The diets of sympatric wintering populations of Common Eider *Somateria mollissima* and King Eider *S. spectabilis* in Northern Norway

Jan Ove Bustnes & Kjell Einar Erikstad

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A total of 2534 food items of 42 species (exclusive eggs of fish) were identified in the diet of Common Eiders *Somateria mollissima* (1650 items of 34 species) and King Eiders *S. spectabilis* (884 items of 35 species) from Troms in northern Norway in April/May. Both species had been feeding on much the same prey species but in quite different proportions. The diet of Common Eiders was dominated by *Mytilus edulis* (46.3% wet wt.), eggs of *Cyclopterus lumpus* (25.9%) and other molluscs, *Modiolus modiolus* (7.3%), *Modiolaria discors* (2.1%) and *Arctica islandica* (2.8%). King Eiders feed mainly on echinoderms, *Ophiopholis aculeata* (27.1%), *Strongylocentrotus droebachiensis* (22.7%) and *Asterias rubens* (15.1%). Other important King Eider food items were molluscs, *Modiolaria discors* (4.8%), *Modiolus modiolus* (3.6%) and *Trophonopsis clathratus* (4.3%). King Eiders had a broader diet than Common Eiders (average number of food species per individual 6.9 vs. 3.6), and the calculated diet overlap was 0.15. The differences in the diet observed is most likely a result of King Eiders feeding at greater depths than Common Eiders.

Jan Ove Bustnes & Kjell Einar Erikstad (correspondence), Zoology and Marine Biology Departments, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway.

Introduction

Common Eider *Somateria mollissima* and King Eider *S. spectabilis* are arctic and subarctic species with a great overlap in their breeding distribution. (Haftorn 1971, Cramp & Simmons 1977). During the winter both species are coastal and their feeding habitats greatly overlap. Along the north Norwegian coast, mainly from Finnmark to Lofoten ca. 100000 Common Eiders and 45000 King Eiders overwinter, and they are by far the commonest wintering ducks there (Nygård et al. in press). The King Eiders are migratory and move into the area in late November, presumably from northern Russia and Svalbard. They return north in April/May. The Common Eiders wintering in Troms are a mixture of resident birds and populations from Svalbard and northern Russia (Cramp & Simmons 1977 and own unpubl. data).

The diets of both species have been described in a large number of studies throughout most of their range (see Cramp & Simmons 1977 for a review). Adult Common Eiders feed mainly on *Mytilus edulis* for most of the year, while King Eiders probably have a more varied diet. Information on the diet of King Eiders, especially from their winter areas, is more fragmentary. However, the few studies of sympatric wintering populations have shown that their diet is quite similar (Preble & McAtee 1923, Soot-Ryen 1941, Siivonen 1941). The objective of this study was to describe their diet during April/May in an area outside Tromsø, northern Norway, where both species winter in large flocks. At this time of the year, when King Eiders and some of the Common Eiders are about to migrate to their breeding area in the north high-quality diet is important. Common Eiders (and presumably also the King Eiders) gain a lot of weight at this time, and will completely rely on their body reserves during breeding (e.g., Cantin et al. 1974).

Material and methods

82 Common Eiders (42 females and 40 males) and 44 King Eiders (33 females and 11 males) were collected in 1986–1987 from accidental fishnet catches in the Sommarøy area, about 60 km west of Tromsø, in

northern Norway (69°40'N, 18°15'E). All birds were caught between 7 April and 11 May. Birds were immediately brought ashore and their gullets and gizzards were removed and deep frozen for later analysis.

All birds which were analysed had considerable amounts of food in their gullets. The material was fresh and could be identified. The food contents in the gizzard were often fragmentary and difficult to identify and were therefore excluded from this study.

A total of 2534 food items of 42 species (excluding eggs of fish) were identified. There was 1650 items of 34 species in Common Eiders and 884 items of 35 species in King Eiders (Appendix 1) and all were weighed (wet weight) to the nearest 0.1 g.

