Beached Bird Surveys in Portugal 1991/92 and relationship between weather and density of corpses

Stookolieslachtoffertellingen in Portugal 1991/92 en de relatie tussen weersfactoren en dichtheid van kadavers

José Pedro Granadeiro & Mário Alexandre Silva,
Serviço Nacional de Parques, Lisboa

Introduction

Following previous work on the Portuguese coast (Teixeira 1986a, Granadeiro & Silva 1992 and references therein), beached bird surveys (BBS) were conducted in 1991/92 on 41 stretches of sandy beaches (*ca.* 50 km/month), between Nazaré on the west coast and Portimão in the Algarve. Three sectors were defined in the study area (see map in Granadeiro & Silva 1992) and all the beaches were allocated to a sector according to their location. The three regions showed consistent differences in the density of seabird corpses found during both the 1990/91 and 1991/92 surveys. Similar differences have been described by Teixeira (1986a) for previous surveys. In order to analyse these differences we tested, for each month, the relationship between the number of seabirds found on the beaches and three weather factors: wind frequency, wind speed and sea condition. This paper presents the results of the BBS 1991/92 and, together with the data from 1990/91 surveys, also aims to relate the density of corpses on each stretch with the local weather conditions prevailing during each month. No stormy weather occurred during either of the study periods, and it is therefore suggested that these variables did not directly affect seabird mortality but may have acted as important drifting factors, determining the geographical distribution of the corpses.

SULA 7(1): 1-8 (1993)

Methods

BBS were conducted on the Portuguese coast in winter 1991/92 using standard methods described elsewhere (Granadeiro & Silva 1992). To analyse the geographical distribution of corpses in each month of the 1990/91 and 1991/92 surveys, we tested the relationship between the stretch density and the corresponding local weather factors. Year-to-year differences in corpse densities were also analysed, using the relative variation of the three weather variables, for each month. Meteorological data were obtained from the Instituto Nacional de Meteorologia e Geofísica (INMG). Wind speed and frequency were measured at three meteorological stations on the west coast and one on the south coast. For each stretch, the monthly frequency of onshore winds was defined as the number of days during which the wind was blowing from three (of eight possible) directions facing that particular stretch. The same procedure was used to compute the average monthly wind speed for each beach. For the sea condition we used data from the computer model MAR 211 (Pires & Rodrigues 1988) running in the INMG. This model computes daily sea disturbance characters based on a time-series of surface wind fields, obtained from the European Centre for Medium Term Weather Forecasting, covering a wide area of the North Atlantic, from the Arctic down to 20°N. Sea condition index was defined as the monthly average of the power density of sea disturbance (expressed as kW/m) obtained from this model. Five meteorological stations were available, four on the west coast and one on the south coast. No data were available for beaches in sector I and these stretches were therefore not included in the analysis.

Results

BEACHED BIRD SURVEYS IN 1991/92 Between October 1991 and March 1992, 144 seabird corpses were found and 308.3 km investigated, resulting in an average density of 0.47/km for the whole period (table 1). The highest densities were recorded in December (0.82/km), thereafter decreasing markedly. Gannets *Sula bassana*, Razorbills *Alca torda* (all first year birds), Lesser Black-backed Gulls *Larus fuscus* and first year Yellow-legged/Lesser Black-backed Gulls *L. cachinnans/fuscus* were the most abundant species, accounting for *ca.* 74% of all corpses found (n = 144). No other species exceeded 10% of the total number of seabirds found (table 1). Highest densities were found on sector I (1.08/km), where *ca.* 64% of all seabirds were found. Much lower densities were recorded on sector II and sector III (0.23/km and

Table 1. Results of the Portuguese Beached Bird Survey 1991/92.
Tabel 1. Resultaten van de olieslachtoffertelling in Portugal, seizoen 1991/92.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Σ	%
Gavia immer	-	-	1	-	-	-	1	0.7
Fulmarus glacialis	1	-	-	-	-	-	1	0.7
Puffinus puffinus	-	1	-	-	-	-	1	0.7
Oceanodroma leucorhoa	-	-	1	-	-	-	1	0.7
Sula bassana	15	4	11	1	1	2	34	23.6
Melanitta nigra	-	2	-	-	-	2	4	2.8
Catharacta skua	-	1	1	-	-	-	2	1.4
Larus ridibundus	1	-	-	1	1	2	5	3.5
Larus melanocephalus	-	-	1	-	-	-	1	0.7
Larus cachinnans	2	2	-	1	8	-	13	9.0
Larus fuscus	1	8	3	3	4	4	23	16.0
Larus cachinnans/fuscus	2	3	5	1	3	4	18	12.5
Larus spp.	-	-	1	-	1	-	2	1.4
Alca torda	1	2	21	7	1	-	32	22.2
Uria aalge	-	-	1	-	-	2	3	2.1
Fratercula arctica	-	1	-	-	-	2	3	2.1
Total	23	24	46	14	19	18	144	
%	16.0	16.7	31.9	9.7	13.2	12.5		
km	37.0	46.9	56.0	43.3	64.4	60.7	308.3	
n/km	0.62	0.51	0.82	0.32	0.29	0.30	0.47	

0.24/km respectively, table 2), a similar pattern to that recorded in 1990/91 (Granadeiro & Silva 1992).

