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Prey remains in grey seal (*Halichoerus grypus*) faeces from the Moray Firth, north-east Scotland

G. J. Pierce, A. Miller, P. M. Thompson and J. R. G. Hislop[2],
Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, and
[2]Department of Agriculture and Fisheries for Scotland, Marine Laboratory, PO Box 101,
Victoria Road, Torry, Aberdeen AB9 8DB

Introduction

Diets of grey seals (*Halichoerus grypus*) on the east coast of Scotland were reported by Rae (1960, 1968, 1973), based on examination of stomach contents, to consist primarily of fish, particularly salmonids and gadids. More recently the Sea Mammal Research Unit found that gadids and sandeels (Ammodytidae) were the most important prey in terms of biomass, as derived from measurements of fish otoliths in faeces (McConnell *et al.*, 1984; Prime & Hammond, 1985; SMRU, 1988). However, in the latter studies, there is no information on diets of grey seals between the Isle of May (Firth of Forth) and Orkney.

Grey seals occur in the Moray Firth, a large inlet in the north-east coast of the Scottish mainland (Fig. 1). Numbers hauling out on beaches and sandbanks in the inner Moray Firth tend to be highest in the summer: more than 300 were counted in the Dornoch Firth in the summer of 1987 (DAFS, Unpubl. data). Caves and cobble beaches near Helmsdale, along the northern shore of the Firth, are also used by grey seals (Bonner, 1976): 280 pups were counted during a survey of all breeding sites between Helmsdale and Berriedale by DAFS in November 1989 (JRGH, Unpubl. data).

Pierce *et al.* (1989) examined digestive tract contents of a small sample of grey seals from the Moray Firth and found that sandeels were the most important prey, although gadid and salmonid remains were also recorded. The present paper describes results from analysis of faecal samples collected in the Moray Firth area during the spring and summer of 1988. Diet is quantified using measurements on fish otoliths and cephalopod beaks, and data from Pierce *et al.* (1989) are reanalysed to quantify the importance of cephalopods in the diet.

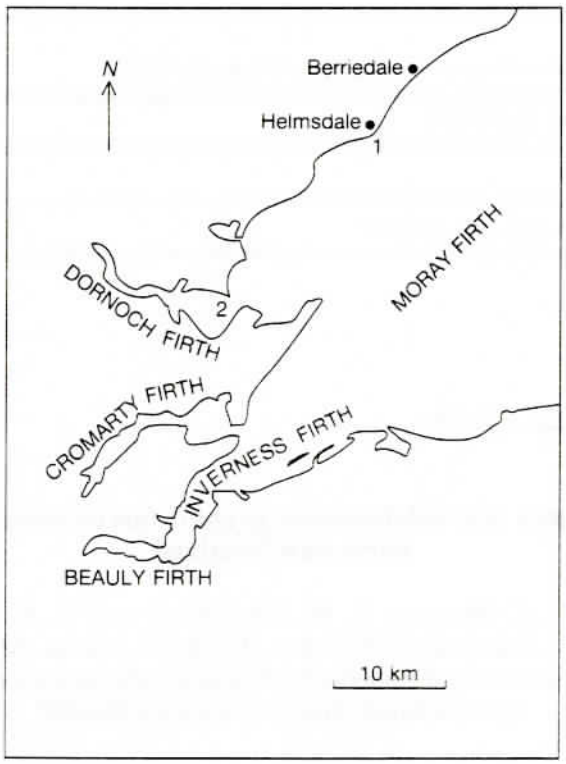

FIG. 1. A map of the study area showing the position of haul-out sites where scats were collected (1 = caves at Helmsdale, 2 = sandbanks in Dornoch Firth).

Methods

Grey seal scats were collected from intertidal sandbanks in the Dornoch Firth during the months April to July. Faeces were attributed to grey seals only if the majority of seals (>90%) at the haul-out site were grey seals. Grey seal scats were also collected from caves at Helmsdale during April. All scats found were collected in separate polythene bags, and stored frozen (−20 °C) prior to examination.

Scats were later thawed and washed through a 0·355 mm sieve. Material remaining in the sieve was retained, and all otoliths and a sample of bony remains were stored dry in glass vials. Cephalopod beaks and other invertebrate remains were stored in 95% ethanol. Otoliths were identified using a reference collection and Härkönen's (1986) otolith guide. Other skeletal elements were identified using a reference collection. Numbers of fish were estimated from counts of numbers of otoliths. Otoliths were measured to derive estimates of fish weight. If more than 30 otoliths of one species were present in a scat, a random sample of 30 otoliths was measured; otherwise all otoliths were measured. Otolith length was measured for intact otoliths, and breadth for otoliths broken lengthways. No correction was made for reduction in otolith size due to

digestion. Fish weights were calculated from regressions of fish size on otolith size and fish weight on fish length (Bedford, Woolner & Jones, 1986; Härkönen, 1986; Coull *et al.*, 1989; JRGH & GJP, Unpubl. data).

Cephalopod weights were estimated from beak dimensions. For octopods the appropriate measurement is hood length of the lower beak (Clarke, 1986). If upper beaks only were present, hood length was measured and a correction factor (0·8; Unpubl. data) applied to obtain estimated hood length for the lower beak. For cuttlefish, total length of the upper beak was measured. This was used as an estimate of buccal mass length, which in *Sepia* spp. represents 13·3% of mantle length (Morton & Nixon, 1987). Body weight of cuttlefish was derived from estimated mantle length (A. Kear, Unpubl. data on *Sepia*). Results are expressed as percentages of the monthly total weight of fish and cephalopods for all species. Cephalopod beaks previously retrieved from grey seal digestive tracts (Pierce *et al.*, 1989) were measured to derive weights.

