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REPORT

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INVESTIGATION OF INSECT REMAINS IN A SAMPLE OF BIRD PELLETS. From William Percy

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1. INTRODUCTION.

Bird pellets are agglomerations of undigested food matter, usually regurgitated by the bird before leaving its nocturnal or diurnal roost and during periods of intense feeding activity. The pellets investigated consisted of large amounts of small mammal fur and fragmented bones, together with varying quantities of insect solerites.

The sample was obtained from the floor of the ruined church tower at Wharram Percy, Yorkshire, a deserted medieval village (figure 1). It was uncertain which avian species had produced the pellets, both kestrel or a variety of owl being possibilities.

Wharram Percy is situated in a valley 6½ miles southeast of the small town of Malton, amidst dales and wolds. The general environment is open-land, with a few small woods and plantations. Isolated farms, houses and hamlets, linked by tracks and minor roads, provide a sparse human population (figure 2).

2. OBJECTIVES.

Insect remains were apparent in sufficient quantities to merit investigation of the pellets, with the following objectives:

i. Identification of insect species represented.

ii. Composition of the bird's diet, suggesting its identity.

iii. Environment exploited by the bird.

iv. Applications within archaeology.

3. IDENTIFICATION OF INSECT REMAINS.

Method.

A sample of ten entire pellets and a quantity of disintegrated pellet material was subjected to investigation. The pellets were assigned identification codes: W.P. (Wharram Percy) 1 to 10 inclusive; the disintegrated pellet material was dealt with as sample W.P. 11. Each was soaked in water until it lost cohesion, then sorted in 70% alcohol to isolate the sclerites. These were then grouped into the constituent parts of insects: head, pronotum, left and right elytra, and other; this latter group included legs, abdomen fragments and aedeagi, (figure 3). Characteristic sculpture was used to sub-divide the remains according to species.

Insect species were identified using various dichotomous keys, reference collections belonging to the British Museum and Dr. Maureen Girling of the Department of Environment, together with the latter's expertise. After recording the sclerites of each species present, the minimum numbers represented were calculated (see record sheets), and frequency diagrams were constructed for each sample, demonstrating composition of the bird's diet (figure 4).

Species Identification.

The species represented by the sclerites were identified by the following criteria, in the order below;

1. Geotrupidae:

Overall characteristics for identification include head shape, oblong body, microsculpture, eye position and area. Size varies with species as does colour. Arched hind tibia with transverse ridges; femur of males commonly toothed. Leg position determination: anterior is triangular in section and shovel-shaped; median and posterior are more square in section, median being less well developed. Sub-genus Geotrupes: (figure 5) pronotum smooth lacking horns or tubercles; two complete transverse borders on the outer side of posterior tibia.

a) Geotrupes spiniger: male with strong tooth on posterior side of posterior femur. Three complete, sharp-edged, transverse ridges on posterior tibia; this is in contrast to G.stercorosus, which has two ridges, and G.stercorarius, which has two and a half. Regular, definite striations in the micro-articulation of G.spiniger's elytra are deeper than those of G.stercorosus.

b) Geotrupes mutator: dorsal surface metallic green, purple or coppery. Elytra with nine striae between the suture and inner side of shoulder prominence. Male with, female

without hook-like tooth on posterior trochanter. Length 15-24mm.Legs have less flamboyent edges than G.spiniger; two spines project from the femur, and the inside edge is milled. G.mutator has less rugose sculpture than G. spiniger.

ii. Carabidae:

These ground-beetles have characteristically long, thin legs. Head shape, microsculpture, and angles of the shoulders are also diagnostic (figure 6).

a) Pteros-tichus niger: inner basal fovea of pronotum prolonged forwards. Elytral striae deep, intervals very convex. Dull, black, velvety appearance. Length 15mm+ .

b) Pterostichus medidus: basal fovea of pronotum delimited externally by a blunt carina. Elytral intervals almost flat, striae punctulate. Black, shiny appearance in comparison to P.niger. Length 13-17mm.

c) Carabus violaceus: diagnostic shoulder angle. Pronotum has flanges at edges, outer margin keel meets neck;the broader outer margin adjoins a smooth area, found between margin and puncturations. Elytral striations have random rugosity; microsculpture consists of points directed backward, likened to drumlins. Head has punctures of three sizes, as well as a constriction to the back of the eyes.