The wet weight of the different food items was used to compare the diets of different birds and species (e.g., Soot-Ryen 1941, Goudie & Ankney 1986). This should be taken into account when comparing our data with studies where volumetric measurements were used (e.g., Siivonen 1941, Pethon 1967, Brun 1971, Cantin et al. 1974). In other studies the gizzard content is also included in the calculation, and this may influence the results as soft-bodied species are digested faster than, e.g., mussels. For example, in this study fish eggs were an important part of the diet of Common Eiders, but their remains were rarely found in the gizzard.

Diet overlap between sexes and species were calculated according to Morisita (1959), quoted by Diamond (1983):

$$C = \frac{2\sum_{i=1}^{s} X_i Y_i}{\sum_{i=1}^{s} X_i^2 + \sum_{i=1}^{s} Y_i^2}$$

where S = number of common food species and x and y = proportions of different food items eaten by different sexes or species.

12 Common Eiders and 12 King Eiders (those with the fullest gullet) were used for detailed analysis of differences in food selection of individual birds.

Results

Common and King Eiders feed on much the same food but there were large differences in the relative frequencies of each item. The main diet of the two species are summarized in Appendix 1 and Fig. 1.

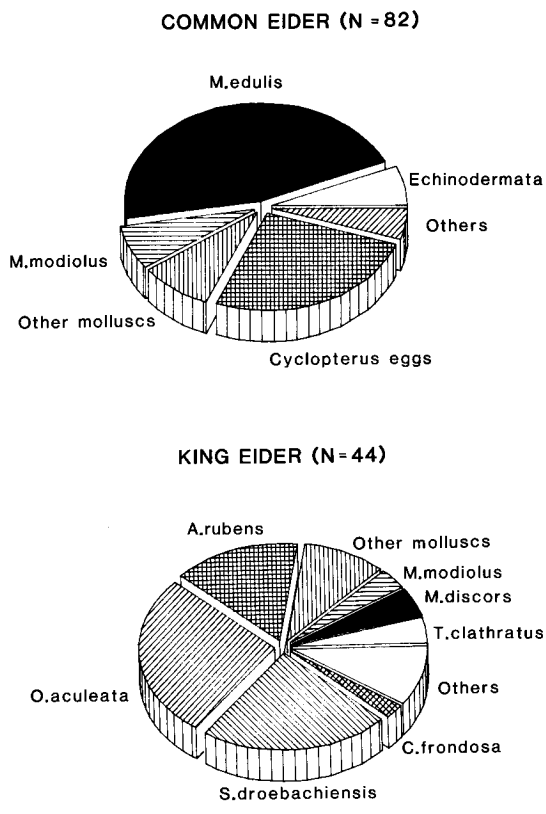

Fig. 1. The diet of Common and King Eiders in Troms, northern Norway in April/May 1986/87 expressed as % wet weight of all food samples.

The dominant food of Common Eider was *Mytilus edulis* which made up 46.3% wet weight and was eaten by 80.5% of the birds. Eggs of *Cyclopterus lumpus* were also important (25.9% wet wt.) but were taken by only 14.6% of the birds.

The diet of the King Eider was dominated by echinoderms (67.8% wet wt.), mainly *Ophiopholis aculeata* (27.1%), *Strongylocentrotus droebachiensis* (22.7%) and *Asterias rubens* (15.1%). King Eiders ate the same species of molluscs as Common Eiders but in much smaller quantities (62.3% in Common Eider vs. 22.8% in King Eider). Crustacea were eaten in small numbers by both species (Common Eider 2.9%, King Eider 3.0%), mostly *Hyas coarctatus* (Common Eider 2.5%, King Eider 1.2%). Eggs of *Cyclopterus lumpus* were less important for the King Eider than for Common Eiders (3.5% vs. 25.9%).

