

Diet of Razorbill *Alca torda* chicks on Græsholmen, central Baltic Sea

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(Med et dansk resumé: Alkeungernes føde på Græsholmen ved Christiansø)

Introduction

This paper describes the food of Razorbill *Alca torda* chicks on Græsholmen in the central Baltic Sea and concludes that sprats *Sprattus sprattus* form the main diet, although sandeels *Ammodytes* sp. in some years constitute up to 22% by number. Clupeids, mainly sprats, are the most important food in the Baltic proper (Andersson et al. 1974, this study), whereas sandeels and/or capelin *Mallotus villosus* form the staple diet in most of the Atlantic breeding range (e.g. Harris & Wanless 1986, Chapdelaine & Brosseau 1996).

Study area and methods

Græsholmen (55°19'N, 15°12'E) is a small rocky island in the Ertholmene archipelago northeast of Bornholm, Denmark, in the central Baltic Sea (Fig. 1). It holds large populations of breeding Herring Gulls *Larus argentatus*, Guillemots *Uria aalge* and Razorbills. From 1983 to 2000 the Razorbill population increased from about 280 pairs to 745, almost all breeding under boulders. The surrounding sea depths range from 20 to 120 m and the water is brackish (0.8% salinity). Due to the low salinity, only relatively few fish species occur around Ertholmene, the most numerous species being cod *Gadus morhua*, sprat, herring *Clupea harengus* (apparently mostly older ageclasses), sandeel (mostly *Ammodytes tobianus*), goby (mostly black goby *Gobius niger*) and blenny

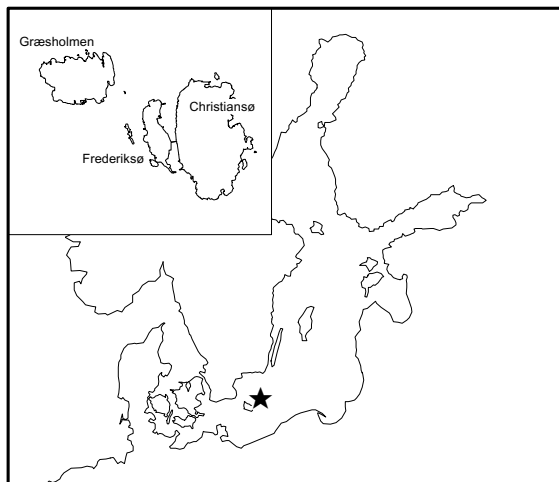
Zoarces viviparus. Occasionally, large schools of sprats surface around the archipelago in mid-June – mid-July, sometimes within a few metres of the coast. For a detailed description of Græsholmen and its birds, see Lyngs (1992).

In May – mid-August 1983-2000 I visited all Razorbill nests on Græsholmen 1-6 times annually to monitor breeding success and ring chicks. In 1985-86 and 1989-2000 food items found in the nests were identified to species. Razorbill chicks were aged from observed hatchings or by comparing the wing length (measured to the nearest mm) with that of 45 chicks of known age. Intact fresh fish were measured to the nearest mm and weighed to the nearest g. Additionally, all feedings observed during a Razorbill ring-reading programme running during 1991-2000 were recorded, noting the number and species/genus of fish delivered.

Results

A total of 228 food items, all fish, was recorded (Table 1); 145 of them were found in the nests, and of these 129 (89%) were sprats and 16 sandeels. Mean length and mass are shown in Table 2; most sprats were in the 120-140 mm length group (Fig. 2), i.e. adult fish. The median length of 20 sprats recorded in nests with chicks 0-2 days old (132 mm, range 90-150 mm, s.e. = 3.30) did not differ from that of 15 sprats found in nests with chicks 4-17

Fig.1. The geographical position of the Ert-holmene archipelago. The insert shows the main islands in the archipelago. Frederikse and Christiansø are inhabited by humans. *Ertholmenes geografiske placering.*



days old (135 mm, range 92-142 mm, s.e. = 3.40; Mann-Whitney U = 137.5, P = 0.69). The remaining 83 fish were recorded in 82 observed feedings: 74 clupeids (89%), four sandeels and five small gobies (probably black goby). Except for a load with two small gobies, all loads consisted of one fish carried crossway in the bill. In other words, 99% of the loads consisted of one fish only, and the average per load was 1.01 fish.