WIND Correlations between stretch densities and both onshore wind frequency and wind speed were computed for each month of the 1990/91 and 1991/92 surveys. No significant values were obtained for onshore wind frequency against stretch density (table 3), indicating a lack of association between these two variables. On the other hand, the onshore wind speed showed significant results in some months (table 3) and values rather close to statistical significance in others (Feb 1990/91, Nov 1991/92). The differences between the sector densities obtained in 1990/91 and 1991/92 (which were expressed as percentages of 1990/91 values) were not correlated with the corresponding percentage variation of wind frequency and of wind speed (Spearman rank correlation, $r_s = 0.178$ and $r_s = -0.464$ respectively, both df = 7, $p > 0.05$).

SEA CONDITION Within each year, the four west coast stations (C. Roca, C. Espichel, Sines and Sagres; figure 1) showed a rather uniform pattern of sea

Table 2. Geographical distribution of seabird corpses on the Portuguese coast in October 1991-March 1992.
Tabel 2. Verdeling van de vondsten van dode zeevogels over drie verschillende sectoren aan de Portugese kust tussen oktober 1991 en maart 1992.

Species	Sector I	Sector II	Sector III	Σ	%
Gavia immer	1	-	-	1	0.7
Fulmarus glacialis	1	-	-	1	0.7
Puffinus puffinus	1	-	-	1	0.7
Oceanodroma leucorhoa	1	-	-	1	0.7
Sula bassana	21	4	9	34	23.6
Melanitta nigra	2	1	1	4	2.8
Catharacta skua	-	-	2	2	1.4
Larus ridibundus	-	3	2	5	3.5
Larus melanocephalus	-	-	1	1	0.7
Larus cachinnans	11	2	-	13	9.0
Larus fuscus	5	14	4	23	16.0
L. cachinnans/fuscus	12	4	2	18	12.5
Larus spp.	1	-	1	2	1.4
Alca torda	32	-	-	32	22.2
Uria aalge	3	-	-	3	2.1
Fratercula arctica	1	1	1	3	2.1
Σ	92	29	23	144	
%	63.9	20.1	16.0		
km	85.0	126.7	96.6	308.3	
n/km	1.08	0.23	0.24	0.47	

condition, with high values throughout the study period. On the south coast, Lagos station showed much lower values for this variable, reflecting a more sheltered position with respect to the dominant N and NW winds of the west coast. From October to December, both years showed a similar increase in the sea condition index (figure 1). However, in January-March the index showed an inverse variation, resulting in two maximum values in 1990/91 (Jan, Mar) and just one in 1991/92 (Feb). Table 3 shows the correlation values obtained between stretch densities and sea condition index, calculated for each month. Small but significant correlations were found in most months, indicating that the density of seabird corpses was related to the sea condition index. The differences between the sector densities of the 1990/91 and 1991/92 surveys (expressed as percentages of 1990/91 values) showed no significant correlation with the corresponding annual variations of the sea condition index ($R_s = 0.26$, df = 18, $p > 0.05$), which indicates that the annual differences in density were not explained by variations in the sea condition.

*Table 3. Spearman rank correlations (degrees of freedom in parentheses) between density of corpses on individual stretches surveyed in 1990/91 and 1991/92 and wind frequency (WF), wind speed (WS) and sea condition index (SC). Significant values are indicated: * p < 0.05, ** p < 0.01, n.a. = meteorological data not available.*

*Tabel 3. Spearman rangcorrelaties (vrijheidsgraden tussen haakjes) tussen dichtheden op het strand in 1990/91 en 1991/92 en heersende windrichting (WF), windsnelheid (WS) en golfhoogte (SC). * p < 0.05, ** p < 0.01, n.a. = meteorologische data niet beschikbaar.*

