THE FEEDING ECOLOGY OF WINTERING EIDERS *SOMATERIA MOLLISSIMA* AND COMMON SCOTERS *MELANITTA NIGRA* ON THE BALTIC SEA COAST OF SCHLESWIG-HOLSTEIN, FRG

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The Common Eider *Somateria mollissima* and the Common Scoter *Melanitta nigra* are the most abundant waterfowl species wintering in the Baltic Sea of Schleswig-Holstein. Their numbers have been estimated by regular aerial counts to be approximately 100 000 and 30 000 birds respectively (Brager & Nehls 1987). From October until March large flocks of both species have been observed mainly in areas of shallow water. It has been proposed that their geographical distribution in the Kiel Bay primarily depends on the depth of water and the zonation of the macrofauna (Kirchhoff 1981). The aim of this study is to compare the feeding habits of these two seaducks in a larger area and to show the differences.

In the two relatively warm winters of 1987/88 and 1988/89 we dissected 175 Scoters and 145 Eiders which were accidentally entangled and drowned in fishing nets. The samples were taken from widespread locations in the Kiel Bay, which are between 6 and 22 metres deep. Both species can be observed together all over the area although in differing proportions. Age and sex of the birds were determined in the laboratory, and the content of the oesophagus was preserved in formalin for later analysis. The content of the gizzards was often fragmentary and difficult to quantify and was therefore excluded from the study. Because of the very short passage time of food items (Swennen 1976) we assumed that the contents of the oesophagus originated from the location where the birds were caught.

Figure 1 shows the diet of all Scoters and Eiders caught in the Kiel Bay expressed as percentage of wet weight. A total of 984 food items from 157 Scoters and 2 108 food items from 143 Eiders were differentiated and weighed with an electronic balance.

The comparison of the two diets shows evident differences in quality and quantity. With the exception of some *Asterias* and very few polycheates and crustaceans the diets of both seaducks consists of molluscs. The large proportions of *Cerastoderma* in Scoters and *Mytilus* in Eiders are the major difference in their composition of food. *Mya arenaria* is quite an important prey item for both species. The importance of *Arctica islandica* has so far been underestimated, since the significance of deep-water-areas as feeding grounds was not appreciated.

We divided the ducks into groups according to the different depths of water in which they were caught. The two depths of water categories correspond to different benthic communities as described in the thorough studies of the Institute of Marine Research in Kiel (Arntz 1971, Weigelt 1987, Brey 1989).

In shallow waters (6-10 m) which are of major importance to the ducks (Brager and Nehls 1987), the two species clearly take different prey species (Figure 2). The proportions of *Cerastoderma* in the Scoter and of *Mytilus* in the Eider become even more prominent. Young Eiders consume also quite a large proportion of *Asterias rubens*. In general the diet of the Eider is more diverse.

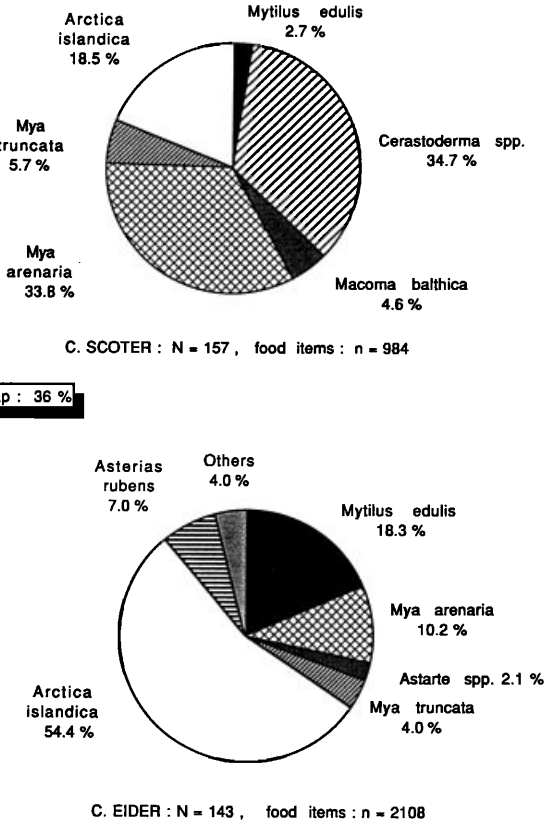

Figure 1. The diet of Common Scoter and Common Eider in the Kiel Bay expressed as percentage of wet weight.

In deeper waters (18-22 m) both seaducks mainly feed on two species of bivalves (Figure 3), due to a smaller diversity of molluscs in the benthos. *Arctica islandica* is of eminent importance. The proportions of *Mya truncata* are remarkable too, since this species usually lives rather deep in the sediment. The small *Abra alba* which is also very common in deep waters is hardly used by the birds.

We got the impression that the food items consumed by the Eiders were on average bigger than those eaten by the Scoter. To test this hypothesis we measured the maximum length of each single bivalve. For the most important species of prey the measurements have been grouped in classes according to size and are shown as relative frequency distributions for both ducks (Figure 4).