It is difficult visually to distinguish small herrings from sprats in the field, but all clupeids found in nests were sprats. In addition, 10 observed clupeids later identified in the hand were all sprats, so it seems likely that this was the case also with the majority, if not all, of the remaining observed clupeids. Clupeids (sprats) constituted 89%, sandeels 9% and gobies 2% by number of the 228 fish recorded. Using the mean mass obtained

Table. 1. The species and number of fish brought to Razorbill chicks on Græsholmen, 1985-2000
Art og antal af fisk registreret som fødeemner hos alkeunger på Græsholmen 1985-2000.

Year <i>År</i>	Observed <i>lagttaget</i>			Found in nest <i>Fundet i rede</i>		Total	Clupeid proportion (%) <i>Andel sildefisk</i>
	Clupeids <i>Sildefisk</i>	Sandeel <i>Tobis</i>	Goby <i>Kutling</i>	Sprat <i>Brisling</i>	Sandeel <i>Tobis</i>		
1985				10	1	11	91
1986				17	3	20	85
1989				13		13	100
1990				3		3	100
1991	1		1	19		21	90
1992	2		2	7	3	14	64
1993	1	1		6	1	9	78
1994	1			7		8	100
1995	3			10		13	100
1996	19	3		16	4	42	83
1997	8		2	5	3	18	72
1998	14			5		19	100
1999	13			6		19	100
2000	12			5	1	18	94
Total	74	4	5	129	16	228	89

for sprats (11.9 g) and sandeels (14.0 g) and a guessed mass of 7 g for gobies (based on an estimated length of 4-6 cm of the observed fish), clupeids (sprats) constituted 89%, sandeels 10% and gobies 1% by wet weight. Using the calorific content of sandeel (4.908+0.22 length (cm)) and sprat (3.215+0.63 length (cm)) presented by Harris & Hislop (1978), the mean value for sandeel becomes 8.5 kJ/g or 119 kJ per fish, while the calorific content of sprat is 11.5 kJ/g or 137 kJ per fish. If all clupeids delivered were sprats, about 92% of the total calorific content of the 223 clupeids/sandeels recorded would derive from this species.

In all years clupeids (sprats) were the most frequent food items, and in six of 14 years only clupeids were recorded (Table 1). In the seven years where both sandeels and clupeids were recorded, the proportion of sandeels ranged from 6-22%, with no significant difference from year to year ($\chi^2_5 = 1.24$, $P = 0.94$). Both clupeids and sandeels were recorded throughout the chickrearing season without any significant difference in the temporal distribution ($\chi^2_5 = 4.78$, $P = 0.44$). Of four sprats sexed in June 2000, two were males, two females.

Discussion

Only few observations on the food of Baltic Razorbill chicks have been published. In his book *Alken* ("The Razorbill"), based on work done on Græsholmen in 1944, Paludan (1947) mentioned only three food items (one sandeel, one clupeid and one herring, the latter actually being a sprat according to the photograph in the book). Anders-

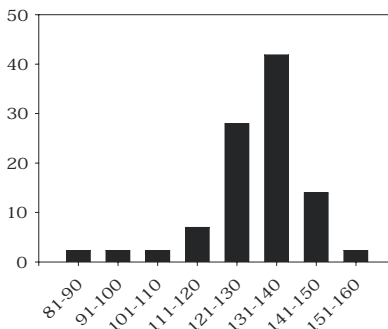


Fig. 2. Frequency distribution (%) of sprat lengths (mm; $n = 43$) found in Razorbill nests on Græsholmen, 1985-2000.