Aedeagus is blade-like, being flatter, smaller and more curved than that of C.problematicus.

d) Carabus problematicus: in comparison to C.violaceus, head is smoother; elytral microsculpture demonstrates lineation not random rugosity; pronotum angle longer and thinner, bordered anterior and posterior angles; aedeagus less curved, blunter, with bulge at apex.

iii. Lepidopterous:

Jaws of moth larvae or caterpillars; clothes-moths are found in birds' nests as well as clothes, since the protein content of feathers and wool is identical. It is probable that the larvae were not eaten by the bird.

iv. Insect larvae:

Complete insect larvae may be of Lepidopterous. Their state precluded consumption by the bird.

4. COMPOSITION OF THE BIRD'S DIET.

Six insect species were identified as forming part of the bird's diet: two dung-beetles, both members of the genus Geotrupidae, and four ground-beetles, all members of the genus Carabidae. The minimum number of each species represented varied in each pellet (see record sheets).

Most pellets contained at least one example of Geotrupes, exceptions being W.P.8 with none, and W.P.3 and W.P.6 with two each. The numbers of Carabidae were more

variable: the most was eight in W.P.1, and the least was none. As was to be expected, the frequency of each species within the pellets was also variable, (see frequency diagrams).

When only the entire pellets were considered, the total number of Carabidae represented was almost twice that of Geotrupes, suggesting Carabidae were more important than Geotrupes in the bird's diet. However, when the disintegrated pellet material was considered alone, Geotrupes was twice as numerous as Carabidae. Contemplation of the whole sample showed approximately equal representation, indicating Carabidae to be only marginally more important than Geotrupes in the bird's diet (see tabulated results).

A Barn Owl (Tyto alba alba) seems most feasible for producing the bird pellets. As it lives predominantly on farmland, its diet consists of beetles, moths, small birds, rodents, frogs, sometimes bats and fish. The insects in the sample may be found in a farmland environment, but are not specific to the Barn Owl. However, the sampling site in the ruined church tower at Wharram Percy would provide an excellent nest-site for this variety of owl.

5. ENVIRONMENT EXPLOITED BY THE BIRD.

The environment exploited by the bird was extrapolated from the characteristic environments inhabited by the insect species represented in the sample.

a) Geotrupes spiniger: associated with herbivorous dung, especially deer droppings; common.

b) Geotrupes mutator: associated with herbivorous dung; common in south England.

c) Pterostichus niger: usually found in parks, thin forests and similar environments, on not too dry soil; often under bark. Common in England and the rest of Britain.

d) Pterostichus madidus: found in open country, often on cultivated soil, in gardens and similar environments; common throughout Britain.

e) Carabus violaceus: inhabits both forests and quite open country; the most abundant species, common everywhere, even in parks and gardens. Widely distributed throughout Britain.

f) Carabus problematicus: inhabits dry country, mostly found on heaths and in thin forests; also at high elevations. Widely distributed throughout Britain.

The environments inhabited by the beetles may all be found in the vicinity of the deserted medieval village of Wharram Percy (figure 2). Open country predominates with some heathland and a few stands of trees; such an area is suitable for use by herbivores, including deer and sheep. Gardens are associated with human settlements, and cultivated soil with the farms.

Consequently, the bird exploited the local environment of Wharram Percy, which presumably formed its territory.

Summer exploitation is indicated by the pellets,

because the beetles represented are active on the earth's surface during the warm seasons. The presence in the sample of complete larvae and larval jaws reinforces this, as it is in summer that this stage in the insect life-cycle is attained.

6. APPLICATIONS WITHIN ARCHAEOLOGY.

Investigation of insect remains has several applications within archaeology, and more specifically within bioarchaeology. Identification of species, together with determination of the environment represented are of great importance in all such studies.

As the pellet sample investigated was modern, the insect remains were well preserved. Confirmation of species by the aedeagus is not usually possible in archaeological material, since such fragile parts do not always survive. Although the insects were comminuted by action of the bird's digestive tract, enough large fragments survived for identification. Under suitable conditions, the sclerites would probably be preserved more intact allowing the use of additional identification criteria.

Problems in the identification of insects from modern samples are also applicable to archaeological material. Additional species are found in modern material, which were thought not to inhabit Britain (Hammond, 1932); this also occurs in archaeology, so providing new indicators of environmental conditions.

Archaeological bird pellets have been recovered from trackways in the Somerset Levels, in particular the Sweet Track and the Abbot's Way. Analysis resulted in the production of insect species lists, environmental interpretations, and discussion of the birds responsible for the pellets (Girling, 1977, 1979).

