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THE FOODS OF CALIFORNIA QUAIL IN KAINGAROA STATE FOREST

by

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1. INTRODUCTION

Califomia quail *Lophortyx californicus* are the most successful and widespread upland gamebird in New Zealand. With the sole exception of Westland, the bird is currently included on the game licence of every Acclimatisation District in the country.

As a result of extensive studies of quail in New Zealand in the 1950's and 1960's (Gurr 1951; Williams 1952, 1955, 1957, 1959, 1960, 1963, 1965, 1966, 1967), we have a good knowledge and understanding of quail distribution, population dynamics, growth-rates and breeding patterns. Habitat requirements and food habits although investigated to some degree by Williams (1952, 1955) are less well known, with the latter being limited to analysis of summer foods of 16 quail from the Taupo area and the winter foods of 16 and 22 quail from Marlborough and Central Otago respectively.

Williams *et al* (1983) in a review of gamebird research, recognised that quail were in exotic forests and that these forests were rapidly expanding. They recommended to the Wildlife Research Liason Group** as priority 1 for Enhancement research, that "The habitat requirements within and utilisation of exotic forest plantations and native forest remnants by California quail", be studied.

The Wildlife Service decided to implement this recommendation and a 12 month investigation of the foods of quail in Kaingaroa State Forest began in February 1985. The results of this study are reported here as a contribution to a more comprehensive inter-agency research project on this species, which includes; a survey of California quail in Kaingaroa State Forest (Harrison 1989), a method of assessing upland game habitat: California quail in Central Otago (Ogle and Caithness 1989), California quail: a national survey (Soulsby and Buchanan 1986).

* This report was presented at a California quail research and management seminar in Wellington, 17 October 1986 by the New Zealand Wildlife Service which is now part of the Department of Conservation.

**The Wildlife Research Liason Group was formed in 1981, to promote wildlife research in New by encouraging communication between all wildlife interest groups and to review recent and current research.

The objectives for this study were:

a) to carry out a comprehensive survey of the foods taken by California quail in an exotic forest.

b) examine seasonal food preferences in relation to their availability.

c) examine feeding activity in relation to time of day and day length.

d) identify species of common plants rejected by quail.

e) consider the role of native plants as food items to an alien bird.

3. STUDY AREA

Kaingaroa State Forest covers some 138,000 ha and lies on the central North Island pumice plateau, stretching from near Taupo to Murupara. Twenty three species of exotic trees, heavily dominated by *Pinus radiata*, are under cultivation. The forest is dissected by roads and firebreaks to form some 1,400 compartments of approximately 100 ha average size. The forest is essentially a continuously changing mosaic of stands, ranging from newly planted to mature 30 year old trees, with a wide diversity of grasses, herbs and shrubs growing between most stands and the road margins.

However, Kaingaroa State Forest is used a great deal for forest management research projects. In some compartments, fertiliser and herbicide trials (among other trials) aimed at promoting tree growth and reducing weed competition respectively are carried out. It follows then, that depending on the particular management regime being tested, there can be marked differences between compartments containing trees of a similar age. The most noticeable are in those compartments where the use of herbicides has left the forest floor and sometimes the margins, bare.

4. METHODS

While quail are widespread in Kaingaroa State Forest, coveys are fragmented into breeding units for half of the year (October-March), in these months, collecting is time consuming and difficult. Consequently, we considered a realistic monthly sample of between 10 and 20 birds, would suffice for the 12 months feeding study. With the exception of September (1985), when only seven were collected, the minimum number was achieved. Overall, 198 birds were taken from 87 forest compartments (Figure 1), at a rate ranging from 7-25 per month.

Quail were located by driving along any vehicle access-way and were shot as opportunity allowed. There was no set collecting pattern on any hunting foray except that for reasons of convenience, the Rotorua-based hunters in taking birds as they found them collected most birds in the northern half of the forest.

For each specimen, time, date, location, age and sex and the full complement of standard measurements (Gurr, 1951) were taken. The latter will be dealt with elsewhere (Caithness, in prep.).

