Rob Dekker, Institute for Sea Research, Den Burg, NL

Food Situation for Common Eiders in the Western Dutch Wadden Sea in 1999-2000 Estimated on Long-term Macrobenthos Monitoring Data

Introduction

In the winter of 1999/2000, mass-mortality of Common Eiders *Somateria mollissima* was observed in the Dutch Wadden Sea. A number of eiders that died during this mass-mortality was dissected. All of them that were severely emaciated and a large number were (94%) infected with the acanthocephalan parasite *Profilicollis botulus* (Camphuysen, 2000). The Shore Crab *Carcinus maenas* is known as the intermediate host to *P. botulus*. Infection with *P. botulus* points to feeding upon Shore Crabs. The severe emaciation is generally thought to be the final cause of death. The cause of this emaciation may be food shortage, high *P. botulus* infection rate, or both. The primary food for eiders in the Wadden Sea is bivalves: Blue Mussel *Mytilus edulis* and Common Cockle *Cerastoderma edule*. During the mass-mortality incident, relatively high numbers of eiders were concentrated along the shores of the Wadden Sea, feeding upon Shore Crabs, which is supposed to be a less preferred alternative prey. Long-term monitoring programs on macrozoobenthos in the Wadden Sea may provide answers to the question whether shortage in shellfish stocks, or abundance of Shore Crabs have attributed to the mass-mortality.

Figure 1: Map of the western Dutch Wadden Sea indicating Balgzand (A) and Piet Scheveplaat (B). The location of the subtidal transects are indicated by solid dots.

Since the 1970s, macrozoobenthos have been monitored at several intertidal areas in the Dutch Wadden Sea. Moreover, from 1989 onwards, three transects in the extensive subtidal area of the central western Dutch Wadden Sea have also been monitored. For the purpose analyzing the mass-mortality of eiders, macrozoobenthos data sets from Balgzand near Den Helder, Piet Scheveplaat south of Ameland, and from the subtidal western Dutch Wadden Sea (Fig. 1), monitored by the Netherlands Institute for Sea Research (NIOZ) are analyzed for shellfish data. Since 1966, Shore Crabs have been caught using a kom-fyke as by-catch, in a monitoring program carried out by NIOZ on migrating fish at the southern tip of Texel (Van der Veer et al., 1992).

Methods

Macrozoobenthos is sampled biannually in all areas: in late winter (February-March) and late summer (August-September). 15 transects and fixed stations at Balgzand and three stations at both Piet Scheveplaat and in the subtidal Wadden Sea are sampled. Beukema (1988) and Dekker & De Bruin (2000) give details on locations and sampling procedures. In respect to shellfish fisheries, both Balgzand and Piet Scheveplaat belong to the five areas that form a no-take zone, which has covered a total of 26% of the intertidal Dutch Wadden Sea since 1993. The subtidal transects are located in the area that is open to shellfish fisheries. The quality of the shellfish (body mass index, BMI) is expressed as the individual weight of the soft parts (in g ashfree dry-mass) divided by the third power of the shell length (BMI in 10^{6*} g mm^{-3}). Daily kom-fyke catches of adult Shore Crabs at the southern tip of Texel were averaged over the 1 September - 15 November period between 1989-1998.

Results

Cockles. The biomass of cockles in all three areas shows considerable variation during the last decade (Fig. 2). Moreover, there is a strong seasonal varia-

tion in biomass. Values are higher in summer as a result of growth and recruitment, while values are lower in winter due to mortality and weight loss caused by food shortage. In particular since 1996, biomass of cockles at Balgzand and Piet Scheveplaat have shown a parallel development. Compared to previous years, mean cockle biomass in both intertidal Balgzand and Piet Scheveplaat was not very low in summer 1999 and the following winter 2000. In summer and winter 1999/2000, the cockle biomass values in the subtidal transects were not exceptionally low. Comparable low values were observed in 1989/1990, 1990/1991 and 1994/1995 (Fig. 2B). Since winter 1999, the low values for cockle biomass in the subtidal transects have been caused by the fishing of most of the dense beds of cockles in large parts of the subtidal areas in the western Dutch Wadden Sea in autumn 1998, in combination with poor recruitment in 1998 and 1999 (Dekker & De Bruin, 2000).

The body mass index (BMI) of adult cockles in 1999/2000 was near the previous decade's average in both intertidal areas, but by far the lowest in the subtidal transects in both the summer and the following winter of the same period, (Table 1).

Mussels. The long-term programs on macrozoobenthos involving the sampling of only a few m^2 of sediment surface per investigation, are not suitable to monitor Blue Mussels, which live clustered in mussel beds. Data on Blue Mussel stocks based on the monitoring programs is therefore not presented.

The quality of both adult and juvenile mussels (BMI) in 1999/2000, in all three areas studied, was within the range of the values found in the preceding decade. The relative quality of the mussels in the subtidal area was lower than in the intertidal areas in 1999/2000 (Table 1).