The calculated means support the hypothesis: the average *Arctica islandica* taken by the Eider was one-and-a-half times as big as that eaten by the Scoter. In spite of this, the maximum frequencies for both seaducks occur in

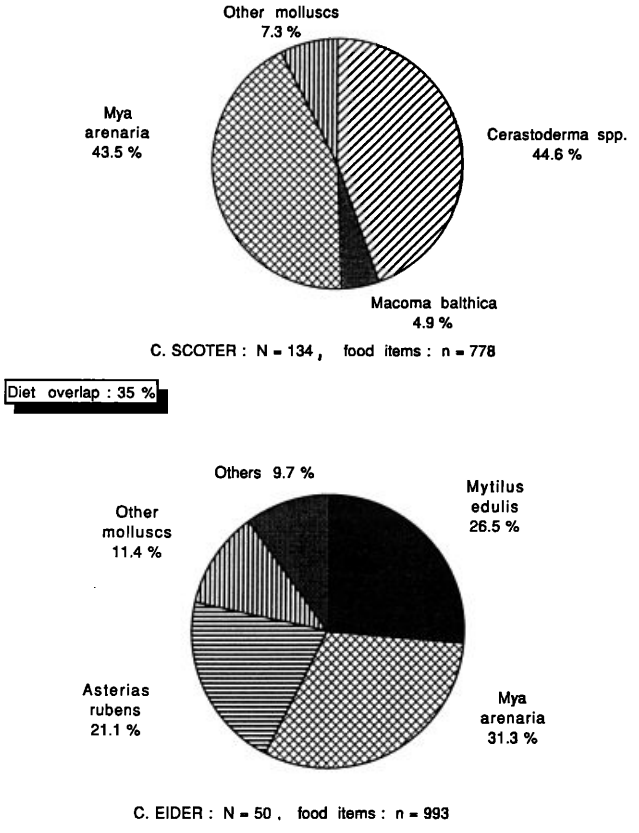

Figure 2. The diet of Common Scoter and Common Eider in 6-10 m water depth expressed as percentage of wet weight.

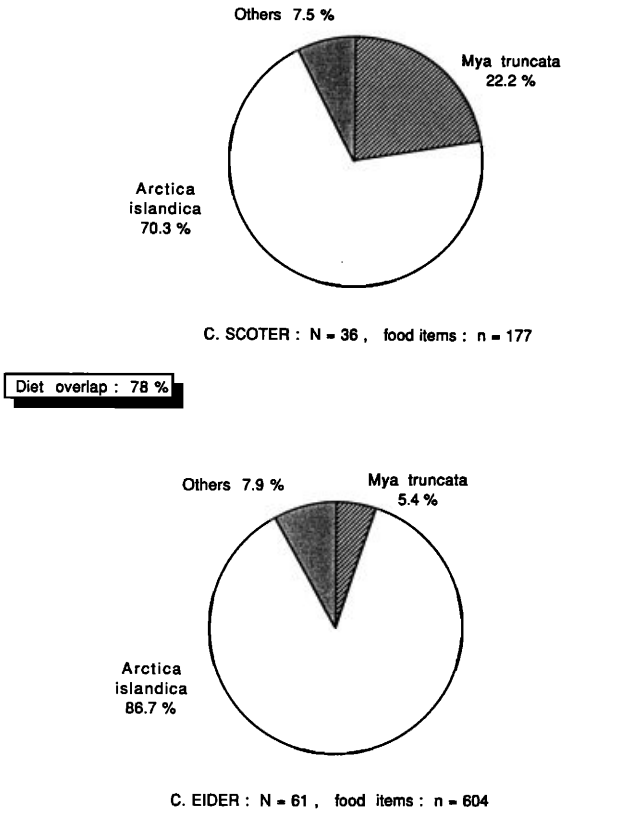

Figure 3. The diet of Common Scoter and Common Eider in 18-22 m water depth expressed as percentage of wet weight.