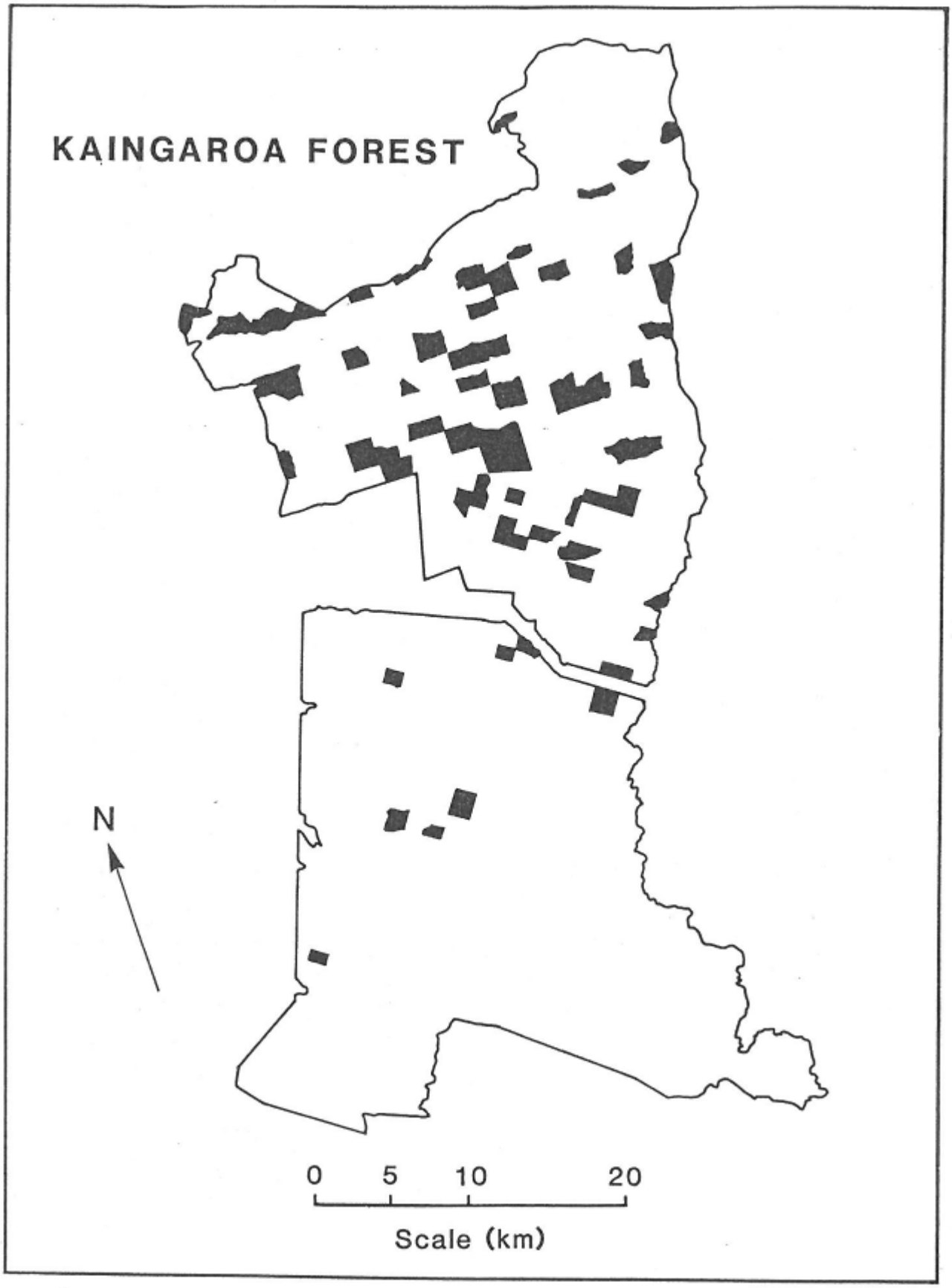

Figure 1 :Compartments of Kaingaroa State Forest from which quail were collected.

On removal from the bird, the intact crop volume was placed in a graduated cylinder and its volume measured to 0.1 cm^3 by displacement of No. 9 lead shot. When the crop contents were emptied onto a petrie dish, the displacement of the crop proper was taken and deducted from the original measurement to give a net crop volume.

Crop contents were sorted into vegetation, seed, grit and insect remains, and the amount of each estimated as a proportion of the total crop volume. Vegetation and seeds were then, in turn, sorted by genus and/or species and the quantity of each recorded as a proportion of the total crop volume.

Most crops contained some unidentifiable material: leaf material was often distorted and fragmented in the preparation process; seeds, especially of the diminutive legumes such as *Lotus* sp. were taken before maturity; and from winter samples, a considerable bulk of unidentifiable and twigs was encountered. We made no attempt to identify grass leaves and seed heads to species but simply lumped them together as unidentified Gramineae (grass).

The foods were identified by comparison with cuticle, seed and insect reference collections.

Although crop collection began in February 1985 and ceased in January 1986, we have appraised and presented the data as though they referred to one calendar year.

Where common names of plants and invertebrates exist they have been used throughout the text. Scientific names are given for invertebrates in Table 1 and for plants in Appendix 1.

5. RESULTS

5.1 Food Composition

The proportions of the four dietary groups (seed, vegetation, invertebrates and including grit) taken throughout the year are shown in Figure 2. Volumetrically vegetation, which includes leaves, flowers, seed-heads and seed pods; dominated in the ranging from 66% in April to 72% in December, and peaking at 92% in October. Seeds, while taken in all months, dominated in January (73%), February (80%) and March (49%). Insects were relatively unimportant in volumetric terms, constituting only 4 - 8% of total food in summer and mid-autumn (Table 1). Caterpillar larvae, grasshoppers, the small plant bug *Nysius huttoni* and staphylinid beetles were the insects most frequently taken. Grit was an insignificant contributor to the volume of crop contents. Williams (1952) also reported finding very small proportions of insect and grit in the 54 quail crops he examined, and he agreed with Schwartz and Schwaaz (1950) that the small amount of grit is correlated with the high percentage of seeds in the diet. In this study, it is notable that grit volumes tended to be generally greater when seed volumes were low, principally through winter (Fig. 3). The classical role of grit as a grinding agent it seems is important when the crop loading is vegetative material and largely fibrous.

5.2 Daily Feeding Pattern

California quail are exclusively diurnal feeders, judging from the fact that their crops are virtually empty at dawn and fullest at dusk. The crop volume and time of collection are known for 189 birds and the daily feeding patterns have been examined by aggregating the monthly samples into the four quarters of the year, viz. 1 January to 31 March, etc. (Figure 4).

In January-March (Fig. 4a.) when seeds were readily available and dominated the diet, feeding patterns seem bi-modal with peaks at mid-morning and late in the day. Williams (1952) reported similar findings. From late autumn until the middle of spring, when day length is short and the birds feed almost exclusively on green vegetation (Fig. 4b & c), the feeding effort appeared to be constant throughout the day. From October until the end of December, when birds were breeding and flower heads were important in the diet (Figure 4d), the trend of increasing crop volume with time of day remains, but feeding intensity shows no obvious pattern. This is probably related to breeding birds engaged in nesting and brood care duties, taking whatever opportunity they had to feed.

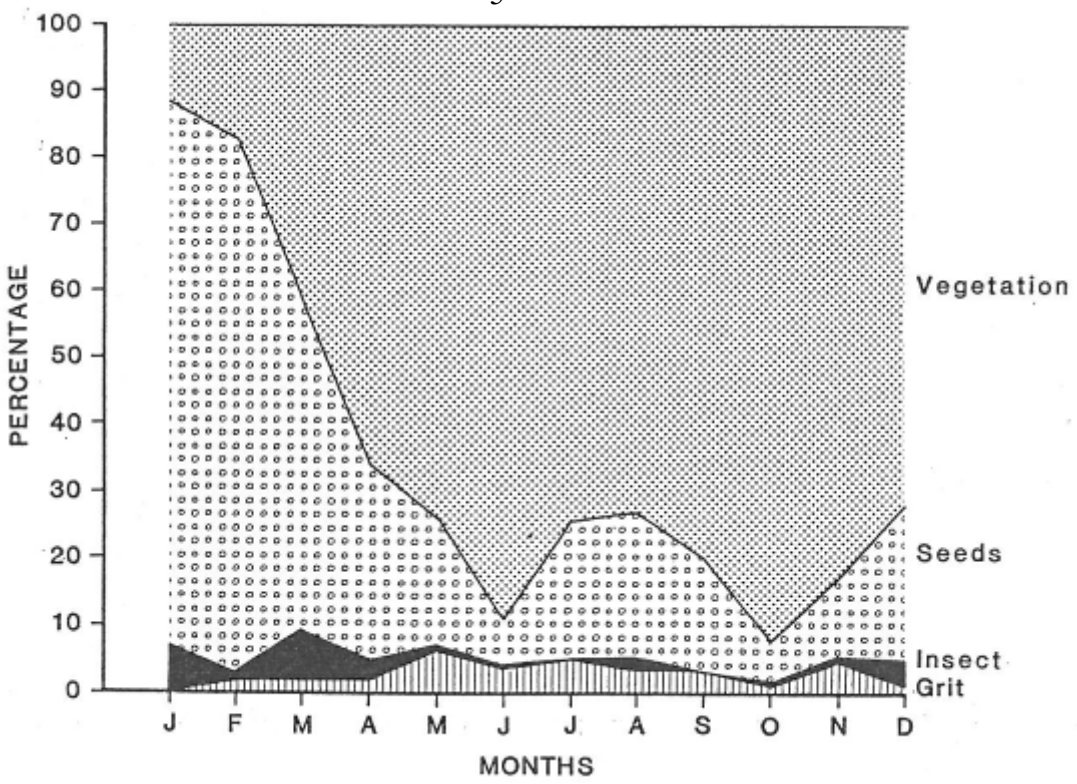

Figure 2: The proportions of vegetation, seeds, insects and grit taken by 198 California quail for each month of the year.

