

The possible impact of climatic change on the avian community of dune ecosystems

H.T.H.M. Meekes

Nature Conservation Department, Agricultural University, Ritzema Bosweg 32a, 6703 AZ Wageningen, The Netherlands

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Abstract

The possible effects of climatic change for the avifauna in the dunes, especially in the Netherlands, were analyzed with two different approaches. It is concluded that although there will be an influence on most species, only three or four species may be threatened, whereas two species may even benefit from the possible changes.

Introduction

Dunes form a very variable landscape, covering many complex gradients between wet and dry, fresh and saline, organic and mineral, exposed and sheltered. This complexity gives rise to a great variety of vegetation structures and associations with corresponding animal communities. Birds form an important group of these communities, occupying many types of dune habitats.

It has been suggested that dunes, because they are geologically very young, are expected to respond more rapidly to climatic change than other systems (Boer and Groot 1990). Therefore special attention should be paid to possible changes in dune habitats caused by the changing climate.

In this paper a qualitative estimation of the possible effects of changes in dune habitats on bird communities is presented.

Methods

In order to assess the possible effects of climatic change on birds in the dune landscape, two different approaches were used. One approach was to translate probable changes in dune habitats to changes in functions these habitats serve to various bird groups or species. This is referred to as the general approach.

The second approach was to study distribution maps from the Netherlands of breeding birds produced by SOVON¹ (SOVON 1979) and selecting those species that have key populations in the dunes. The selection criterium was the impression obtained by eye from the breeding distribution maps. In other words: those species were selected that have a discontinuous breeding range with a distinct population in the coastal zone. This is referred to as the specific approach.

The changes in the dune landscape were derived from those described in the LICC discussion

* ¹Samenwerkende Organisaties Vogelonderzoek Nederland (Cooperating Organization on Avian Research in the Netherlands).

papers and conference proceedings (LICC executive committee 1989; Boer and Groot 1990).

General approach

Sea level rise and coastal erosion

Sea level rise as such will not affect the birds greatly. Freely moving as they are, they readily adapt to new geophysical situations. As pointed out in the conference proceedings (Boer and Groot 1990), in a number of situations with positive sedimentation budgets, disappearing dunes will be replaced by newly formed dunes at the new beaches. Where the coastline is fixed by artificial seawalls and where no net-sedimentation takes place, breaks in the dune system may arise. This situation is present at various locations on the European coasts. However these gaps can be readily overcome by birds and the problems that may arise for them are linked with the prevention of plant species or insects to colonize the new dune formations. A special problem may arise if coastal erosion proceeds quickly and results in total disappearance of the present dunes. Then only very young stages of dune formation may be present in a certain area. This then would lead to habitats only profitable to pioneer species and to the disappearance of the diversity of later stages of succession.

Soil moisture content and ground water level

These factors are affected by several processes brought about by climatic change. The processes involved will be covered in other contributions to this volume and will therefore not be dealt with here. The complexity of the hydrological balance in the dunes makes it impossible to make firm statements about effects on the bird fauna. Nevertheless, in general, birds tend to be attracted more by humid conditions than by arid conditions. Therefore where climatic change results in more arid dune landscapes, the value for birds will decrease, hence bird numbers in these areas will become

Table 1. Presence of breeding birds in square grids in the coastal dune area compared to that in the whole country (Data from SOVON 1979).

Species	total number of grids where present	number of grids where present in dune area	%
Spoonbill	23	8	35
Shelduck	640	72	11
Eider	32	24	75
Marsh Harrier	462	19	4
Hen Harrier	151	24	16
Montagu's Harrier	79	7	9
Kentish Plover	182	36	20
Woodcock	466	37	8
Curlew	802	60	7
Common Gull	91	51	56
Lesser Black-backed Gull	32	26	81
Herring Gull	123	51	41
Sandwich Tern	27	16	59
Arctic Tern	66	19	29
Little Tern	56	21	38
Short-eared Owl	349	36	10
Whinchat	656	48	7
Stonechat	164	45	6
Wheatear	668	69	10
Red-backed Shrike	160	33	21
Tawny Owl	618	16	3
Nightjar	256	11	4
Green Woodpecker	829	33	4
Lesser Spotted Woodpecker	488	7	1
Woodlark	335	16	5
Tree Pipit	902	46	5
Redpoll	141	41	32

lower. Desiccation of lagoons and marshes in dunes may cause problems for shorebirds that use these habitats for resting at high tide (Gulls *Laridae* and Waders *Charadriidae*). On the other hand the reverse development in other areas may create new and alternative opportunities for these species.

Vegetation and relief

Changes in vegetation are to be expected if soil moisture, salinity, exposure or soil composition and structure are altered due to climatic change. Additionally, vegetation elements may specifically

react to shifting temperatures. As pointed out in various contributions to the discussion report (LICC executive committee 1989), changes in vegetation have their effects on the dune relief by the stabilizing effect of plant growth on the soil.

Although relief itself may not be very important to birds, vegetation, which is closely related to topography, is a key feature. Many bird species have specialized on various stages of dune development with their corresponding vegetation, ranging from the Kentish Plover *Charadrius alexandrinus* inhabiting sparsely vegetated beaches and fore-dunes, via Wheatear *Oenanthe oenanthe* and Curlew *Numenius arquata* inhabiting dunes with low vegetation, to many woodland species inhabiting scrubs and woods in the landward parts of the dunes. How the various species may be affected by altered vegetation will be described in the next section.

