FEEDING ECOLOGY OF THE TUATARA *(SPHENODON PUNCTATUS)* ON STEPHENS ISLAND, COOK STRAIT

G. Y. WALLS

*Zoology Department. Victoria University of Wellington**

SUMMARY: Food habits of the tuatara *(Sphenodon punctatus)* on Stephens Island, in north-western Cook Strait, were studied by field observations and faecal analysis. The tuatara is a selective predator, feeding on a wide range of small animals, mainly large insects. Its diet shows seasonal changes and habitat differences, related to local conditions: the coastal broadleaf forest habitat, which predominated in pre-European times but is now only represented by remnants, seems to be most favourable. The tuatara population, although large, seems to be no threat to the survival of any of its prey species.

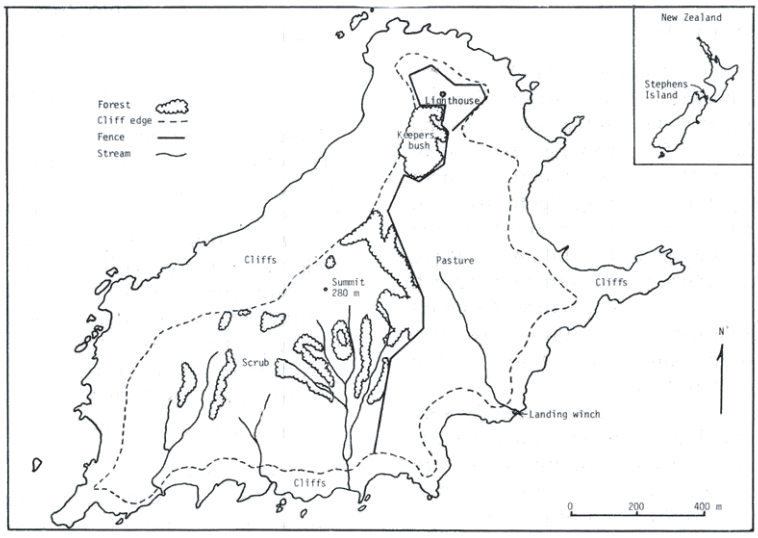

FIGURE 1. *Map of Stephens Island, showing main habitat types.*

INTRODUCTION

The tuatara *(Sphenodon punctatus),* confined to offshore islands possessing breeding colonies of seabirds in New Zealand, has excited much scientific curiosity since its discovery by Europeans over a century ago, but most research has centred around anatomy and physiology whilst the animal's ecology has been neglected.

The literature shows that little is known of tuatara feeding ecology beyond a few casual observations and artificial feeding trials in captivity. In most general reports on tuatara habits, comments on food and feeding behaviour have often been speculative.

Buller (1876), Reischek (1881; 1885), Falla (1935), Dawbin (1949; 1962) and Newman, Crook and Moran (1979) have given the fullest descriptions of tuatara foods. Between them they have listed beetles, wetas, snails, geckos, skinks, earthworms, centipedes, flies, grubs, grasshoppers, spiders, eggs and chicks and adults of seabirds, and the remnants of fish and crustacea brought into burrows by seabirds, as items of natural diet. Though a few faecal pellets have been examined to reach these conclusions, much is supposition.

Various natural and artificial foods have been accepted by tuatara in captivity, including earth

* Present address: Botany Division, DSIR, Nelson.

worms, flies, cicadas, caterpillars, geckos, skinks, small fish, raw liver and steak, mealworms, locusts and new-born mice (Buller, 1876; 1878; Falla, 1935; Mertens, 1964; Newman, *et al.*, 1979).

The mode of capturing and eating prey has been described in some detail: an initial approach; cocking of the head; a darting grab; and then slow chewing and swallowing. Movement of the prey was deduced by these authors (Buller, 1878; Falla, 1935; Dawbin, 1953) to be the prime stimulus triggering the feeding response.

There has been no attempt though to elucidate the broad spectrum of diet in relation to season, habitat differences and potential prey availability. This field study on Stephens Island was designed to fill that gap.

STUDY AREA

Stephens Island is a cliff-bound island, 150 ha in extent, situated in northern Cook Strait (Fig. 1). It is exposed to frequent gales and is the breeding ground of large numbers of burrowing seabirds, in particular the fairy prion *(Pachyptila turtur)*. Human modification of the vegetation during lighthouse and farming operations has culminated in most of the original forest cover being lost, and now there remains a mosaic of scrub types, remnant forest, planted shrubs, tall grassland and pasture. Coupled with the large population of tuatara, this has provided a unique opportunity for study of the reptile in a variety of habitats.

