.

In actual fact, we do not know whether the number of migrating birds is five or even ten times higher than the number observed on a given day. The wintering areas in Africa are too vast and insufficiently known for us to be able to give information on the total numbers of bird populations.
The large feeding areas, viz. the Danish, German and Dutch Wadden areas (over 600,000 hectares), the Delta area in the Netherlands (120,000 hectares), the Bay of Veys (34,000 hectares) and the Bay of l'Aiguillon (100,000 hectares), the Tagus and Sado estuaries (together 50,000 hectares) and the Marismas of the Guadalquivir (250,000 hectares) are separated from one another by anything from a few hundred to many hundred kilometres.
Apart from all manner of small favourable habitats, the links in the chain of feeding areas appear to lie fairly wide apart. The elimination of one or more of these links or the reduction in size of an important feeding area might therefore have an adverse effect on the stock of the various species.

Threats to the feeding areas

The feeding areas are threatened by the following factors:

a. *damming-off and reclamation*

Through the damming-off of estuaries, valuable habitats are lost, since the supply of water rich in food is cut off, so that impoverishment and other changes occur. In the event of (partial) reclamation, an area disappears or shrinks. As an example, I would mention the Delta Project in the Netherlands, where estuaries are being dammed off; the same is true of the Lauwerszee and possibly also the Dollart in the North of the Netherlands.
The latter two areas are parts of the Wadden Sea, for the damming and partial reclamation of which (as also perhaps in the German and Danish Wadden Seas) plans have already been made.
The Bay of l'Aguillon in France is, or was, like other areas along the French coast, threatened with (partial) reclamation.
The cultivation of rice and other land-clearance projects in the interests of agriculture, industry and harbour development (De Beer, Europort – Hook of Holland) constitute further threats.
This development might lead to such a considerable reduction in feeding areas that the consequences for various species of waders could be disastrous.

b. *pollution through effluent*

Industrial effluent in particular may have a highly pollutant effect. Domestic effluent plays a less important part, both qualitatively and quantitatively. Effluent is discharged not only into inland waters but also – and in large quantities – on the high seas.
According to a study by De Wolf (1965), this entails many dangers, since the various masses of water lead a more or less independent existence; the result is that the desired dilution and purification do not take place quickly, if they do take

place at all. There are, for instance, indications that there are in the North Sea eight separate water masses – the continental water mass is but one of them – between which little exchange occurs. It would seem that the North Sea water changes only once every two years. In view of these two factors, noxious concentrations may affect sensitive organisms and their environment for some considerable time.
This may mean that apparently good feeding areas are, or become, of little importance to the waders, owing to pollution.
A good example of this is provided in the Netherlands, by the Eastern and Western Scheldt. The former estuary has hardly been polluted, if at all, whereas the latter has been polluted to a considerable degree. Consequently, the mud flats in the latter estuary are different in composition and contain considerably fewer invertebrates and so there is a marked difference between the numbers of their respective bird populations (personal communication from W. J. Wolff).

c. *poisoning of the habitat by pesticides*

We know, for instance from research conducted by Moore and Tatton (1965), that residues of chlorinated hydrocarbon insecticides have also been found in seabirds in recent years. *Sterna sandvicensis* has been greatly reduced in numbers in the Netherlands, most probably by such pesticides, and Koeman and Van Genderen (1965) have found such pesticides also in the liver of *Platalea leucorodia* (5.8–6.1 p.p.m. of dieldrin) and in the liver of *Haematopus ostralegus* (9.1–9.5 p.p.m. of dieldrin); they also found endrin and DDE. The five specimens they examined were found on the island of Texel either dead or dying.
In countries (or territories) where such pesticides are used extensively or where leakages during the manufacturing process occur, these persistent substances, which are concentrated in the food chain, may have a disastrous effect on the organisms at the end of the food chain. The effect may be particularly strong on piscivorous birds. These substances may also greatly raise the mortality figure in respect of many waders that feed on *Crustacea, Polychaeta* and *Mollusca,* particularly while migrating when they use up their fat reserves in which those substances are generally stored. They exert their toxic effect as soon as they are released into the bloodstream. Although research into this problem is still going on and although much of the foregoing is based on a small number of facts and indications, a warning note is due: habitats, prey fauna and waders are all in danger.

d. *interference by Man*

All kinds of human activities in the habitat may cause the birds (temporarily) to avoid the area and prevent them from using a favourable habitat.
Various species of waders such as *Calidris canutus* react strongly to gun-fire and abandon areas used for firing practice. Intensive game-shooting in a given area may cause the birds to leave in spite of favourable feeding conditions. Fishing activities, and the cultivation of mussels and oysters may have the same effect. All such disturbing factors may cause an otherwise good area to be avoided.

Conclusion

It will be very necessary to continue and widen research activities into the numbers of migrating, loafing and wintering waders in addition to qualitative and particularly quantitative research into feeding in connection with the carrying capacity of a habitat, since the habitats are endangered in various ways. Particularly the dangers inherent in pollution and the use of insecticides should be subjected to a closer investigation.

Summary

The significance of the habitat along the coasts of Western Europe is the subject of discussion.

The abundance of food is due to the supplies of anorganic and organic material deposited in the shallow coastal waters. As sunlight can penetrate into the water, there is a strong growth of phytoplankton, which activates a rich growth of zooplankton, which in turn gives rise to a rich invertebrate and vertebrate fauna.

A sketch is given of the quantities of food available to the waders in the form of Polychaeta, Crustacea and Mollusca, the Dutch Wadden Sea being taken as an example.

A few quantitative examples of the ratios between predator and prey are also given. The predation percentages of one single species or of a group of species are found to lie between 10 and 20. After severe winters, when many prey populations have been decimated, the predation percentages may be considerably higher.

A summary is given of the principal feeding areas along the coasts of Western Europe. The areas involved and the maximum numbers of waders present there are given wherever possible.

Good feeding areas appear to be fairly rare and they are often from a few hundred kilometres to many hundred kilometres apart.

Some of those areas are in danger through damming-off, reclamation and pollution by effluent and pesticides.

Moreover, military exercises, hunting, fishing, etc. may cause birds to neglect (temporarily) good feeding areas.

In view of the high predation percentages and the fact that good feeding areas are relatively rare and in danger, the food situation and the great distances between between the feeding areas may become factors restricting the stock of waders.

More research into the numbers of birds, quantitative food research in connection with the carrying capacity of a habitat and research into pollution and the effect of pesticides are urged.

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