Results

Thirty-five grey seal scats were obtained: one each in May and July, 22 in April (21 of which were from Helmsdale) and nine in June. The July sample contained no prey remains and the May sample contained three sandeel otoliths. Results on diet composition in April and June are tabulated (Table I). Grey seal diet in April 1988 consisted largely of sandeels and octopus (*Eledone cirrhosa*). In June 1988, octopus were absent from grey seal faeces. Catfish (*Anarhichas lupus*) teeth occurred in a number of grey seal scats, although no otoliths were found.

Octopus beaks were present in two of the grey seal digestive tracts analysed in Pierce *et al.*

TABLE I

Grey seal diet in the Moray Firth, April and June 1988: (a) % frequency of occurrence of hard remains (otoliths and or bones); (b) % frequency of occurrence of otoliths; (c) total number of fish otoliths and cephalopod beaks in samples; (d) % biomass, estimated from otoliths and beaks

	(a)		(b)		(c)		(d)	
Species	Apr.	Jun.	Apr.	Jun.	Apr.	Jun.	Apr.	Jun.
Gadus morhua	4·6	0	4·6	0	1	0	4·3	0
Merlangius merlangus	9·1	0	9·1	0	10	0	4·6	0
Trisopterus spp.	4·6	0	4·6	0	1	0	0·3	0
All Gadidae	18·3	0	18·3	0	12	0	9·3	0
Ammodytidae	95·5	77·8	86·4	55·6	1296	106	61·0	100·0
Anarhichas lupus	9·1	22·2	0	0	0	0	0	0
Trachurus trachurus	4·6	0	0	0	0	0	0	0
Cyclopterus lumpus	4·6	0	0	0	0	0	0	0
Limanda limanda	4·6	0	4·6	0	1	0	2·1	0
Microstomus kitt	4·6	0	4·6	0	6	0	6·0	0
Pleuronectes platessa	4·6	0	0	0	0	0	0	0
All Flatfish	18·4	0	18·4	0	9	0	9·2	0
Eledone cirrhosa	22·7	0	—	—	7	0	20·2	0
Rossia spp.	4·6	0	—	—	1	0	0·3	0
All Cephalopoda	22·7	0	—	—	8	0	20·5	0
Polychaetes	4·6	0	—	—	—	—	—	—

(1989), and octopus were estimated to have formed 2% of the diet at Helmsdale, and 25% of the diet in the Dornoch Firth (reducing the importance of sandeels from 99% to 74%).

Discussion

As was the case in Pierce *et al.* (1989), the results refer to a small sample of restricted seasonal distribution, and no account was taken of reductions in otolith size during digestion. Nevertheless, the present study supports results derived from digestive tract contents, with sandeels dominating the diet both numerically and in terms of biomass. The importance of catfish could not, however, be quantified.

In June, sandeels made up 100% of the diet as assessed from otoliths, as compared to 61% in April. However, it is not possible to say whether this reflects seasonal or local geographical differences in diet. An increase, from spring to summer, in the importance of sandeels was reported in grey seal diets at the Farne Islands and in Orkney (Prime & Hammond, 1985).

In April, the octopus *Eledone cirrhosa* formed 20% of combined fish and cephalopod biomass in grey seal diets in the Moray Firth. The biomass of cephalopods eaten by grey seals was not quantified in Pierce *et al.* (1989), but reanalysis indicated that octopus formed 25% of the prey biomass in six grey seal digestive tracts from the Dornoch Firth.

Few studies on grey seal diets have indicated that cephalopods are of more than incidental importance in the diet. However, Lockie (1962) records that cephalopods formed an estimated 73% by weight of prey represented by remains in eight stomachs from grey seals killed in salmon nets. There is, however, evidence that cephalopod beaks may be retained in pinniped stomachs longer than are fish bones (Bigg & Fawcett, 1985).

Most otoliths are probably reduced in size during passage through seal digestive tracts, but cephalopod beaks are more resistant to digestion (e.g. Harvey, 1988). Thus back-calculation of prey size without correcting for size reduction may over-estimate the importance of cephalopods in the diet. Nevertheless, the present results illustrate the importance of quantifying the role of cephalopods in the diet of an animal generally considered to be largely piscivorous.

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Gastrointestinal helminths of the otter, *Lutra lutra*, in Shetland

J.-M. WEBER*, Institute of Terrestrial Ecology, Banchory, Scotland

Introduction

Most of the studies on the European otter, *Lutra lutra*, concern its ecology and there are few data about the parasites of this species. Stephens (1957) established a list of some parasites occurring in the otter. Unfortunately, the author only gave the genera of the parasites. Kontrimavichus (1966) collected references on the parasitic helminths of the otter. Chanin (1985) and Mason & Macdonald (1986) cited some parasites affecting otters and emphasized the lack of data in that area. Recently, the situation was enlightened by Jefferies, Hanson & Harris (1990). They studied the prevalence of gut parasites in coastal otters in Britain. However, they did not examine any otters from Shetland.

The aim of this study was to collect data on the parasitic helminths living in the digestive tract of some otters from Shetland.

Materials and methods

The otters were collected between 1984 and 1987 in Shetland. They all were living in—or very close to—marine habitat (Table I). Additionally, some otters from the Scottish mainland (freshwater habitat) were also examined. Most of the autopsied individuals were road kills.

* Present address: Université de Neuchâtel, Institut de Zoologie, Chantemerle 22, 2000 Neuchâtel, Switzerland