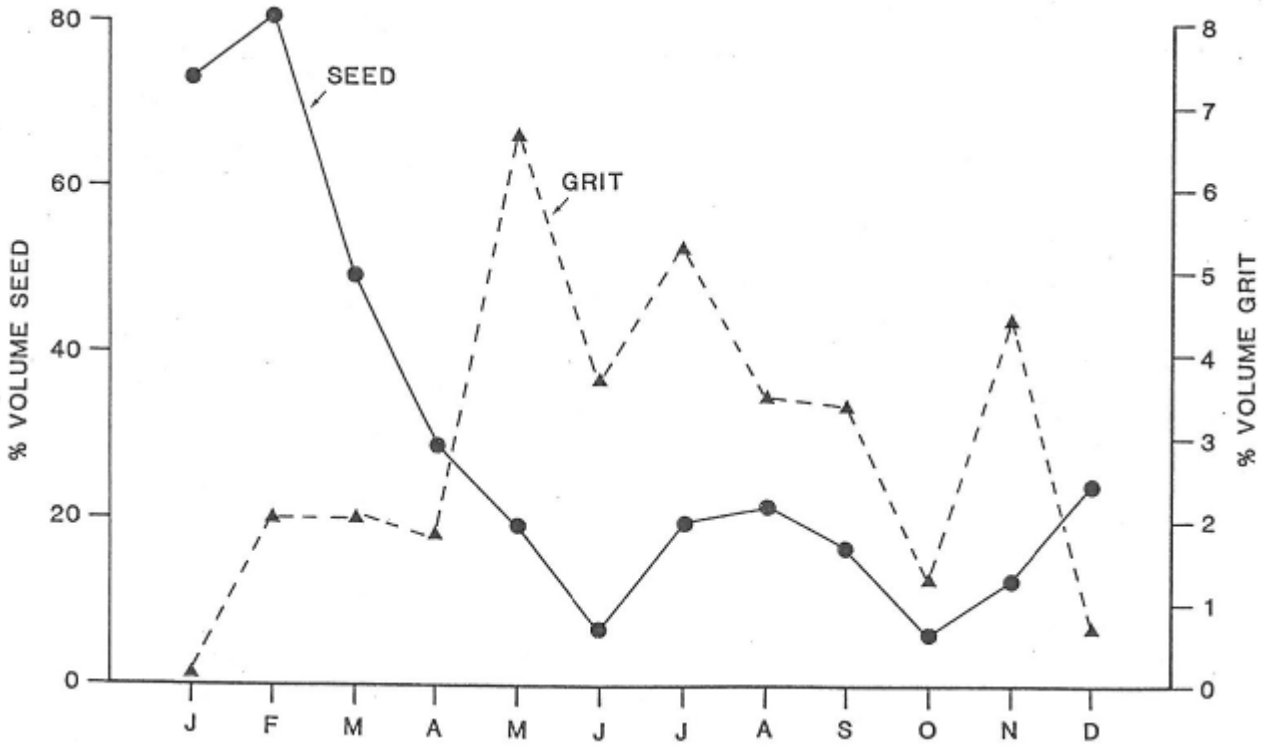

Figure 3 : Percentage volume of seed compared with the percent volume of grit for each month of the year.

Table 1: percent of California quail taking invertebrates each month

Superscript L = larvae, P = pupae, N = nymph, others = adults

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
No. of birds	18	11	21	12	15	18	16	19	7	19	25	17
ORTHOPTERA (Grasshoppers and wetas)												
Acrididae	6	9	29	8	-	6	-	-	-	-	-	-
Tettigoniidae	6	-	-	-	-	-	-	-	-	-	-	-
HYMENOPTERA (Wasps and ants)												
Ichneumonoidea	-	-	-	8	-	-	-	-	-	5	-	-
Formocoidea	6	-	-	17	-	-	-	-	-	-	-	6
HEMIPTERA (Plant and shield bugs)												
Lygaeidae	6	9	5	-	-	-	-	-	-	5	-	29
Pentatomidae	-	-	-	-	-	-	-	-	-	-	-	6
HOMOPTERA (Cicadas)												
Cicadidae	17	-	-	-	-	-	-	-	-	-	-	12^{N}
DIPTERA (Flies)												
Tipulidae	6	-	5	-	-	-	-	-	-	-	-	6
Calliphoridae	6	9	-	8	-	-	-	-	-	-	-	-
COLEOPTERA (Beetles)												
Carabidae	-	9	-	-	-	-	-	-	-	-	-	6
Cicindelidae	11	-	-	-	-	-	-	-	-	-	-	18
Coccinellidae	-	-	-	-	-	-	-	-	-	-	4	-
Curculionidaae	-	-	5^{L}	-	-	-	-	-	-	-	-	6
Elateridae	6	18	5^{P}	-	-	-	-	-	-	-	4^{L}	18
Scarabaeidae	-	-	-	-	-	-	-	-	-	-	-	24
Staphylinidae	11	-	5	-	-	-	6	5	-	11	-	6
Anobiidae	-	-	-	-	-	6	-	-	-	-	-	-
LEPIDOPTERA (Moths & butterflies)	39^{L}	9^{L}	$43^{L\ \&\ P}$	17^{L}	-	11^{L}	-	-	-	5^{L}	-	-
ARANEAEA (Spiders)	22	-	5	17	-	6	-	-	-	-	-	-
MILLIPEDA	11	-	5	-	-	-	-	-	-	-	12	18
AMPHIPODA	-	-	-	-	-	-	-	5	-	-	-	-
Unidentified fragments	11	-	5	17	7	-	13	5	-	-	-	-