Størrelsesfordeling (mm) af 43 brislinger fundet i alkereder på Græsholmen 1985-2000 (procent).

Table 2. Size and mass of fish found in Razorbill nests on Græsholmen 1985-2000.

Størrelse på fisk fundet i alkereder på Græsholmen 1985-2000.

	Sprat <i>Brisling</i>	Sandeel <i>Tobis</i>
Mean length (mm) <i>Længde</i>	130.6	161.7
Range	90-151	80-200
n	43	6
s.e.	2.0	19.0
Mean mass (g) <i>Vægt</i>	11.9	14.0
Range	8-16	13-15
n	18	3
s.e.	0.4	0.6

son et al. (1974) identified 175 clupeids and one sandeel by observing Razorbills returning with fish to breeding areas in the archipelago of Stockholm, Sweden, in the early 1970s. Casual observations from Stora Karlsö off Gotland, Sweden, suggest that clupeids, mainly sprats, constitute the most important food items here, although a few sticklebacks *Gasterosteus aculeatus* and sandeels have also been recorded (own observations, H. Österblom pers. comm.). In conclusion, clupeids (mainly sprats) appear to be the most important food of Razorbill chicks in the Baltic proper; no information is available from the Gulf of Finland or the Gulf of Bothnia.

In Britain, small sandeels are the most important food of Razorbill chicks, apparently everywhere constituting 80% or more by number. On Fair Isle in 1986-89, Harris & Riddiford (1989) recorded 61 fish of which 59 (97%) were sandeels and two were clupeids. Furness (1983) noted that "Sandeels are the staple diet of Razorbills on Foula in summer. Most birds bring rather small sandeels to their chicks; the modal size class 60 to 69 mm is much smaller than taken by Guillemots ... (and) ... Puffins". On the Isle of May in 1982-84, sandeels constituted 85-98% (96-99% by mass) of 841 fish brought to the chicks; other species included 1% sprat, 1% herring and 4-15% rockling *Ciliata/Gaidropsarus* spp. by number (Harris & Wanless 1986). Eight sandeels found at sites with chicks had a mean length of 126 mm and weighed 3-10 g, while 69% of the observed sandeels had an

estimated length of less than 100 mm. On Canna, five recorded loads contained 2-7 sandeels less than 90 mm long (Swann et al. 1991). Harris (1970) noted that the Razorbills of Skokholm and Skomer in Wales mainly brought sandeels (mean length 79 mm, range 52-158 trim, $n=11$), while Corkhill (1973) reported that among 20 food items recorded here in 1970, 16 (80%) were sandeels (*A. marinus*) with a mean length of 64 mm, and 4 were sprats with a mean length of 54 mm. Likewise, Lloyd (1976) recorded 168 sandeels and 21 clupeids (apparently mostly sprats) on Skokholm in 1972-73, with mean lengths of 53 and 54 mm, respectively. Wagner (1997) recorded 992 feedings on Skomer in 1989 and identified 94% of the fish as sandeels, 6% as clupeids (mainly sprats).

In the northern parts of the Razorbill's breeding range, capelin becomes an important food source. On Hornøy in the Norwegian part of the Barents Sea, Barrett (1984) noted that sandeel and capelin were the main diet of seabirds in 1980-82. In 1983, 24 loads brought to Razorbill chicks consisted of 17% capelin and 83% sandeel (by number), while in 1989, 21 loads consisted of 76% capelin and 24% sandeel (Furness & Barrett 1985, Barrett & Furness 1990). Fish length ranged from about 30-110 mm for sandeel and 80-160 mm for capelin. For White Sea Razorbills, Bianki (1967) noted that "... in Kandalaksha Bay the young receive almost exclusively sand eels, herring being a rare treat. Capelin apparently takes second place in Onega Bay ...".