Introduction into particular ecological areas of species requiring different habitats to those immediately available, may lead to problems in interpretation. However, as birds avoid undertaking long journeys whilst carrying pellets, environmental inferences might not be significantly altered. It is as well to be aware of this possible source of error (Kenward, 1975, 1976).

Insects are frequently used as environmental indicators because of their specific habitat requirements. Consequently, particular archaeological micro-climates, often man-made, may be extrapolated from insect remains, as well as more general climatic changes on a larger scale. In such cases, the insect remains would not usually be contained in bird pellets.

The investigation of insect remains in a sample of bird pellets from Wharram Percy, Yorkshire, has provided valuable experience in the field of entomology.

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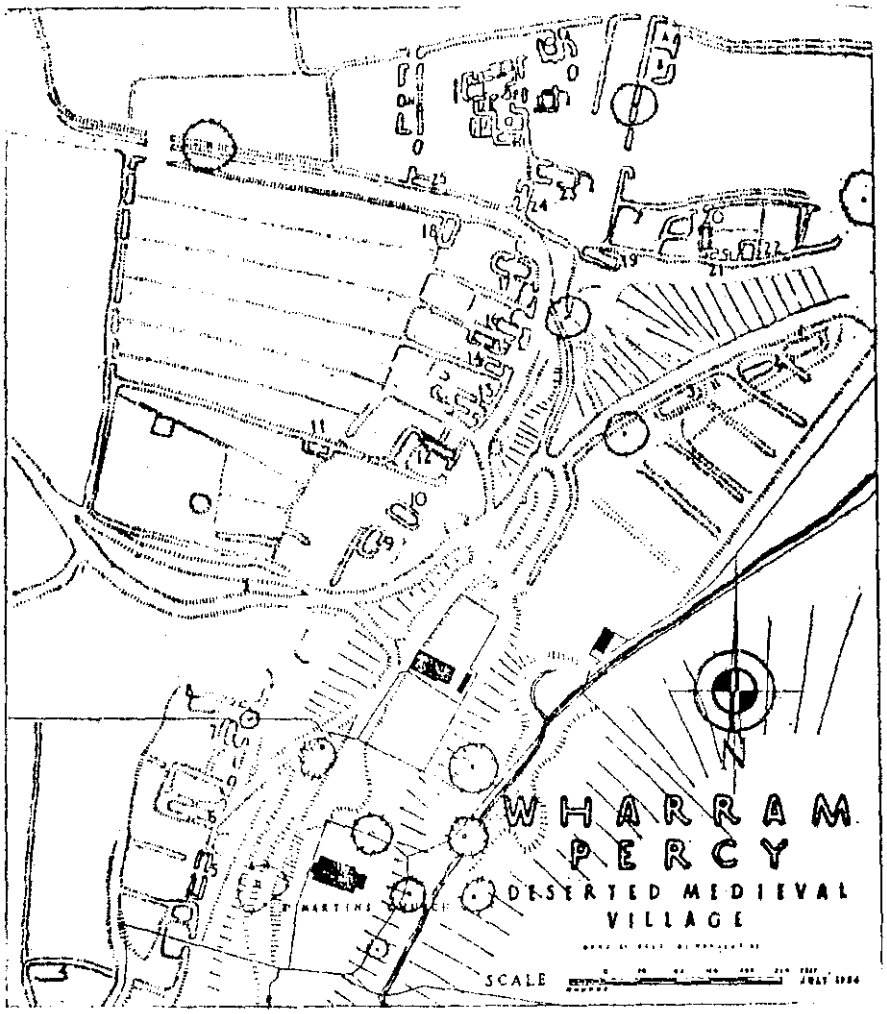
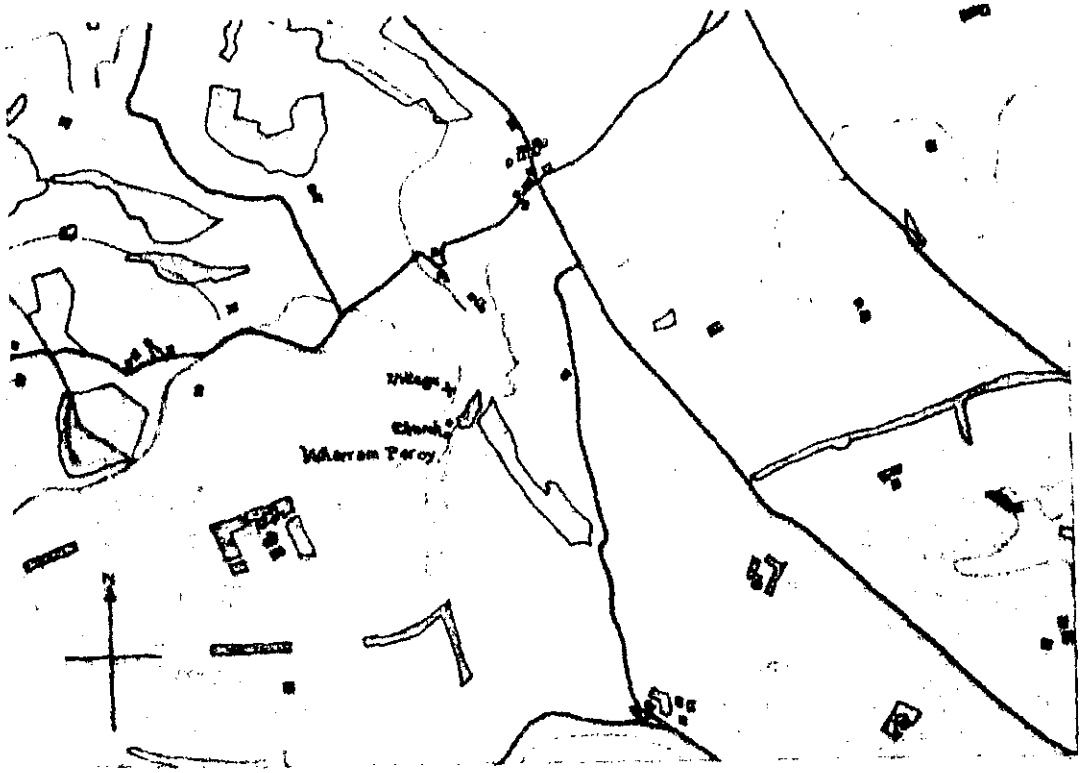