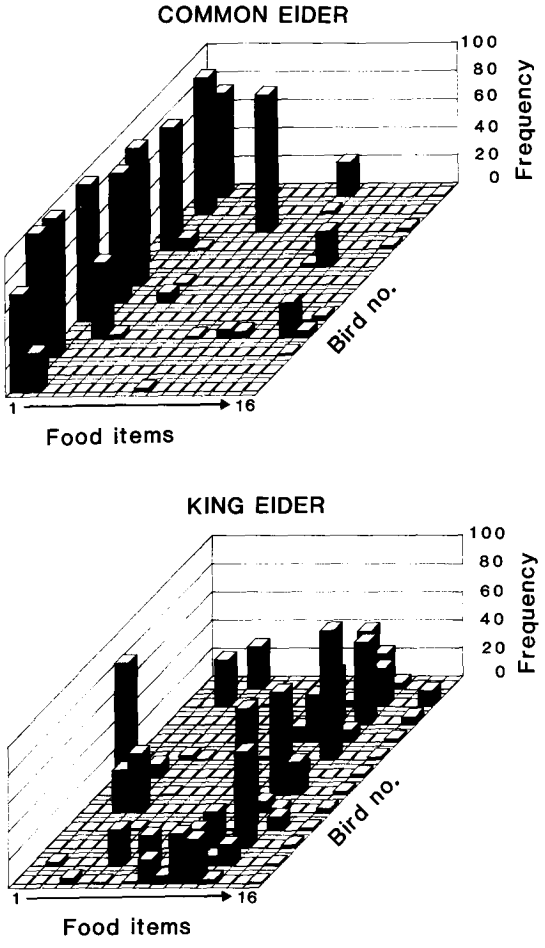

Fig. 2. The diet of 12 Common Eiders and 12 King Eiders expressed as % wet weight of different food species in each bird. Birds with the fullest crops were selected. Food items: 1 = Eggs of *C. lumpus*, 2 = *M. edulis*, 3 = *M. modiolus*, 4 = *M. discors*, 5 = *H. arctica*, 6 = *C. islandica*, 7 = *A. islandica*, 8 = *A. pilosa*, 9 = *Terebellidae spp.*, 10 = *H. coarctatus*, 11 = *A. rubens*, 12 = *O. acuelata*, 13 = *S. droebachiensis*, 14 = *C. frondosa*, 15 = *Actinaria spp.*, 16 = Others.

The calculated diet overlap between males and females of each species was large (overlap index of 0.97 in Common Eiders and 0.91 in King Eiders) but low between the two species (0.15). The diet spectrum of 12 birds of each species was much wider in King Eiders than in Common Eiders (Fig. 2). The diet of all but one of the Common Eiders was dominated either by *Mytilus edulis* or eggs of *C. lumpus*. Both items never occurred in large quantities in the same bird. The diet of King Eiders also varied from bird to bird but in most cases several food items dominated. The mean (± SD) number of prey species per bird was 3.6±2.1 in Common Eider and 6.9±3.0 in King Eider (Mann-Whitney U-test, P=0.003).

Discussion

The results in this study show both similarities with and differences from earlier descriptions of the diet of the two eider species. The dominance of *M. edulis* in the Common Eider has been described in a large number of studies from most of the distribution range: Canada (Cantin et al. 1974, Goudie & Ankney 1986), Alaska (Preble & McAtee 1923), Scotland (Dunthorn 1971, Player 1971), Norway (Soot-Ryen 1941, Pethon 1967), Denmark (Madsen 1954), Finland (Bagge et al. 1973) and NW Russia (Belopol'skii 1960). It is also evident that *M. edulis* forms the bulk of the diet during all seasons (e.g., Madsen 1954, Pethon 1967, Cantin et al. 1974), but it is probably most important in winter, spring and summer, whereas crustaceans are more common in the diet in August to October (Pethon 1967). Common Eiders are however opportunistic and their diet varies according to the availability of different prey species. Brun (1971) found that nearly 50% of the winter diet of Common Eiders in a fjord only about 50 km from this study area consisted of *Chlamys islandica* (2.3% recorded in this study).