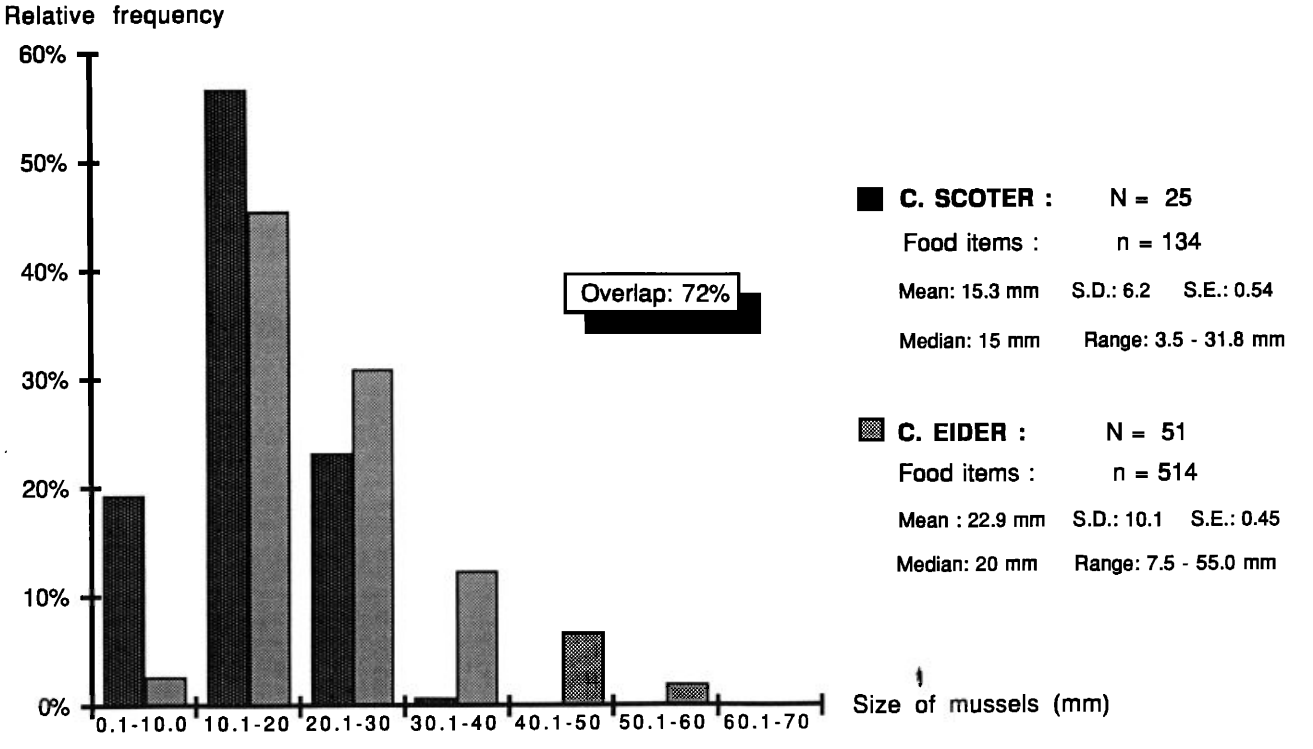

Figure 4. Consumption of *Arctica islandica* by Common Scoters and Common Eiders.

Table 1. Inter- and intra-specific diet overlap of Common Eiders and Common Scoters.

Depth of water	Species Eider / Scoter	C. Eider immature / adult	C. Eider ♂ / ♀	C. Scoter immature / adult	C. Scoter ♂ / ♀
6 - 10 m	35% N = 50/134	42% N = 35/15	74% N = 30/20	82% N =26/78	61% N = 70/34
18 - 22 m	78% N = 61/36	- N = 2/59	93% N = 33/28	93% N = 25/10	92% N = 13/22

the same size class. The differences are caused by the skewed distributions and the few very big bivalves consumed by Eiders. Due to morphological differences the Eider can take a much wider size range of food items but apart from this in deep water no selection for size could be detected.

The frequency of occurrence of a certain food item in the oesophagus depends on its abundance on the sea-bottom. Although from the energetic point of view it might be more effective to consume big molluscs, it does not make much sense for the Eider to avoid the smaller ones.

Wintering seaducks could choose different feeding grounds, which would lead to a geographical segregation. In the Kiel Bay the two duck species occur in the same places and feed in the same depths of water. It is interesting, therefore, to compare the overlap in the diets of the two species (Bustnes & Erikstad 1988). An index for the diet overlap was calculated using the following formula (Colwell and Futuyma 1971):

$$D_o = 1 - 0.5 \sum_{i=1}^{n} | P_{E_i} - P_{S_i} |$$

where "n" represents the number of food species, "P_E" the proportion of food species eaten by Eiders, and "P_S" the proportion of food species eaten by Scoters.

Table 1 shows all inter- and intraspecific diet overlaps in detail. In general the diet overlaps are large in deep waters (Figure 3). Only for immature and adult Eiders does there seem to be no overlap at all, but this is because young Eiders are not present in deep waters in any significant numbers. In shallow waters the two age groups of the Eider mainly feed on different prey species and, as we expected there is a high overlap between sexes. Within the Scoter there seem to be no intraspecific differences either in shallow or in deep waters.

In shallow waters the two duck species choose different prey species (Figure 2). Adult Eiders mainly feeding on the beds of *Mytilus* banks and on some *Mya arenaria*, while young Eiders feed on *Mya arenaria*, *Asterias rubens* and on very small epiphytic *Mytilus*. All Scoters regardless of sex and age feed on *Cerastoderma*, *Mya arenaria* and a very few *Macoma*. In deep water all ducks with the exception of young Eiders are present and feed on almost the same prey in terms of species and size (Figures 3 & 4).

In very cold winters the situation may change because then the shallow coastal waters can be covered by ice and food resources may run short. Then deep offshore waters may become even more important for all seaducks.

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