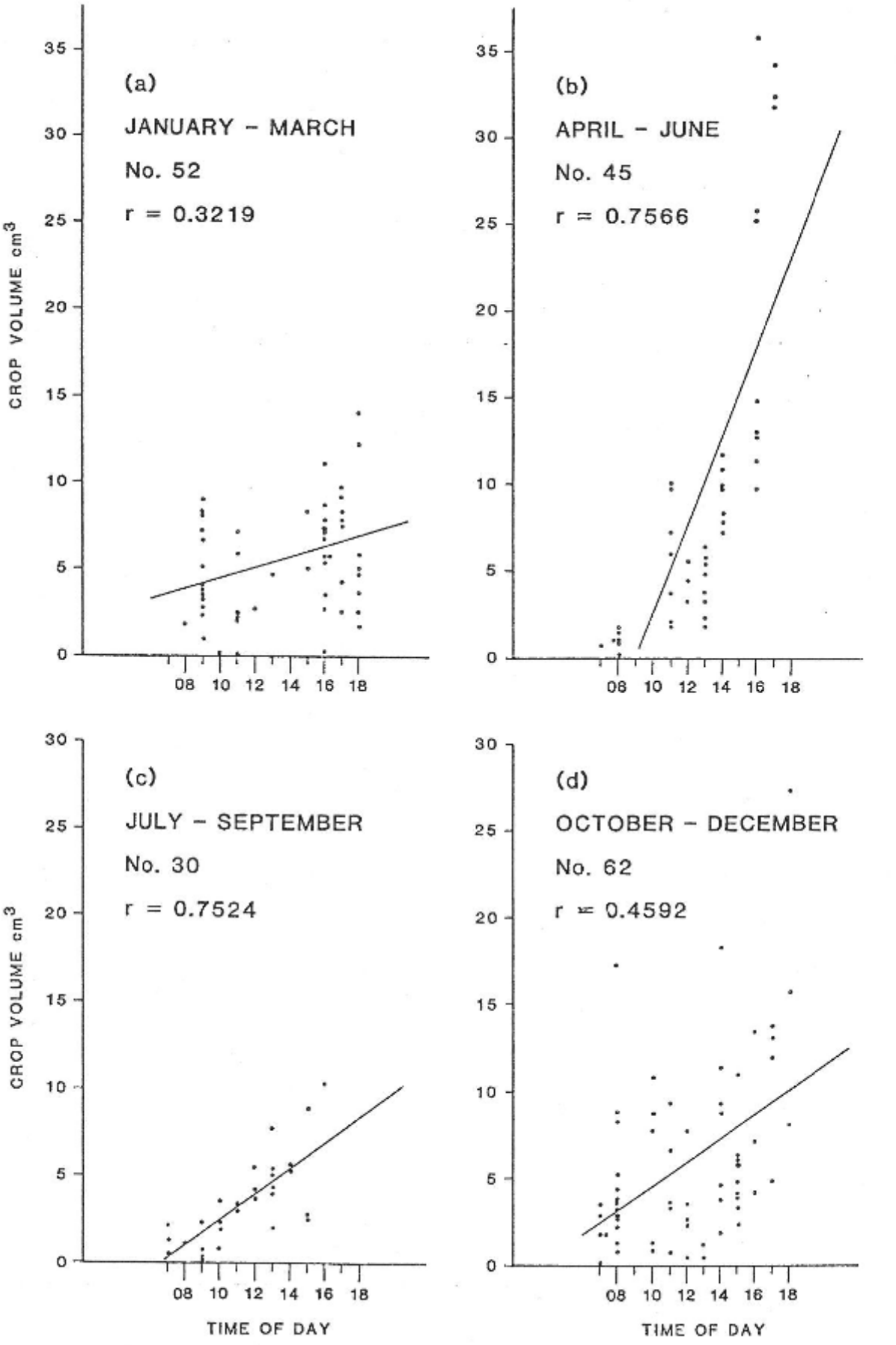

Figure 4: Crop volumes cm3 in relation to time of day for January-March 4a, April-June 4b, July-September 4c and October-December 4d

5.3 Foods

From the 198 crops examined, 43 plants were identified to species and an additional 24 plants to genus (Appendix 1). Of the 43 identified to species, eight; broom, lotus, white clover, scotch thistle, hawksbeard, catsear, dandelion and sheep's sorrel, featured prominently in the diet because they were taken regularly throughout the year as either leaf, flower, seed-head or seed, according generally to each species' annual phenology. Lotus and sheep's sorrel were particularly important, in combination, in the diet excluding their seeds, they jointly made up 31% of the total vegetative intake. Excluding scotch thistle, which was taken only as seed, the above species made up 68% of that vegetative material which could be identified.

Nearly half (27) of the plant species were taken in one month only, with 25 being recorded from single birds.

Perhaps the most novel identifications were those of a single seed of marijuana, in September, and in March six birds from one covey consuming large amounts of mammalian dung (cattle were grazing through this compartment).

Seeds were taken from all but nine of the 67 plants identified to at least genus, those that were not were; fireweed, dandelion, *Mentha* sp., staggerwort, Spanish heath, mallow, tea tree, scarlet pimpernel and bracken, which of course has only spores. Twenty-six plants were taken as both vegetation and seed, while 32 were taken as seed only.

The 58 different seed species were, of course, largely taken through the seeding period of summer and into autumn with the peak diversity per bird occurring in February (Figure 5). Throughout winter, when the seed intake was least, the seeds consumed tended to be large and/or durable eg. those of the legumes, blackberry and *Coprosma* sp.

Almost all species taken as leaf material had leaves which were largely glabrous (without hairs); the two exceptions to this being hawksbeard and catsear. The leaves of fireweed, a truely pubescent (hairy) plant, were taken by a single bird in April. Including fireweed, four other pubescent plant species, woolly mullein, tar weed, hairy buttercup and buddleja, are very common in Kaingaroa State Forest, but none of these appeared in the crops.