Fish eggs have been reported in the diet of Common Eider by several authors. Gjøsæter & Sætre (1974) found Common Eider along the coast of Finnmark in northern Norway following the Barents Sea capelin on spawning migration in March/April. The five birds shot had fed exclusively on capelin eggs at a depth of 25–50 m. Further south, herring *Clupea harengus* eggs were reported by Solheim (1940) and Cantin et al. (1974), and Soot-Ryen (1941) and Madsen (1954) also mention fish eggs.

Eggs of the lumpsucker *C. lumpus* in the diet of Common Eider have not been reported before, but are apparently a locally important food in our study area during the spring. The lumpsucker is common in Norway and spawns in April/May in the shallow sublittoral zone along the outer coast (Pethon 1985). Most birds analysed were caught in fishing nets used for catching spawning lumpsuckers. This have not, however, influenced the comparison of the diets between the two species as they often were caught in the same net.

The large difference between the diets of Common and King Eiders found in this study is in contrast to earlier descriptions (Preble & McAtee 1923, Soot-Ryen 1941, Siivonen 1941, Brun 1971, Gjøsæter and Sætre 1974). The results do, however, support earlier findings that King Eiders have a more varied diet than Common Eiders (see Cramp & Simmons 1977 for a review).

The high proportion of echinoderms in King Eider diet, which was the main cause of the difference between the two species in this study has not been reported before. The highest values in the literature are those of Cottam (1939: 17%) and Preble & McAtee (1923: 12%).

The food items (exclusive fish eggs) dominating the diet of both species are typical for the hard bottom fauna in the area (Gulliksen 1978, Holte & Gulliksen 1987, Jakola & Gulliksen 1987). However it is evident from this study that King Eiders feed at a greater depth than Common Eiders, which is in agreement with earlier assumptions (see Brun 1971, Gjøsæter & Sætre 1974). *M. edulis* which dominated the diet of Common Eiders do not occur below 5 m, while *S. droebachinensis,* important food for the King Eiders, live down to 20 m and is most abundant between 5–10 m (Evans et al. 1980). The high proportion of eggs of the lumpsucker in the diet of Common Eiders and also own observations of birds in feeding flocks agrees with this conclusion. Common Eiders are found in loose flocks most often in the sublittoral zone whereas King Eiders form denser flocks farther offshore.

The variations in the caloric content of molluscs and echinoderms are small (Wacasey and Atkinson 1987) and the fact that several species are easy prey for diving ducks may explain the large number of species included in the diet. The differences in the diet between single birds of both Common and King Eiders in this study and also the large differences from one area to another found in the literature is most probably a simple reflection of the local differences in the density of the food species involved.

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Selostus: **Haahkan ja kyhmyhaahkan talviravinto**

Pohjoisnorjalaisilta talvehtimisvesiltä kerättiin 1986–87 82 kalaverkkoihin kuollutta haahkaa ja 44 kyhmyhaahkaa.

Lintujen vatsasta määriteltiin 2534 ravintoeläintä. Haahkan pääravintoa olivat sinisimpukat, kyhmyhaahkan pääasiassa eri piikkinahkaislajit. Ruokavalion ero johtuu pääasiassa siitä, että kyhmyhaahka sukeltaa ravintonsa syvemmältä kuin haahka.

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Appendix. Spring diet of Common Eider *Somateria mollissima* and King Eider *Somateria spectabilis* in Troms, northern Norway, 1986/87. Asterisk = Weight less than 0.1 g or one per mille (0.1%) of the total.