On St. Mary's Islands in the Gulf of St Lawrence, Canada, sandeel was the most frequently observed food item (64-78%) followed by capelin (21-36%) (1990-92; Chapdelaine & Brosseau 1996). However, by mass capelin was the most important food item (53-69%) compared with 31-46% sandeel. Median length of capelins ranged from 123 to 138 mm, of sandeels from 89 to 119 mm. A few herrings and rainbow smelts *Osmerus mordax* were also recorded, but only in 1990. Herring formed the major part of the chick diet in another Canadian study at Machias Seal Island, lower Bay of Fundy, constituting 79-98% by number in 1995-99; white hake *Urophycis tenuis* made up 1-17% and sandeel 0-11% (Bernard et al. 1999).

In West Greenland, capelin apparently forms the main diet of Razorbill chicks, although little information is available. Salomonsen (1950) noted that "... a few fish examined by me have been capelin...", while Kampp & Falk (1994) recorded two loads consisting, respectively, of

four capelins and of one capelin and one arctic rockling *Onogadus argentatus*.

Thus, Razorbills generally feed their chicks with small schooling fish. Local availability of suitable prey seems to be the major determinant of the fish species chosen, and a preference for fish with high energy contents (e.g. sprat) remains to be documented. It is noteworthy, however, that when feeding chicks with sprat the load-size carried by the adults appears to be smaller than when feeding with sandeel or capelin. On Græsholmen, no loads with more than one sprat have been recorded, while on Skokholm, the mean size of loads containing only sprat was 1.2 (Wagner 1997). In contrast, on the Isle of May, where most of the food delivered to the chicks consisted of sandeels, 37% of the loads consisted of more than one fish, and the mean load-size was 3.7 (Harris & Wanless 1986). On St. Mary's Islands, where the chicks were fed with sandeel and capelin, 61-66% of the sandeel loads and 70-80% of the capelin loads consisted of more than one fish, with an overall mean load-size of 1.6 (Chapdelaine & Brosseau 1996). As most sprats weigh less than 15 g, it is hardly their size that limits their number in a load. Chapdelaine & Brosseau (l.c.) estimated the maximum mass of a load at 83 g; the mass of the heaviest capelin actually weighed was 28 g (G. Chapdelaine in litt.).

The average time schedule of Razorbill pairs on Græsholmen allows the birds to feed their chick five times a day (Benvenuti et al. in press). Casual observations through the years nevertheless suggest that the chicks are usually fed only about three times a day. If the chicks receive three daily meals consisting of sprats weighing 11.9 g, the intake per chick equals 35.7 g, equivalent to an energy intake of 411 kJ. On St. Mary's Islands, Chapdelaine & Brosseau (1996) estimated a daily intake of 39.5 g (286 kJ), while Harris & Wanless (1986) estimated a value of 21 g (150 kJ) on the Isle of May. Adult Canadian Razorbills are larger than British Razorbills, weighing 15% more (728 g versus 620-640 g), and the chicks depart from the nest at a higher mass (199 g versus 170-180 g; Lloyd 1976, 1979, Furness 1983, Harris & Wanless 1986, Chapdelaine & Brosseau 1996). On Græsholmen, the mean mass of adult Razorbills is 715 g ($n=22$) and of departing chicks 200 g ($n=150$). Assuming the energy requirements to be higher for larger birds, Chapdelaine & Brosseau (1996) explained the difference in daily intake rates between Canadian and British chicks by the size difference of the birds. As Baltic Razorbills are



Sprats constitute the basic diet of the Razorbill chicks on Græsholmen in the central Baltic Sea. Photo: P. Lyngs. *Brislinger udgør den vigtigste føde for alkeungerne på Græsholmen ved Christiansø.*

almost as heavy as Canadian Razorbills, the results from Græsholmen support this explanation. Still, the estimated daily calorific intake of the chicks from Græsholmen is 44% higher than that of the Canadian chicks, apparently without any effect on, e.g., the mass at departure from the nest.