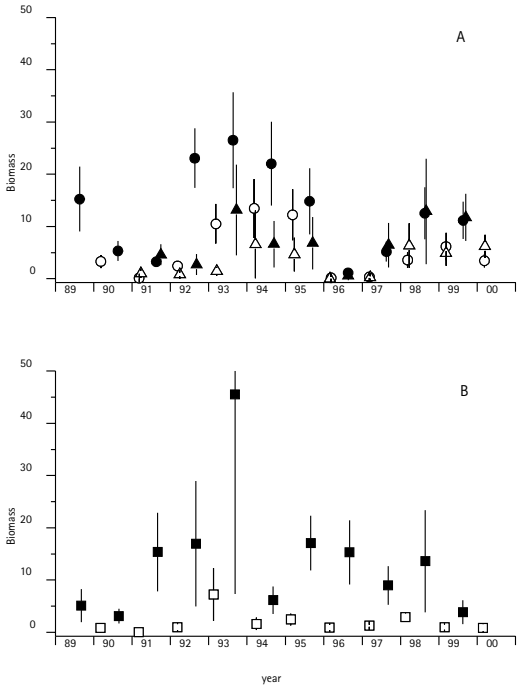

Figure 2: Biomass (g m^{-2} ashfree drymass) ± SE of cockles in August-September (solid symbols) and February-March (open symbols) 1989-2000. A: intertidal areas at Balgzand (circles) and Piet Scheveplaat (triangles), B: subtidal transects in the western Dutch Wadden Sea.

Shore Crabs. Daily adult Shore Crab catches during autumn at Texel showed relatively low values in the period from 1990 to 1996. Catches were high between 1997 and 1998. The daily catches in autumn 1999 were near the mean of the catches in the autumn period in the previous decade (Table 2) In 2000, adult Shore Crabs observed in late winter in the transects in the subtidal of the western Dutch Wadden Sea showed relatively high densities compared to earlier years. The densities of adult Shore Crabs in 1999/2000 in the western Dutch Wadden Sea were probably moderately high compared to previous years when these two data sets are combined

	intertidal		subtidal
	Balgzand	Piet Scheveplaat	west. Wadden Sea
Common Cockle			
1999/2000	12.2	10.7	9.2
mean 1989/1999	11.7	12.2	11.1
min.-max. 1989/1999	9.8-13.7	9.3-15.0	9.5-12.3
Blue Mussel adult			
1999/2000	5.7	no data	4.4
mean 1989/1999	5.9	no data	5.1
min.-max. 1989/1999	4.7-7.0	no data	4.3-5.8
Blue Mussel juvenile			
1999/2000	4.3	4.2	no data
mean 1989/1999	4.2	4.5	3.7
min.-max. 1989/1999	3.5-5.4	4.0-5.0	3.0-5.5

Table 1: Quality of cockles and adult and juvenile Blue Mussels, expressed as body mass index (BMI in 10^{6}*g mm^{-3}, mean of the summer and following winter values), in two intertidal areas (Balgzand and Piet Scheveplaat) and in the subtidal of the western Dutch Wadden Sea.

Table 2: Adult Shore Crabs (>20 mm carapace width) in the western Wadden Sea in the period 1989–2000. Mean daily catch numbers in the kom-fyke at the southern tip of Texel in the period 1 September – 15 November, and mean densities found at the three subtidal macrozoobenthos transects in late winter (February-March).

Period	Daily catch (n) kom-fyke Texel	Density (n m^{-2}) subtidal transects
1989/1990	103	0.0
1990/1991	81	0.4
1991/1992	91	1.5
1992/1993	85	0.4
1993/1994	68	0.0
1994/1995	162	0.0
1995/1996	101	0.0
1996/1997	64	0.4
1997/1998	282	0.4
1998/1999	445	0.0
1999/2000	147	0.7
mean 1989/1999	148	0.3

Conclusions

The size and the quality of the cockle stock in unfished intertidal areas (Balgzand and Piet Scheveplaat) were not very low in 1999/2000, compared to the previous decade. Both size and quality of the cockle stock was low in the subtidal western Dutch Wadden Sea. For the amount of mussels present, it is impossible to carry out proper assessments based on the long-term data series. The quality of the mussels in the intertidal area was average and quite low in the subtidal area.

The mass-mortality of eiders in 1999/2000 due to emaciation in the Dutch Wadden Sea, and the shift in prey selection by many surviving eiders to less-preferred food items, strongly points to the scarcity of those preferred prey items which could be utilized in an energetically profitable way. As most of the dissected dead eiders were infected with *Profilicollis botulus*, most dead eiders had eaten crabs before dying. This can mean two things: 1) Shore Crabs were insufficient in density and availability to contribute significantly to the energy demands of the eiders, or 2) the parasites originating from the Shore Crabs increased the energy demand of the eiders and thus contributed to the emaciation. These two possible causes cannot be separated, but are of secondary importance. Of primary importance remains the obvious lack of profitable first-choice food, as the eiders were forced to shift to less preferred food items.

The subtidal areas are optimal foraging grounds for eiders, given that there is enough food in high densities. Eiders collect their food by diving, meaning they can forage 24 hours per day in these shallow subtidal areas, in contrast to intertidal areas, where feeding must be interrupted while the tidal flat is underwater. A removal of the best prey in terms of availability, combined with uncertain mussel stocks, may have created severe problems for the eiders in the Dutch Wadden Sea, during the winter of 1999/2000.

References

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Rob Dekker
Netherlands Institute for Sea Research (NIOZ)
P.O. Box 59
1790 AB Den Burg Texel
The Netherlands
rdekker@nioz.nl