	1990/91			1991/92		
Month	WF	WS	SC	WF	WS	SC
October	-0.138	0.495*	0.512**	-0.137	0.700**	0.518*
	(18)	(18)	(25)	(13)	(13)	(19)
November	0.225	0.460*	0.460*	0.325	0.525	0.445*
	(19)	(19)	(19)	(14)	(14)	(20)
December	-0.042	0.089	0.400*	0.225	0.147	0.409*
	(19)	(19)	(26)	(21)	(21)	(27)
January	0.033	0.162	0.092	0.048	0.247	0.461*
	(19)	(19)	(26)	(15)	(15)	(22)
February	0.279	0.444	0.449*	n.a.	n.a.	0.205
	(18)	(18)	(25)			(26)
March	-0.198	0.381	0.110	n.a.	n.a.	0.001
	(17)	(17)	(26)			(25)

Discussion

The results of the Beached Bird Surveys in 1991/92 showed that the geographical distribution of the mortality was very similar to that recorded in the 1990/91 survey (Granadeiro & Silva 1992), with most strandings occurring in sector I, in the northern part of the study area. As in 1990/91, sector II and sector III showed much lower density values, with no important differences between them. However, the overall densities decreased markedly in relation to the last survey, being about half the values obtained on that occasion (0.47/km in 1991/92 *vs.* 0.96/km in 1990/91). All species were found in much lower numbers except Lesser Black-backed Gull, which increased slightly. As in 1990/91, the number of Razorbills found near the Tagus estuary (sector II) were much lower than those reported previously by Teixeira (1985, 1986b), suggesting that mortality caused by entanglement in gillnets has decreased markedly. No oiling incidents were detected in 1991/92. Less than 5% of the birds were oiled and some of them were probably contaminated after death by oil on the beach or at sea. The low proportion of oiled

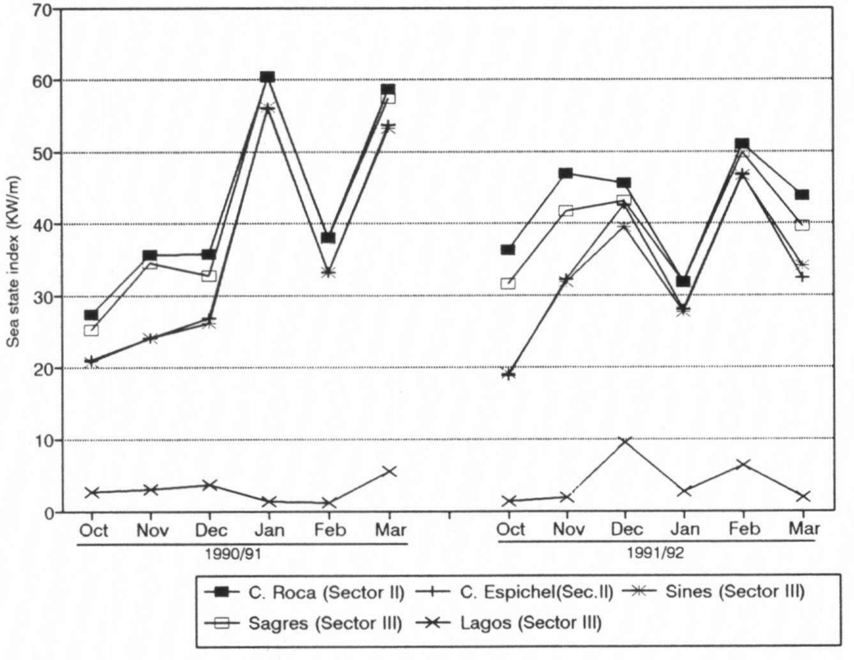

Figure 1. Variation of the average sea condition index at five meteorological stations on the Portuguese coast, recorded during Oct-Mar 1990/91 and 1991/92.
Figuur 1. Variatie in de toestand van het zee-oppervlak bij vijf meteorologische stations aan de Portugese kust tijdens de tellingen, okt-mrt 1990/91 en 1991/92.

birds in different surveys (*e.g.* Teixeira 1986a, Granadeiro & Silva 1992) suggests that so far this is not a major threat to seabirds in Portuguese waters, contrary to what has been demonstrated in northern European countries (*e.g.* Camphuysen 1989, Skov *et al.* 1989).