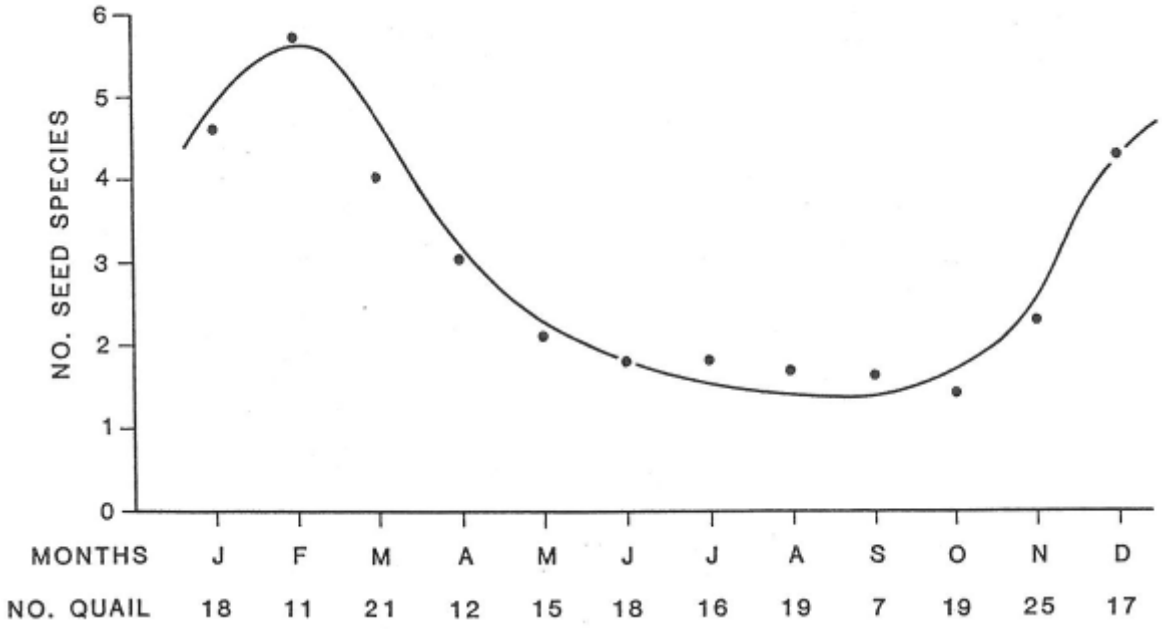

Figure 5: Average number of seed species taken per bird each month, calculated from three point running mean.

Native plants did not figure prominently in the quail's diet. However, of the nine native species taken, four were occasionally important (Appendix 1). Shrubbly haloragis was taken as seed heads and seeds in summer and autumn; tree tutu leaves and seeds were eaten in low volumes, mainly in winter; *Hydrocotyle* sp. seeds were eaten throughout the year; and *Coprosma* sp. leaves, seed heads and seeds were taken in winter and spring.

The monthly proportions by volume of vegetative material and seed are presented in 12 pairs of pie diagrams in Figures 6 (a, b, c,). The relative proportions of each dietary group are also shown at the top of these diagrams as vegetation, seed, insect and grit.

Marked changes in the species composition of foods taken between months, (June as distinct form May and July) doesn't necessarily imply a similarly marked change in availability. The major influences here are the small monthly sample sizes and more importantly, the differing locations from where the birds were collected.

The greatest diversity of foods were recorded in summer and early autumn. Here, the combine 159d vegetation and seed identifications made for December to March are significantly greater (X^2= 31.0 < 0.001) than in the four months, April to June when 102 identification were made. Species diversity was also narrow in late winter and spring when 124 identifications were made, this being significantly lower (X^2= 9.88, 0.05 < P > 0.001) than in the summer period.

6. DISCUSSION

Contributing in no small way to the success of California quail in New Zealand are its feeding habits. It is clear from the findings in this study and those of Williams (1952) that apart from markedly pubescent (hairy) plants, California quail will feed on an extremely wide variety of vegetative material. While introduced, low habit plants dominate, almost any leaf, but, flower or seed regardless of species and within reach, (within c.a 20 cm of ground level) will be consumed.

Seeds are preferred foods in January, February and March. Vegetative material, especially leaf, although ever present, dominate the diet for the nine months from April to December inclusive.

Day length has a profound influence on the quail's feeding rhythm. Throughout the year there is a general trend for crop volumes to increase as the day progresses. This is less marked in spring and than in autumn and winter, when shortened days limit the opportunity to feed.

While native plants are not generally distributed throughout the forest, some were occasionally taken by quail.

We conclude that other than in those areas of Kaingaroa State Forest where herbicides have been used extensively to reduce competition between weeds and young exotic trees, or the forest floor dense canopy, frost influence etc., that food availability alone, is unlikely to be a factor limiting the distribution or local numbers of California quail.

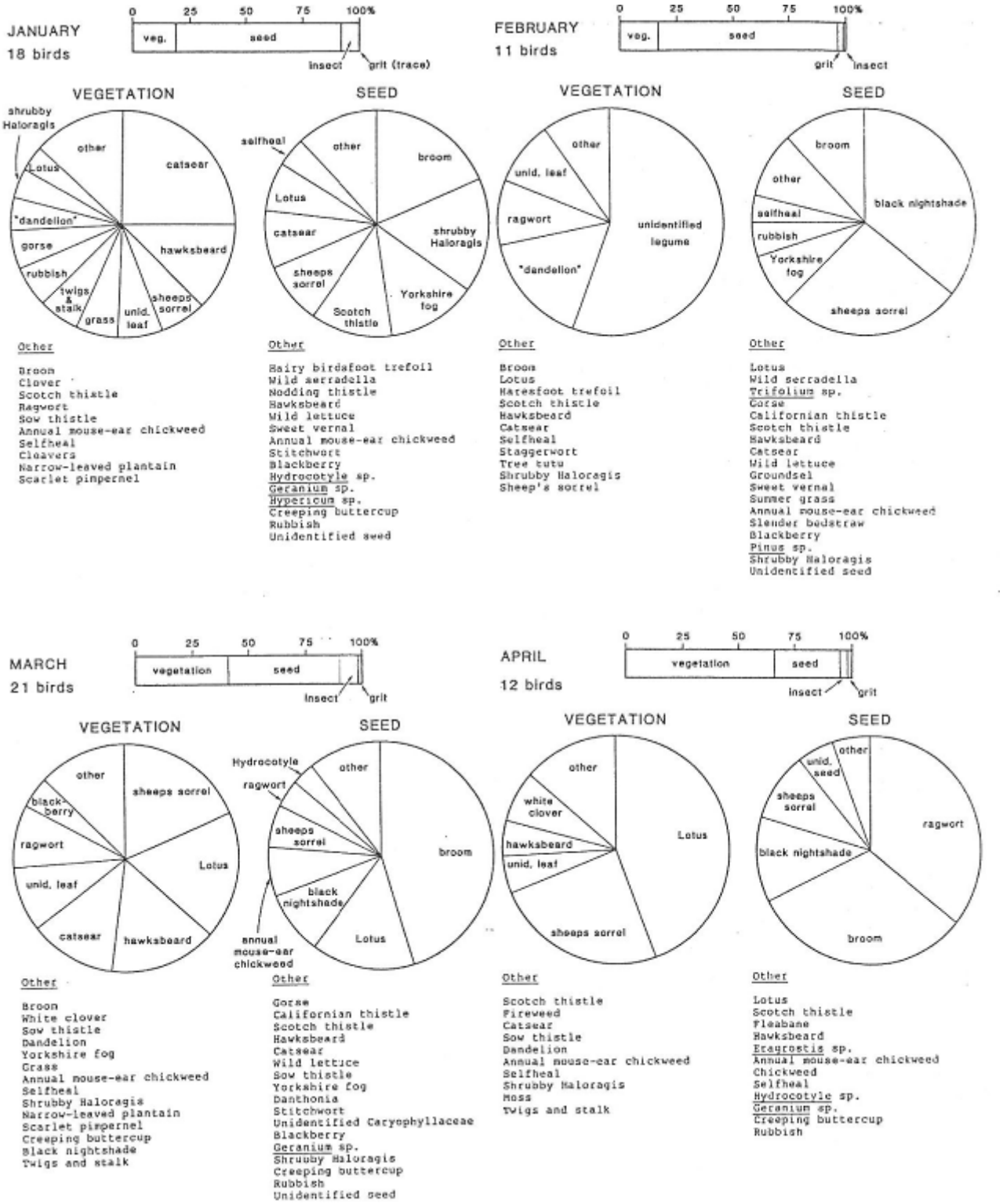

Figure 6a: Monthly proportions of total diet, vegetation, seed, insect and grit.

