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Summary

A total of 120 faecal pellets were collected in July 1995. Contents showed that diets of black rats in the Shiants included a high proportion of vegetational matter (stems, leaves, grass seeds and moss) supplemented by Coleoptera and larval hepidoptera. Occasional feathers suggested scavenging or predation and the presence of small (rat) bones indicated possible cannibalism.

REPORT ON THE DIET OF THE BLACK RAT *(RATTUS RATTUS)* INHABITING THE SHIANT ISLES BY ANALYSIS OF FAECAL MATERIAL

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Abstract

A total of 120 faecal pellets from the black rat (Rattus rattus) population on the Shiant Isles were examined. The pellets originated from 5 separate localities. Their diet was shown to include a high proportion of vegetative matter such as the stems, leaves and seeds of grasses, and moss. Supplementing this were various types of invertebrates, the most frequently consumed being adult Coleoptera followed by larval Lepidoptera. The detection of feathers in the Old House area indicated that avian predation or scavenging had occurred. Evidence of probable cannibalism was provided by the discovery of pharyngeal bones markedly similar to those possessed by black rats.

Back2round

The Shiant Isles of the Outer Hebrides possess one of the few remaining free living Black rat populations in the British Isles (pers comm - N. Buxton).The rats freely associate with the island's seabirds and a Puffin (*Fratercula arctica*) colony has previously been noted as flourishing in their presence (Bourne 1981). To investigate the diet of the Shiant Isles rat population samples of their droppings were collected in July 1995 for subsequent examination.

Method

Samples from 5 areas were received labelled as 'Old House and Fank', 'Sheilings', 'Garbh Eilean Sheilings'and 'Boulders South End'. The label from the final area was illegible and will be referred to as 'Unlabelled'. On receipt the faecal material from each of the five sample areas was soaked in water for a minimum of 48 hours. The resulting swollen pellets were individually teased apart under a binocular microscope and their contents examined. Material was visually ascribed to one of two categories, vegetation or animal, and the percentage contribution estimated. Although generally finely comminuted, where possible ingested material was identified down to class level. Identification was carried out using reference animals and/or key identification features. As it is unclear into how many pieces an ingested plant or invertebrate will break into, exact quantification of individual food items was not attempted. Food items were therefore recorded simply as present or absent for each of the five sample sites though a rough visual indication of the most frequently occurring material could be made.

Results and Discussion

TABLE 1. Visual estimate of % Vegetation and % Animal matter consumed for each sample area.

Sample Area	**No. pellets**	% **Vegetation**	% **Animal**
Old House and Fank	48	75	25
Sheilings	31	80	20
Garbh Eilean Sheilings	14	80	20
Unlabelled	4*	90	10
Boulders South End	22	80	20
Mean.		81	19

* = Excludes faecal pellet containing all chitin.

Plant Material

The bulk of the faecal material for all 5 sample areas was made up of finely comminuted plant material (Table 1). The Unlabelled area had the highest percentage plant faecal material of 90%, compared to the lowest of 75% in the Old House area. The pooled average gives 8 1 % vegetative material against 19% animal. These results are only a guide. Large differences existed in sample sizes and the Unlabelled area contained an unusual faecal pellet, described later, which was excluded from the estimation.

Most plant material was finely ground but from the more identifiable pieces a similar composition for each area became apparent (Table 2). Stems and leaves of grasses predominated in all areas with grass type seeds appearing in 3 areas. Samples of moss occurred in all 5 areas. A dark coloured course twiggy material resembling the woody stem of a plant was present in the Old House area only. Other plant material possessed a purple colouration and resembled in shape the spikelets seen in certain ,grasses. Initially thought to be a heather *(Calluna sp.)*, subsequent comparisons proved otherwise. This material occurred in all areas except Unlabelled. Unique to the Unlabelled area were numerous unidentified (>50) tiny round black seeds.

Invertebrate Material.

Invertebrate remnants made up the remainder of the faecal material (Table 1) ranging from 25% for the Old House area to just 10% for the Unlabelled area. Present in all areas except Unlabelled was the remnants of Lepidoptera larvae. Differences in skin pigmentation indicated more than one larval species being eaten. No remains of adult Lepidoptera were found.

The most commonly occurring invertebrate remains belong to adult Coleoptera. Pieces of elytra, limbs, antennae, etc., were prevalent in all areas. Identification to species level was usually not possible but occasionally clues could be found. Ground beetles (Carabidae) had been consumed in the Sheilings area as evidenced by the finding of their distinctively notched front tibia with which they clean their antennae.

Coleoptera larvae were found in the Old House area, Unlabelled area and Boulders South End. Most larvae were of the apodous type commonly seen in weevils although one click beetle larva was identified. The presence in the Old House area of several tiny wings indicated adult Diptera had been consumed. Diptera larvae were discovered in the Sheilings and Boulders South End areas of which one was recognisable as belonging to the Nematocerae family. The remains of a single centipede were discovered in the Boulders South End area and a single tiny whole spider in the Old House area. The very small flies and spider consumed may have been inadvertently ingested when the rats were feeding on vegetation.