Weather is often referred to as a cause of seabird mortality either through direct action upon their energetic balance or by affecting the distribution and/or availability of their prey (Elkins 1988, Camphuysen 1989). Moreover, some factors can affect the probability of seabird detection on coastal surveys, since they can act upon the direction and speed of the drifting corpses. Although onshore wind frequency is usually described as a major factor acting on the drifting pattern of corpses (Jones 1969, Bibby 1981, Underwood & Stowe 1984, Camphuysen 1989), in the present study it did not correlate with the densities found on the beaches. In fact, no significant relationship was found between the number of days of onshore wind and the density of seabird corpses in each month. On the other hand, the speed of onshore winds showed a significant correlation with the stretch densities in some months (table 3). The range of wind speed values recorded during both 1990/91 and 1991/92 indicates that most probably this factor was not the direct cause of mortality. These results suggest that wind speed can act as an important drifting factor, decreasing the time between birds' deaths and the strandings, and thus reducing the possibilities of corpse predation, sinking and/or disintegration. The sea condition index showed significant correlations with the stretch densities in most months. Again, this factor was probably not the cause of the seabirds' deaths. However, the computer model defines the directional characters of sea disturbance, which are currently used to estimate the solid transportation patterns along the Portuguese coast (Pires & Rodrigues 1988). Therefore, sea condition may be a good predictor of the drifting patterns of seabird corpses and it should be considered if a predictive model for seabird mortality (taken as the density of corpses found on the coast) is to be constructed. No correlation was found between annual variation of wind frequency, wind speed and sea condition and the corresponding year-to-year variations in the number of corpses found on the beaches. This fact emphasises that the temporal differences in the density of corpses found during BBS (either month by month or year by year) are not likely to depend on the variables analysed in this paper, and are probably much more dependent on the number and condition of the seabirds wintering off the coast.

Acknowledgements

Thanks are due to H. Rosa (Faculdade de Ciências de Lisboa) for helpful advice and to the Instituto Nacional de Meteorologia e Geofísica for providing the meteorological data. Drs. A.M. Teixeira, C.C. Moore and M. Armelin gave useful suggestions on early drafts of this paper. We also thank the participants in the fieldwork, especially Raúl Serra Guedes, Martim Mello, Alexandre Vaz and the members of the BBS team of QUERCUS association in Lisbon.

Samenvatting

De samengevatte resultaten van de Beached Bird Surveys in Portugal in 1991/92 laten zien dat, hoewel de totale hoeveelheid gevonden zeevogels gehalveerd was ten opzichte van het voorafgaande jaar, de hoogste dichtheden aan kadavers net als toen in het noorden van het land werden vastgesteld. In dit artikel wordt vervolgens een poging gedaan om deze geografische dichtheidsverschillen te correleren met

weersomstandigheden en met een index van zeeconditie. Er kwam uit dat de frequentie van aanlandige wind niet positief gecorreleerd was met de dichtheid aan dode vogels. Wel blijkt de windsnelheid van de aanlandige wind een positieve invloed te hebben op het aantal aanspoelende vogels. Omdat in geen van de beschouwde tijdsperioden sprake was van extreme stormen, wordt het onwaarschijnlijk geacht dat deze positieve correlatie verband houdt met een vanwege harde wind opgetreden verhoogde sterfte, doch wordt gesuggereerd dat hogere windsnelheden kadavers sneller naar de kust voeren. Ook de waarneming dat bij ruwere zee de dichtheden aan dode zeevogels op de kust een lichte toename vertonen is consistent met deze interpretatie.

References

Bibby C. 1981. An experiment on the recovery of dead birds from the North Sea. Orn. Scand. 12: 261-265.

Camphuysen C.J. 1989. Beached Bird Surveys in the Netherlands 1915-1988; Seabird mortality in the southern North Sea since the early days of oil pollution. (Techn. Rapport Vogelbescherming 1), Werkgroep Noordzee, Amsterdam.

Elkins N. 1988. Weather and bird behaviour. Poyser, Calton.

Granadeiro J.P. & Silva M.A. 1992. Beached Bird Surveys in Portugal 1990/91. Sula 6: 22-27.

Jones P.H. 1969. Tideline bird corpses on two Merioneth beaches. Seabird Report 10: 13-21.

Pires H.O. & Rodrigues A. 1988. Modelo de Agitação Marítima - MAR211. Instituto Nacional de Meteorologia e Geofísica.

Skov H., Danielsen F. & Durinck J. 1989. Dead seabirds along the European coasts, 1987 and 1988. Results of the International Beached Bird Survey. Sula 3: 9-19.

Teixeira A.M. 1985. More auk deaths in Iberian nets. BTO News 138: 1.

Teixeira A.M. 1986a. Winter mortality of seabirds on the Portuguese coast. In: MEDMARAVIS & Monbailliu X. (eds.). Mediterranean Marine Avifauna. NATO ASI Series (Ser. G. Vol. 12), Springer, Berlin, pp. 409-419.

Teixeira A.M. 1986b. Razorbill *Alca torda* losses in Portuguese nets. Seabird 9: 11-14.

Underwood L.A. & Stowe T.J. 1984. Massive wreck of seabirds in eastern Britain, 1983. Bird Study 31: 79-88.

José Pedro Granadeiro & Mário Alexandre Silva, Serviço Nacional de Parques, Reservas e Conservação da Natureza, Rua Filipe Folque 46, 3° 1000 Lisboa, Portugal