Site plan of the deserted medieval village at Wharram Percy, Yorkshire.

[Hurst, J.G. (1956). Deserted Medieval villages and the excavations at Wharram Percy, Yorkshire. pp. 251-274 in (Bruce-Mitford, R.L.S. ed.) Recent Archaeological Excavations in Britain. Routledge and Kegan Paul: London.]

FIGURE 1 : Plan of Wharram Percy, Yorkshire.



Scale:- 1 : 50,000

Key:-

- metalled road
- stream
- building
- stand of trees
- Land > 152 m above sea level

[Sheets 100 and 101 of Ordnance Survey, 1:50,000 First Series]

FIGURE 2 : Map showing general environment around the deserted medieval village of Wharram Percy, Yorkshire.

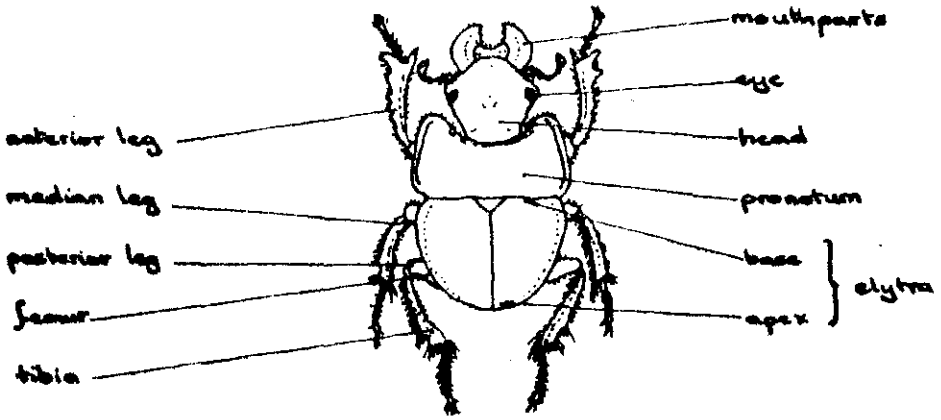


FIGURE 3 : General morphology of beetle.

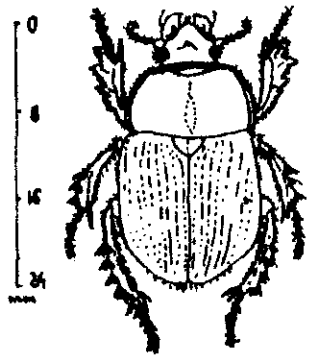


FIGURE 5 : Geotrupes.