The accessible parts of the island were divided into four main habitats (Fig. 1), mainly on the basis of vegetation, though further subdivisions are possible according to soil type (two main types, according to Ward, 1961), topography and zoological features:

1. Forest

Coastal broadleaf forest, comprised mainly of taupata *(Coprosma repens),* ngaio *(Myoporum laetum),* kohekohe *(Dysoxylum spectabile),* kawakawa *(Macropiper excelsum),* nikau *(Rhopalostylis sapida)* and mahoe *(Melicytus ramiflorus)*. The canopy is dense, wind-shorn and 4-6 m in height, and the understoreys are sparse. Forest occupies about 10% of the island's area.

2. Scrub

Varied vegetation including bracken *(Pteridium esculentum)* pohuehue *(Muehlenbeckia complexa),* akiraho *(Olearia paniculata),* the annual herb *Senecio sterquilinus,* tall grasses, New Zealand spinach *(Tetragonia trigyna)* and low shrubs of taupata and ngaio. Typically dense and tangled, this vegetation rarely exceeds 2 m in height and covers about a third of the island.

3. Edge

The junction between forest or tall scrub and pasture and. This contributes a minor though conspicuous habitat on the island, following the fences which separate the scrub and forest from the pasture.

4. Pasture

Pasture of introduced and native grasses and herbs, grazed by sheep and cattle, covering about a quarter of the island.

The fifth main habitat, that of the encircling coastal cliffs comprising about 40% of the island's area, was unsuitable for a full study, although some scat collections and faunal observations were made. The cliffs consist of precipitous unstable sedimentary rock and house some tuatara and many insects, geckos and nesting seabirds.

METHODS

Alternate periods of two weeks were spent on Stephens Island between April 1974 and April 1975, in order to explore the extent of seasonal changes.

Seasonal divisions were as follows:

Winter: four visits; late May to mid August 1974
Spring: three visits; early September to mid November 1974
Summer: three visits; early December 1974 to early February 1975
Autumn: three visits; April 1974, late February to early April 1975.

During each visit, a variety of activities was repeated.

Food available

A range of techniques was used to gain an indication of the food potentially available to tuatara in the field:

1. Pit-trapping. Tins embedded in the ground, (twenty in each of the four main habitats) were checked every 3 days for captured invertebrates and lizards.
2. Light-trapping. A light trap was set up in suitable weather conditions in a forest margin site to sample nocturnal flying insects.
3. Ground survey. Logs and rocks were lifted and ground cover examined for presence of invertebrates and reptiles in selected places in all habitats.
4. Burrow inspection. The breeding behaviour of fairy prions was followed with the aid of burrows fitted with observation lids (Walls, 1978). Subterranean activities of tuatara and invertebrates were also noted.

5. Soil sampling. Samples of soil from a variety of localities in each habitat were examined for the presence of ground-inhabiting invertebrates. A spade was used to take the soil samples, which were approximately 30 cm x 30 cm in surface area and the depth of the topsoil.
6. Night counting. Counts were made in fixed places at night of invertebrates, lizards, tuatara and birds on the ground surface and on low vegetation.

Monthly records from these methods were combined, and for each habitat the relative abundance of each prey group was estimated on a 0-3 scale:

0 = absent or rare 1 = low-moderate numbers
2 = common 3 = high numbers

Food eaten

Freshly deposited faecal pellets (scats) were collected from all over the island.

Each scat was teased apart in a 2 mm sieve under running water, then examined in a dish with a binocular microscope. A sample of the washings was examined under high magnification for indication of soft-bodied animals, such as earthworm setae and moth scales. Nearly 400 scats were examined in this way.

Owing to the coarse mastication given food by the tuatara, most fragments were large and easily recognisable. Once a familiarity with the Stephens Island fauna had been gained it was possible to quickly identify (to group at least) almost all fragments of invertebrates, reptiles and birds. The other constituents - plant material and inorganic matter - were also readily recognisable.

Each constituent or item in a scat was recorded, with an estimate of its percentage volume. Obviously, in attempting to quantitatively reconstruct the composition of the tuatara diet, this would bias the interpretation towards prey having solid or indigestible parts, such as beetle exoskeletons and gecko skin and bone. To try to allow for this, fresh specimens of items known to be almost entirely digested, such as earthworms and moths, were separately hand-macerated, and their importance in each scat estimated by comparison. The resulting figures were simplified to a 0-3 scale of abundance and aggregated according to prey group, habitat and season for comparison with data on potentially available food.

Feeding behaviour

Hunting, feeding and other activities of tuatara were observed, both by day and by night, by watching animals and noting events as they happened. Similarly, the behaviour of other organisms and seasonal phenomena were noted.