TABLE2. Identified foods consumed in the different sample areas.
(+ = consumed)

ITEM EATEN	OLD HOUSE AND FANK	SHEILINGS	GARBH EILEAN SHEILINGS	UNLABELLED	BOULDERS SOUTH END
ANIMAL					
ARACHNID	+				
DIPTERA					
-ADULT	+				
-LARVAE		+			+
JILEPIDOPTERA.					
-LARVAE	+	+	+	+	+
COLEOPTERA					
-ADULT	+	+	+	+	+
-LARVAE	+	+			+
FEATHER	+				
BONE					+
FUR	+	+	+	+	+
CHILOPODA					+
VEGETATION					
SEEDS	+			+	
LEAF/STEM					
GRASSES	+	+	+	+	+
MOSS	+	+	+	+	+
PURPLE PLANT MATERIAL	+	+	+		+
TWIGS	+				

Bone

One faecal pellet from the Boulders South End area yielded two small pharyngeal bones that appeared to fit together. Comparison with pharyngeal bones from an assortment of small mammals and birds at the Manchester Museum suggested strongly that the bones originated from the front foot of a Black rat. Thus cannibalism probably does occur within the Shiant black rat population.

Fur

Faecal pellets from all areas contained matted clumps of fur. As all this fir had the same appearance it was assumed to be rat fur ingested during grooming. However, the discovery of what were almost certainly black rat bones in a later faecal pellet casts doubts on whether all ingested fur is from self grooming or were acts of cannibalism. Ingested rat fur has been recorded before in the stomach contents of black rats. Daniel (1973) found rat fur but no flesh or bones and attributed it as '... probably ingested during grooming'. Gales (1982) however discovered rat fur (species undetermined) with flesh attached.

Feathers

One faecal pellet in the Old House and Fank area contained 21 small downy feathers, 2 small possibly breast feathers and one larger feather. The rat had obviously fed on a bird but whether it had been killed directly or just scavenged it is not possible to say. The bird supplying the feathers could not be identified. Out of the 120 faecal pellets examined only this one showed evidence of rat predation on birds.

Comments

Foraging Black rats will deliberately consume a variety of food materials to constitute a meal rather than gorging on any one food item (Clark 1982). Benefits of this strategy include nutritional balance and prevention of toxin accumulation. The composition of the Shiant rat faecal pellets also showed a variety of foods had been consumed except for one pellet from area 4. This pellet was of typical size and appearance but contained solely adult Coleoptera remains. This interesting phenomenon has been noted before albeit in Brown rats (Rattus norvegicus) by Pye and Bonner (1980) who found one faecal pellet '....the bulk of which was beetle chitin when other pellets contained only a small amount of beetle remains'. Adult female andjuvenile rats have been shown to prefer more animal matter in their diets than adult males (Gales 1982, Moors 1985) thus protein enrichment may play a hand in these unusual pellets.

Previous studies of diet in *Rattus sp*. have looked at stomach contents (Clark 1982; Gales 1982; Moors 1985) or faecal pellets (Pye and Bonner 1980,- Drummond 1960). A more complete picture of food consumed will obviously be gained from the relatively undigested stomach contents than from faecal material, though Daniel (1973) looked at both and found a rough correlation between the two regarding seasonal changes in diet. Animal matter was found to predominate in the Black rats diet by Daniel (1973) and Gales (1982) whereas Clark (1982) and Key et al. (1996) found a predominance of vegetable matter. The relevance of a direct comparison to the Shiant rats diet is limited as habitat, time of year, available food, etc., all differ widely. What is important is the ability of Black rat to utilise many different food sources enabling it to colonise substantially different environments. Diet will change throughout the year as different foods become available and others diminish. A most noticeable change will occur when the breeding season of the islands' birds begins. Black rat predation on island birds is variable and inconsistent. Some bird populations are devastated (Hindwood 1940; Grant et al. 198 1) whilst others are unaffected (Feare 1979). Co-existence between rat and bird is reputedly the most common outcome (Atkinson 1985). Rat predation on the Shiant birds was inconclusive with only one faecal pellet in the Old House area yielding evidence of feathers. However, as Moors and Atkinson (1984) describe, the birds breeding strategy and behaviour will contribute to the severity of predation thus losing a few birds can have as severe consequences as losing many. Vulnerable species will, for example, have only one clutch a year, a small clutch size and late reproductive maturity. Apart from stomach or faecal analysis direct evidence of rat predation on birds can be difficult to find. Bourne 198 1) points out that stealing an egg or chick only takes a few seconds and as rats are mainly nocturnal evidence of their predation can be missed. Circumstantial evidence of rat predation can sometimes be gained by the presence of partly eaten eggs or chicks around the nest sites (Moors 1983).

Acknowledgement

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REFERENCES:

Atkinson **I.A.E.** (1985) The spread of commensal species of Rattus to oceanic islands and their effects on avifaunas. ICBP *Tech. Pub. 3* 35-81

Bourne W.R.P. (198 1) Rats as avian predators: Discussion. *Atoll Res Bull* 255 69-72