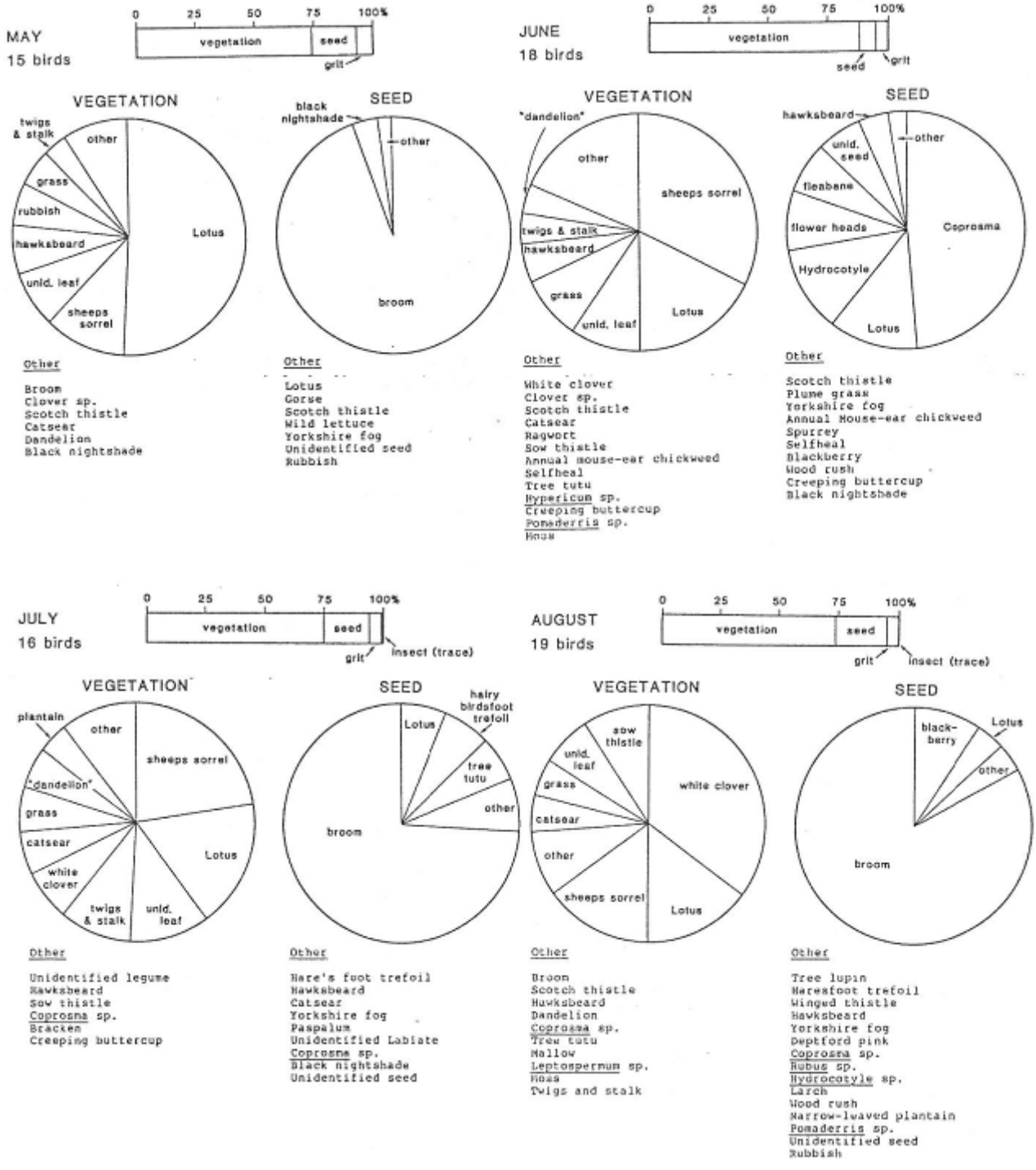

Figure 6b: Monthly proportions of total diet, vegetation, seed, insect and grit.