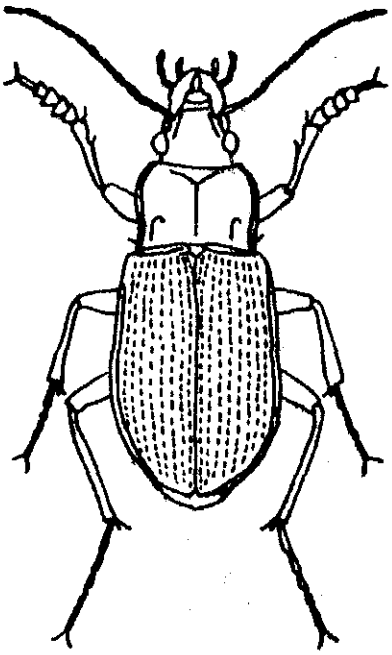


FIGURE 6 : Carabidae.

Scale ?

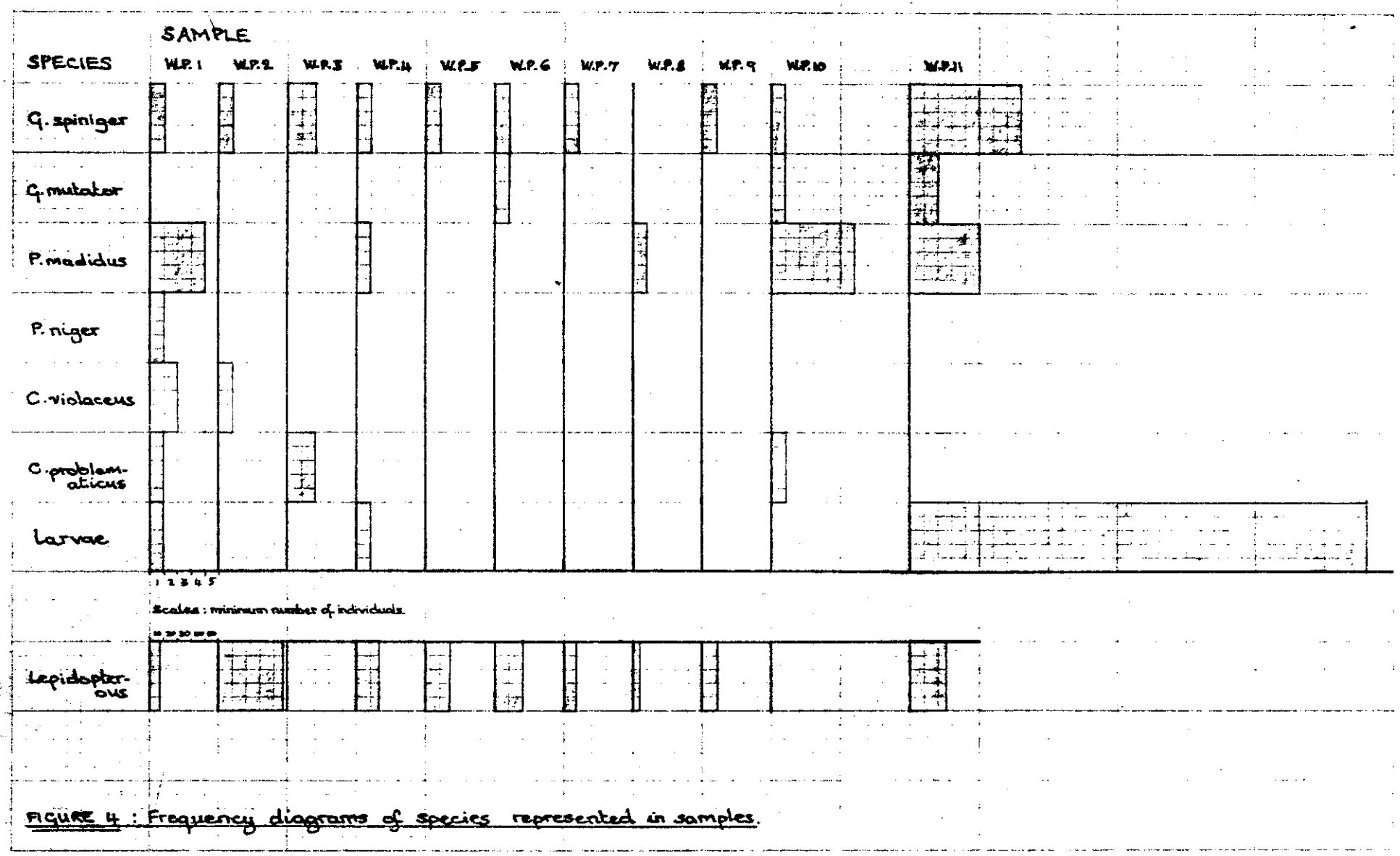


FIGURE 4 : Frequency diagrams of species represented in samples.