Specific approach

Bird species distribution in the Netherlands

The results of the general breeding bird census in the Netherlands (SOVON 1979) were used as the basis of the specific approach. In this census report, species distribution is presented in geographical maps of the presence of the species as breeding bird in each of the 1671 5 × 5 km² grids that cover the Netherlands. For the present paper, bird presence in grids in the coastal dune area was compared to the presence in all grid squares and expressed as a percentage. As indicated in the Methods-section, only those species were enlisted that have discontinuous breeding ranges and distinct populations in dune areas. The results are presented in table 1. The coastal dune area is represented by 80 square grids which amount to 5% of the total number.

It should be noted that the distributions used here are qualitative more than quantitative. For a number of species the number of breeding pairs per square grid may be much higher - or lower - in dunes than those in other landscapes (e.g. a colony of 2000 Herring Gulls in the dunes is denoted in the

same way as one isolated breeding pair in the eastern part of the Netherlands).

Effects of climatic change on the selected species

The results of the specific approach are summarized in table 2. The effects on the dune populations and on the total populations in the Netherlands are indicated in the columns entitled "Dune" and "Total", respectively.

Changes in the dune landscape and migratory birds

It is well known that many passerine birds (Thrushes *Turdus spec.*, Starlings *Sturnus vulgaris*, Warblers *Sylviidae*, Finches *Fringillidae*) have migration routes leading along the sea coast, and consequently along the dunes. Many of them use the dunes to rest and feed on the berries and seeds of the dune vegetation, making the dune landscape an important feeding area. Another factor contributing to the importance of the dunes for birds is their hesitation to cross the sea which leads the birds to follow the coastline. It is not known what the effects might be of changes in the dune landscape on the populations of these migratory birds.

Concluding remarks

Because the effect of climate induced changes in the dunes on a local scale is hard to predict, no firm quantitative conclusions can be drawn. Only some cautious qualitative conclusions may be drawn.

The alterations in the dune landscape and vegetation that arise from climatic change will probably be reflected in the avian community of this ecosystem. The changes in bird populations will depend on the range of habitats that will remain, which, as yet, cannot be estimated.

Species that are confined to dunes for breeding (Gulls), appear to be sufficiently tolerant to endure considerable changes in the dune landscape.

Many wetland species inhabiting the dunes may

Table 2. Effects of climatic change on breeding population of selected species.

Species	Dune	Total	Comment
Spoonbill <i>Platalea leucordia</i>	+	=	– sea level rise and higher precipitation increase isolation of nesting sites in dune lakes
	–	=	– aridification causes increased predator intrusion in colonies
Shelduck <i>Tadorna tadorna</i>	=	=	– species does not feed in the dunes and is not critical in vegetation type as long as good sheltered sites are present
Eider <i>Somateria mollissima</i>	=	=	– species does not feed in dunes, no specific vegetation for nesting site
Hen Harrier <i>Circus cyaneus</i>	–	–	– isolation is most influential, any change therein will have effect
Montagu's Harrier <i>Circus pygargus</i>	–	–	– same as former species
Marsh Harrier <i>Circus aeruginosus</i>	–	=	– same as former species, but less depending on dunes
Kentish Plover <i>Charadrius alexandrinus</i>	+	+	– salt intrusion and new formation of dunes increase the preferred areas of sparsely vegetated sandy beaches
Woodcock <i>Scolopax rusticola</i>	–	=	– aridification and salt intrusion threaten the preferred woodlands with humid soils
Curlew <i>Numenius arquata</i>	– ?	=	– species is capable of adapting to changes; if climatic change results in too high vegetation or its disappearance, the species will leave the dunes
Gulls <i>Larus spec.</i>	=	=	– these species will only be affected if dune vegetation shifts to tall woodlands
Terns <i>Sterna spec.</i>	=	=	– these species are confined to sandflats and are not influenced by changes in the dune habitat
Short-eared Owl <i>Asio flammeus</i>	–	–	– if short to middle high vegetation changes, either to less vegetated habitat or to forest, this will affect the dune population, which is the most stable part of the Dutch population
Whinchat <i>Saxicola rubetra</i>	–		– same as former species
Stonechat <i>Saxicola torquata</i>	–		– same as former species

Table 2. Continued

Species	Dune	Total	Comment
Wheatear <i>Oenanthe oenanthe</i>	t	+ ?	– this species will benefit if dune become less vegetated or are newly formed, because it prefers sparsely vegetated habitats
Red-backed Shrike <i>Lanius collurio</i>	–	–	– the most important (and most vulnerable) Dutch population is that the dunes of the Wadden Islands
Tawny Owl <i>Asio otus</i>		=	– these species are characteristic of the forested landward parts of the dunes.
Nightjar <i>Caprimulgus europaeus</i>	–	=	However, the dune populations comprise only minor parts of the Dutch populations. Decrease of dune forests will impoverish bird diversity in the dune landscape
Green Woodpecker <i>Picus viridis</i>	–	=	
Lesser Spotted Woodpecker <i>Dendrocopos minor</i>	–	=	
Woodlark <i>Lullula arborea</i>	–	=	
Tree Pipit <i>Anthus trivialis</i>			
Redpoll <i>Carduelis flammea</i>	–	=	– in the Netherlands this species used to be confined to birch and coniferous forests in the dunes, but recently it dispersed landward and therefore is less vulnerable now

suffer from aridification, but most have alternative similar habitats not in the dunes.

Some species (Kentish Plover and Wheatear) may benefit from aridification.

Three or four species (Curlew, Whinchat, Stonechat and Red-backed Shrike) may lose a major part of their breeding population in the Netherlands, when circumstances in the dunes deteriorate.

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