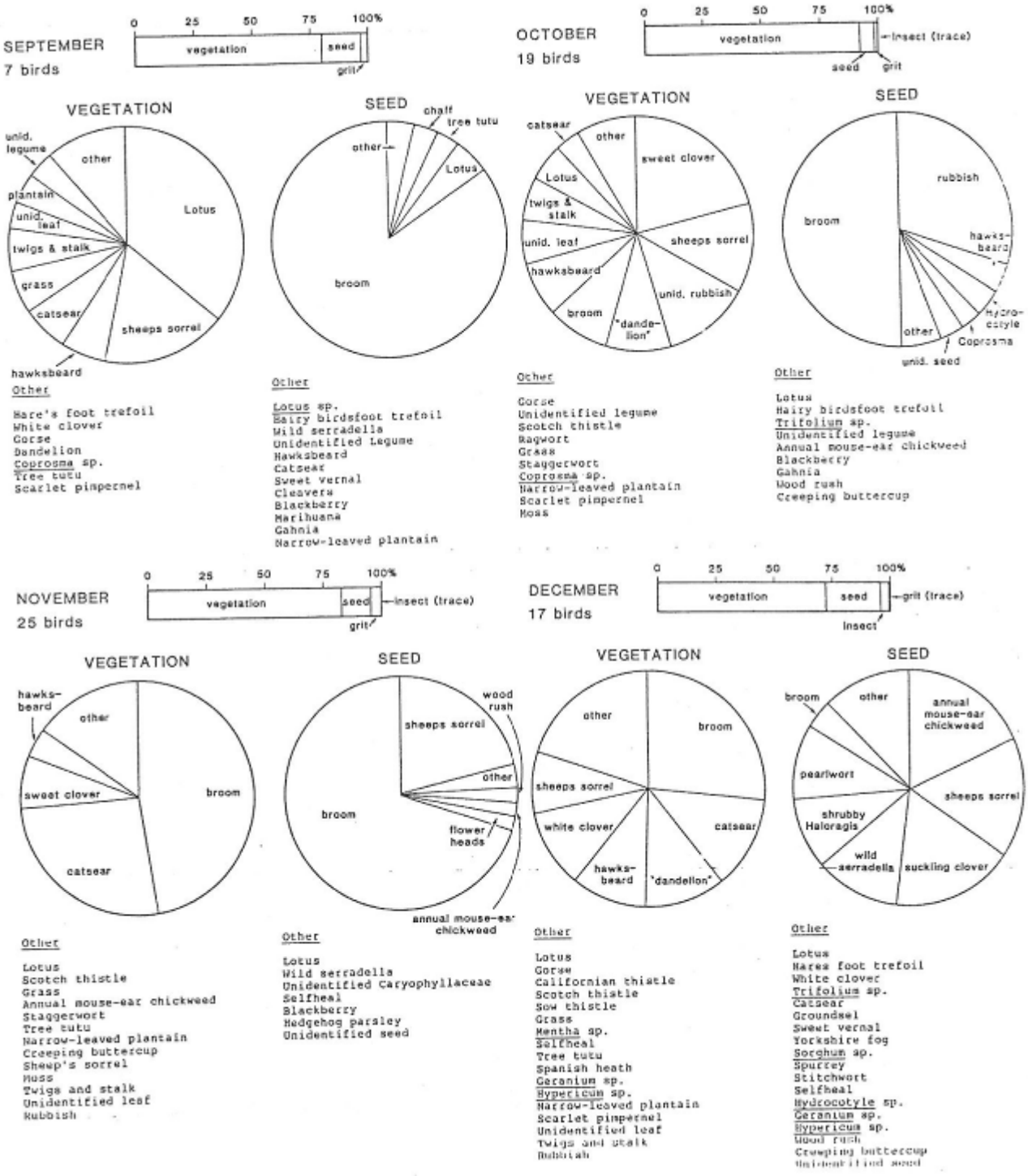

Figure 6c: Monthly proportions of total diet, vegetation, seed, insect and grit.

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	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
LEGUMINOSAE												
Cytisus scoparius	17F.lf	9Lf	14Sh.lf	-	7Sh		-	5Lf	-	16F	68F	59F
Broom	44	18	33	8	27	-	19	32	29	26	28	12
Lotus pedunculatus	17Lf.sh	9Sh.lf	14Sh.lf	92Lf.sh	93Lf.sh	94Lf.sh	81Lf.sh	32LF	100Lf	42Lf	12Lf	29Lf.sh
Lotus	72	9	67	50	27	56	25	21	43	11	4	29
L. suaveolens	-						-		-	-		
Hairy-birdsfoot trefoil	11	-	-	-	-	-	25	-	14	11	-	-
L. sp.									-			
	-	-	-	-	-	-	-	-	43	-	-	-
Lupinus arboreus								-				-
Tree lupin	-	-	-	-	-	-	-	11	-	-	-	6
Ornithopus perpusillus	-	-							-	-	-	-
Wild serradella	17	9	-	-	-	-	-	-	29	11	12	41
Trifolium arvense		9Lf					-	-	14Lf			-
Haresfoot trefoil	-	-	-	-	-	-	6	5	-	-	-	12
T. dubium												-
Suckling clover	-	-	-	-	-	-	-	-	-	-	-	18
T. repens	28Lf.f	9Lf	5Lf	25Lf		17Lf.sh	19Lf	42Lf	14Lf	47Lf	8Lf	35Lf
White clover	-	-	-	-	-	-	-	-	-	-	-	6
T. sp.		-			7Lf	6Lf.sh				-		
	-	9	-	-	-	-	-	-	-	5	-	-
Ulex europaeus	33Sh.lf	-	-		-				29F.lf	16Lf.sh		6Lf.sh
Gorse	-	9	5	-	7	-	-	-	-	-	-	-
Unidentified Leguminosae		36Lf.sh					12Lf.sh		29Lf	5Lf		
	-	-	-	-	-	-	-	-	14	5	-	-

Appendix 1: Percent occurrence by month of vegetation and seeds. F = flower, Sh = seed-head, Lf = leaf. Upper case denotes dominance. Seeds = lone figures, lower line.

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
COMPOSITAE												
Carduus nutans Nodding thistle	– 6	–	–	–	–	–	–	–	–	–	–	–
C. tenuiflorus Winged thistle	–	–	–	–	–	–	–	– 5	–	–	–	–
Cirsium arvense Californian thistle	–	– 9	– 5	–	–	–	–	–	–	–	–	–
C. vulgare Scotch thistle	11F.1f 44	9F.1f 18	– 33	25Sh.f.1f 25	13Lf.sh 7	6Lf 17	–	21Lf –	–	5Lf –	16F.1f –	18F.1f –
Conyza sp. Fleabane	–	–	–	– 8	–	–	–	–	–	–	–	–
Crepis capillaris Hawksbeard	56F.sh.1f 61	18F.sh.1f 18	62F.1f.sh 14	42F.sh.1f 25	20F.1f –	56Lf.sh 50	6Lf 6	5Lf 5	29Lf 14	42Lf.F 11	20F.1f –	53F.1f –
Erechtites sp. Fireweed	–	–	–	8Lf.sh –	–	–	–	–	–	–	–	–
Hypochaeris radicata Catsear	61F.sh.1f 78	27F.sh.1f 9	43F.sh.1f 33	17F.sh.1f –	33Lf.f –	11Lf.sh –	38Lf 19	37Lf –	29Lf 14	21Lf –	44Lf.f –	59F.1f 12
Lactuca sp. Lettuce (wild)	– 17	– 9	– 10	–	– 7	–	–	–	–	–	–	–
Senecio jacobaea Ragwort	6F.1f –	9F.1f –	43F.sh.1f 38	– 25	–	11sh.1f –	–	–	–	5F –	–	–
S. vulgaris Groundsel	–	– 18	–	–	–	–	–	–	–	–	–	– 12
Sonchus sp. Sow thistle	11Lf.f –	–	19F.1f 5	8F.1f –	–	6Lf –	12Lf –	21Lf –	–	–	–	6Lf.f –
Taraxacum officinale Dandelion	33Lf.f –	–	5F.1f –	17F.1f –	7Lf –	39Lf –	38Lf –	21Lf –	29Lf –	32Lf –	16Lf.f –	71Lf.f –
Unidentified Compositae	–	–	–	–	–	–	–	–	–	–	–	– 6