	Common Eider				King Eider			
Taxon	No	Wgt	(%)	% of stomachs	No	Wgt	(%)	% of stomachs
Mollusca								
Tonicella rubra	1	0.2	(*)	1.2	2	0.4	(0.1)	4.5
Velutina velutina	3	1.2	(0.1)	3.7	2	2.1	(0.5)	4.5
Margarites groenlandicus	44	2.8	(0.3)	8.5	10	0.7	(0.2)	15.9
Margarites helicinus	1	*	(*)	1.2	–	–	–	–
Gibbula cineraria	49	6.8	(0.8)	15.9	2	0.2	(*)	4.5
Lacuna divaricata	4	0.4	(*)	3.7	1	0.1	(*)	2.3
Littorina saxatilis	12	1.2	(0.2)	3.7	4	0.8	(0.2)	9.1
Littorina obtusata	8	1.4	(0.2)	7.3	17	4.3	(1.0)	27.3
Littorina littorea	–	–	–	–	2	1.2	(0.3)	4.5
Hydrobia ulvae	2	0.1	(*)	2.4	3	0.3	(0.1)	9.1
Rissoa interrupta	1	*	(*)	1.2	–	–	–	–
Thais lapillus	2	1.1	(0.1)	2.4	1	0.1	(*)	2.3
Trophonopsis clathratus	49	6.5	(0.8)	9.8	104	19.4	(4.3)	38.6
Trophonopsis truncatus	3	0.5	(0.1)	3.7	5	0.4	(0.1)	9.1
Trichotropis borealis	–	–	–	–	2	0.2	(*)	4.5
Nassarius incrassatus	1	0.4	(*)	1.2	3	0.6	(0.1)	6.8
Buccinum spp.	–	–	–	–	2	7.3	(1.6)	4.5
Acanthodoris pilosa	–	–	–	–	31	6.7	(1.5)	4.5
Modiolaria discors	75	17.4	(2.1)	20.7	76	21.7	(4.8)	20.5
Modiolus modiolus	32	61.4	(7.3)	8.5	17	16.1	(3.6)	11.4
Mytilus edulis	1231	390.8	(46.3)	80.5	21	5.5	(1.2)	11.4
Chlamys islandica	1	2.6	(0.3)	1.2	6	129	(2.9)	13.6
Arctica islandica	2	23.6	(2.8)	1.2	–	–	–	–
Hiatella arctica	26	6.7	(0.8)	15.9	7	1.1	(0.2)	13.6
Mya truncata	1	0.9	(0.1)	1.2	–	–	–	–
Total	1548	526.0	(62.3)	92.7	318	102.1	(22.8)	86.4
Polychaeta								
Terebellidae spp.	–	0.7	(0.1)	1.2	–	13.0	(2.9)	15.9
Crustacea								
Gammarellus homari	2	0.3	(*)	1.2	2	0.5	(0.1)	4.5
Gammarus oceanicus	3	0.4	(*)	2.4	9	0.6	(0.1)	2.3
Ischyrocerus anguipes	–	–	–	–	1	(*)	(*)	2.3
Idotea baltica	2	0.3	(*)	2.4	–	–	–	–
Idotea emarginata	2	0.7	(0.1)	1.2	10	0.3	(0.1)	2.3
Hyas coarctatus	9	21.0	(2.5)	9.8	4	5.2	(1.2)	9.1
Hyas araneus	–	–	–	–	3	5.4	(1.2)	4.5
Galanthea nexa	–	–	–	–	3	1.6	(0.4)	4.5
Balanus balanoides	4	1.5	(0.2)	2.4	–	–	–	–
Total	22	24.2	(2.9)	18.3	32	13.6	(3.0)	18.2
Echinodermata								
Asterias rubens	14	7.6	(0.9)	8.5	100	67.5	(15.1)	43.2
Crossaster papposus	–	–	–	–	1	0.8	(0.2)	2.3
Ophiopholis aculeta	40	17.4	(2.1)	13.4	239	121.5	(27.1)	56.8
Ophiura spp.	2	0.2	(*)	1.2	28	1.8	(0.4)	11.4
Strongylocentrotus droebachiensis	20	30.5	(3.6)	8.5	150	101.5	(22.7)	50.0
Cucumaria frondosa	1	0.3	(*)	1.2	16	10.7	(2.4)	15.9
Total	77	56.0	(6.6)	23.2	534	303.8	(67.8)	72.7
Coelenterata								
Actiniaria spp.	3	19.2	(2.3)	2.4	–	–	–	–
Fish eggs								
Cyclopterus lumpus	–	218.6	(25.9)	14.6	–	15.6	(3.5)	2.3
Total	1650	844.0	–	–	884	448.1	–	–