SPECIES	SAMPLE										Species total.	Genus total.		Species total.	Genus total.
	W.P. 1	W.P. 2	W.P. 3	W.P. 4	W.P. 5	W.P. 6	W.P. 7	W.P. 8	W.P. 9	W.P. 10			W.P. 11		
Geotrupes spiniger	1	1	2	1	1	1	1		1	1	10	11	8	18	21
Geotrupes mutator						1					1		2	3	
Pterostichus madidus	4			1				1		6	12	20	5	17	25
Pterostichus niger	1										1			1	
Carabus violaceus	2	1									3			3	
Carabus problematicus	1		2							1	4			4	
Lepidopterous	7	46		16	18	20	9	5	11			132	25		157
Larvae	1			1								2	33		35

TABULATED RESULTS.

NAME	SITE	W.P.	①			
	HEADS	PRONOTA	L.ELYTRA	R.ELYTRA	OTHERS	TOTAL
Geotrupes spiniger	H. I J. I M. I		A. I ?F. I	B. I	LEG. A. I M. I P. I AB. F. III	1
Carabus violaceus	H. II	L.H. II	B. I A. I ?F. I	B. II	LEG. I USD. F. I	2.
Pterostichus niger				B. I A. I F. I		1
Pterostichus madidus	H. IIII	II F. IIII LH. I RH. I	B. IIII II F. II	B. IIII F. III		4
Carabus problematicus		I		A. I		1
larvae					I	1
Lepidopterous					J. IIII IIII IIII	7
		W.P.	②			
Geotrupes spiniger		F. I			LEG. A. II M. II P. I	1
Carabus violaceus					USD. F. IIII I	1
Lepidopterous					J. IIII IIII IIII I IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII	46
		W.P.	③			
Geotrupes spiniger	H. II J. I	F. III	AF. I F. I	AF. I	LEG. A. II M. I P. II USD. F. III PLATE I	2.
Carabus problematicus	H. II	F. II	?F. I		LEG. IIII ADCS. I	2.
		W.P.	④			
Pterostichus madidus			?F. II			1
Geotrupes spiniger		F. III			LEG. I	1
larvae					I	1
Lepidopterous					J. IIII IIII IIII IIII IIII IIII I	16
		W.P.	⑤			
Geotrupes spiniger		F. II			LEG. F. I	1
Lepidopterous					J. IIII IIII IIII IIII IIII IIII IIII I	18

NAME	SITE HEADS	W.P. PRONOTA	⑥ L.ELYTRA	R.ELYTRA	OTHERS	TOTAL
Geotrupes spiniger	F.1	F. 卌 II			LEG. M. II P. II	1
Geotrupes mutator					LEG. A. 1	1
Lepidopterous					J. 卌 卌 卌 卌 卌 卌 卌 卌 IIII	20
		W.P.	⑦			
Geotrupes spiniger		?F. 1.			LEG. A. 1	1
Lepidopterous					J. 卌 卌 卌 II	9
		W.P.	⑧			
Pterostichus madidus	1	1			AG. F. 1	1
Lepidopterous					J. 卌 IIII	5
		W.P.	⑨			
Geotrupes spiniger					LEG. M. II	1
Lepidopterous.					J. 卌 卌 卌 卌 1	11
		W.P.	⑩			
Geotrupes spiniger					LEG. P. 1 F. 1	1
Pterostichus madidus	卌 1	II F. 1 LH. II RH. II	II B. IIII A. 1	II B. II A. 1	AGS. IIII AB. F. II	6
Carabus problematicus	F. 1	ANG. A. 1 P. 1	?F. 1			1
		W.P.	⑪			
Geotrupes spiniger	1 F. 1	II LH. II F. III RH. II	1 A. 1	A. II	LEG. A 卌 卌 卌 TH. 卌 III P. 卌 卌 II	8
Geotrupes mutator.					LEG. P. II	2.
Pterostichus madidus.	II	1 F. 1	B. 卌	B. III		5
Lepidopterous.					J. 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 IIII	25
Larvae.					卌 卌 卌 卌 卌 卌 III	33