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
GRAMINEAE												
Anthoxanthum odoratum	–	–							–			–
Sweet vernal	44	18	–	–	–	–	–	–	14	–	–	35
Dichelachne sp.						–						
Plume grass	–	–	–	–	–	6	–	–	–	–	–	–
Digitaria sanguinalis		–										
Summer grass	–	9	–	–	–	–	–	–	–	–	–	–
Eragrostis sp.				–								
	–	–	–	8	–	–	–	–	–	–	–	–
Holcus lanatus	–	–	19Sh.lf		–	–		–				–
Yorkshire fog	95	27	52	–	7	6	–	5	–	–	–	12
Paspalum dilatatum							–					
Paspalum	–	–	–	–	–	–	6	–	–	–	–	–
Rytidosperma sp.			–									
Danthonia	–	–	5	–	–	–	–	–	–	–	–	–
Sorghum sp.												–
	–	–	–	–	–	–	–	–	–	–	–	6
Unidentified Gramineae	67Sh.lf		5Sh.lf		27Lf	61Lf	25Lf	63Lf	57Lf	5Lf	4Lf	12Lf.sh
	–	–	–	–	–	–	–	–	–	–	–	12
CARYOPHYLLACEAE												
Cerastium glomeratum	6F.lf	–	5F.sh	8F.sh		11F.lf				–	4F.lf	–
Annual mouse-ear chickweed	17	9	10	17	–	6	–	–	–	5	8	59
C. sp.				–								
Chickweed	–	–	–	8	–	–	–	–	–	–	–	–
Dianthus armeria								–				
Deptford pink	–	–	–	–	–	–	–	5	–	–	–	–

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
CARYOPHYLLACEAE (Cont'd)												
Sagina procumbens Pearlwort	-	-	-	-	-	-	-	-	-	-	-	- 6
Spergula arvensis Spurrey	-	-	-	-	-	- 6	-	-	-	-	-	- 6
Stellaria media Stitchwort	- 6	-	- 5	-	-	-	-	-	-	-	-	- 6
Unidentified caryophyllaceae	-	-	- 5	-	-	-	-	-	-	-	- 4	-
LABIATAE												
Mentha sp.	-	-	-	-	-	-	-	-	-	-	-	6Lf -
Prunella vulgaris Selfheal	22F.lf 83	27F.sh.lf 64	5Sh.lf -	17Sh.lf 33	-	17Sh.lf 11	-	-	-	-	- 4	18F.lf 23
Stachys arvense Staggerwort	-	9F -	-	-	-	-	-	-	-	5F.lf -	4F.lf -	-
Unidentified Labiatae	-	-	-	-	-	-	- 6	-	-	-	-	-
RUBIACEAE												
Coprosma sp.	-	-	-	-	-	- 23	6Sh.lf 13	5Lf.sh 5	14Sh.lf -	5Sh.lf 11	-	-
Galium aparine Cleavers	6Sh.lf -	-	-	-	-	-	-	-	- 14	-	-	-
G. divaricatum Slender bedstraw	-	- 9	-	-	-	-	-	-	-	-	-	-

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
ROSACEAE												
Rubus fruticosus Blackberry	– 39	– 27	5Lf.sh 10	–	–	– 11	–	– 11	– 14	– 11	– 8	–
R. sp.	–	–	–	–	–	–	–	– 5	–	–	–	–
UMBELLIFERAE												
Hydrocotyle sp.	– 6	–	– 24	– 8	–	– 39	–	– 5	–	– 18	–	– 6
Torilis nodosa Hedgehog parsley	–	–	–	–	–	–	–	–	–	–	– 4	–
PINACEAE												
Larix sp. Larch	–	–	–	–	–	–	–	– 5	–	–	–	–
Pinus sp. Pine	–	– 9	–	–	–	–	–	–	–	–	–	–
CANNABIDACEAE												
Cannabis sativa Maribuana	–	–	–	–	–	–	–	–	– 14	–	–	–
CORIARIACEAE												
Coriaria arborea Tree tutu	–	9Lf –	–	–	–	6Lf –	– 31	5Lf –	14Lf 14	–	4Lf –	6Lf –
CYPERACEAE												
Gahnia sp. Gahnia	–	–	–	–	–	–	–	–	– 14	– 5	–	–
ERICACEAE Erica lusitanica Spanish heath	–	–	–	–	–	–	–	–	–	–	–	6Lf –

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
GERANIACEAE												
Geranium sp.	– 33	–	– 10	– 8	–	–	–	–	–	–	–	6Lf 18
HALORAGACEAE												
Haloragis erecta? Shrubby haloragis?	44Sh 39	9Sh 9	– 5	8Sh –	–	–	–	–	–	–	–	– 47
HYPERICACEAE												
Hypericum sp.	– 6	–	–	–	–	6Lf –	–	–	–	–	–	6Lf 18
JUNCACEAE												
Luzula sp. Wood rush	–	–	–	–	–	– 6	–	– 5	–	– 5	– 16	– 18
MALVACEAE												
Malva sp. Mallow	–	–	–	–	–	–	–	5Lf –	–	–	–	–
MYRTACEAE												
Leptospermum sp. Teatree	–	–	–	–	–	–	–	5Lf –	–	–	–	–
PLANTAGINACEAE												
Plantago lanceolata Narrow-leaved plantain	17Lf –	–	5Lf –	–	–	–	25Lf –	–	14Lf 14	5Lf –	4Lf –	6Lf –
PRIMULACEAE												
Anagallis arvensis Scarlet pimpernel	6F.lf –	–	5F.lf –	–	–	–	–	–	14Lf –	5F.lf –	–	6F.lf –
PTERIDACEAE												
Pteridium esculentum Bracken	–	–	–	–	–	–	6Lf –	–	–	–	–	–

	JAN	FEB	MAR	APR	MAY	JNE	JLY	AUG	SEP	OCT	NOV	DEC
No. Crops	18	11	21	12	15	18	16	19	7	19	25	17
RANUNCULACEAE												
Ranunculus repens Creeping buttercup	– 33	–	5Lf 5	– 8	–	10Lf 6	6Lf –	–	–	– 5	4Lf –	– 6
RHAMNACEAE												
Pomaderris sp.	–	–	–	–	–	6Lf –	–	– 5	–	–	–	–
POLYGONACEAE												
Rumex acetosella Sheep's sorrell	50Lf.sh 56	9Lf.sh 45	57Lf.sh 57	67Lf.sh 58	60Lf.sh –	94Lf.sh –	81Lf.sh –	63Lf –	86Lf –	42Lf –	16Lf.f 24	35Lf.f 76
SOLANACEAE												
Solanum nigrum Black nightshade	–	– 45	5Sh.1f 10	– 8	7Sh.1f 7	– 6	– 6	–	–	–	–	–
BRYOPHYTE Moss	–	–	–	8Sh.1f –	–	17Sh.1f –	–	5Sh.1f –	–	5Sh.1f –	4Sh.1f –	
Unidentified stalk and twigs	50	–	5	8	33	22	69	32	57	37	8	24
Unidentified leaf) Unidentified seed)	72 61	18 36	81 42	67 33	80 27	83 50	94 25	53 5	43 –	68 21	8 8	29 29