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Resumé

Alkeungernes føde på Græsholmen ved Christiansø

Denne artikel beskriver alkeungernes føde på Græsholmen ved Christiansø. I årene 1985-86 og 1989-2000 noteredes alle fødeemner fundet i alkereder igennem ynglesæsonen. Fødeemnerne, der alle udgjordes af fisk,

blev artsbestemt og, hvis de var friske, også målt og vejjet. Samtidig bestemtes ungens alder ud fra dens vingemål. Endvidere noteredes alle observationer af fodringer gjort under det aflæsningsprogram af voksne Alke, som har kørt på Græsholmen siden 1991. I alt blev der bogført 228 fisk (Tabel 1), hvoraf 145 blev fundet i rederne og 83 blev observeret. Af de 145 fundne fisk var 129 brislinger og 16 tobiser. De fleste brislinger var 120-140 mm lange (Fig. 2) og gennemsnitsvægten var 11,9 g, hvilket viser, at det hovedsagelig drejede sig om voksne fisk. Tobiserne var i snit 16 cm lange og vejede 14 g. Også blandt de observerede fisk udgjorde sildefisk 89% og tobiser hovedparten af resten, men der sås også fem kutlinger. Selvom unge sild og brislinger er svære at bestemme i felten, var langt de fleste af de observerede sildefisk antagelig brislinger, sådan som det var tilfældet med alle de 10 fisk, hvor arten senere kunne verificeres i hånden. Hvis alle de observerede sildefisk var brislinger, udgjorde brisling 89%, tobis 9% og kutling 2% af de 228 registrerede fisk. Den energimæssige andel af brislinger beregnedes til at udgøre 92%. I alle

år udgjorde brislinger den største andel af føden, og i seks ud af 14 år blev der kun registreret brislinger. I de år, hvor der både blev registreret brislinger og tobiser, udgjorde tobiser 6-22%. Der var ingen forskel i den tidsmæssige fordeling af disse to arter, ligesom der heller ikke fandtes nogen størrelsesforskel på de fisk, der blev bragt til hhv. helt små og større unger.

De få undersøgelser, der findes fra Østersøen, tyder klart på, at brisling i dette område er den vigtigste art på alkeungernes spiseseddel. I andre dele af yngleområdet er tobis og lodde de vigtigste fødemidler. Tobis er helt dominerende omkring de Britiske Øer, mens lodde er vigtigst i det nordlige Norge, i Canada, og tilsyneladende også på Grønland. Sild er kun anført som det vigtigste fødeemne i en enkelt undersøgelse fra det sydlige Canada, hvor hverken lodde eller brisling forekommer. Generelt fodrer Alkene deres unger med små stimefisk, og det er de enkelte fiskearters tilgængelighed, der bestemmer kostplanen. De fleste steder fodrer Alkene deres unger ca. tre gange om dagen. Det indebærer, at ungerne på Græsholmen som oftest får tre brislinger dagligt. De steder, hvor Alkene fodrer deres unger med fisk med et højt energiindhold (såsom brisling), kommer fuglene som regel kun med én fisk ad gangen, mens de i områder hvor mere energifattige fisk (såsom tobis) dominerer oftest kommer med flere fisk ad gangen. På de Britiske Øer (i dette tilfælde Isle of May) modtager ungerne i snit omkring 21 gram fisk om dagen, mens de på Græsholmen og i det nordlige Canada (St. Mary's Islands) får 36-40 gram. Forskellen på den modtagne fødemængde skyldes bl.a., at de baltiske og canadiske fugle er omkring 15% større end de britiske og derfor har brug for mere mad; men interessant nok får alkeungerne tilført 44%, mere energi på Græsholmen end i Canada - uden at det sætter sig synlige spor i fx ungerne vægt, når de forlader reden.

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