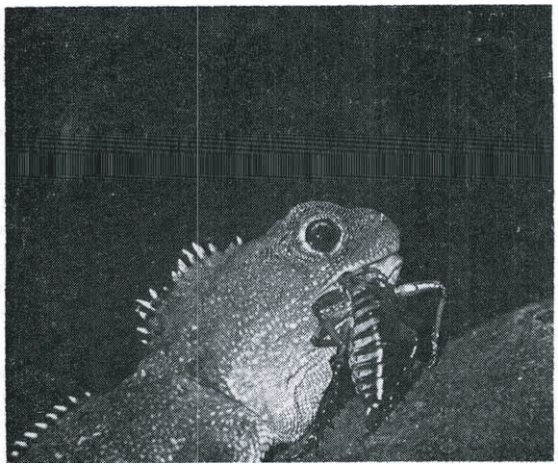

FIGURE 2. *Male tuatara eating a tree weta* (Hemideina crassidens)

Some experiments were performed to gauge the reaction of tuatara to various stimuli, including assorted invertebrates offered as food, using individuals in the wild and some caged temporarily for ease of observation.

RESULTS

Feeding behaviour

Most of the active foraging and feeding by tuatara in their natural environment occurs between dusk and midnight. They emerge from their burrows at night and move about the ground surface. Although least active in winter, tuatara do emerge on warmer evenings then, and throughout the year individuals are often above ground during the day and the latter part of the night if weather conditions (especially temperature) are suitable.

Prey were invariably seized in the mouth and crushed between the jaws (see Fig. 2), before being slowly chewed and swallowed. The tongue was sometimes seen to be used in manipulating prey in the mouth, but appeared not to be physically important during actual capture. Most impressive was the clumsiness of the feeding method: not only were prey frequently missed, at least initially, but other material such as vegetation and soil was often grabbed and ingested with prey.

By far the largest prey taken by tuatara were petrel eggs and chicks. Eggs and young chicks were eaten whole, but bigger chicks were killed by persistent biting and chewing, and subsequently gnawed. Large chicks were found that had escaped alter attack, usually with badly damaged limbs. Most

bird predation occurs in the burrows, and it is likely that tuatara visit different burrows in search of prey, although they normally inhabit a single home chamber.

Experiments showed that movement of the prey is of prime importance in eliciting feeding behaviour. A stick shuffled in leaf litter was sufficient to initiate repeated biting, and objects waved in the air attracted attention readily. Thus tuatara can be tempted into trying to ingest objects such as leaves and feathers.

Although a tuatara will attempt to ingest almost anything that moves in its vicinity, provided it is not too large or rapid-moving (in which case it acts as a deterrent), the shape, colour and texture of objects are also conditioning stimuli. Rounded, dark, smooth, shiny objects elicited the greatest response in feeding experiments. That olfaction plays a part in feeding too is suggested by the taking of petrel eggs and carrion, and the avoidance of certain invertebrates, as will be discussed further.

Material ingested

Over one hundred different items or types of material were recognised in the faeces (Appendix 1).

Insects, of which beetles were the major component, comprised 54% of the items detected in scats. Other invertebrates (spiders, millipedes, centipedes, earthworms, woodlice, snails, slugs, etc.) comprised 20 %. Reptiles and birds made up only 4 % each, and other animal material (feathers and sloughed reptile skin) 3 %. Plant material (leaves, flowers, seeds, stalks, twigs, etc.) comprised 14%, and inorganic material (soil and small stones) 2 % of the total number of items.

The most frequently occurring prey was the large darkling beetle *Mimopeus opaculus*. Other common prey were other darkling beetles, chafer beetles, small weevils, small ground beetles, wetas, moths, darkling beetle larvae, blowflies, small bugs, spiders. millipedes and earthworms.

Tuatara remains appeared only once in the analysed scats, these being most of a juvenile animal of less than 10 cm in total length. Portions of a forelimb of another juvenile were found in an old scat. Thus cannibalism appears to be rare.

Several items were clearly too small to have been deliberately ingested, and probably found their way into the scats either with other material or subsequent to defaecation. Some, such as blowfly maggots and rove beetles, were present because of the adult insects' attraction to freshly-deposited faeces. Hookworms and threadworms appear to be tuatara gut parasites. They are possibly scoured from the intestine by hard jagged items in the food, since they were most common in scats comprised predominantly of beetle and weta exoskeletons.

Soil, present in most scats, and stones are likely to have been ingested with animal matter, especially earthworms, since this was observed frequently as tuatara grabbed at moving prey. Plant material, especially grasses, was also very common in scats, but it is unlikely that any of this was deliberately eaten. Feathers, which abound on the ground surface during the periods in which seabirds are visiting the island, may have been mistaken for food because of movement, or perhaps eaten during attacks on adult birds.

Items not recorded in the scats analysed are known to have been ingested by tuatara. These include pieces of string and coloured knitting wool, which have been recorded in scats by lighthouse keepers; adult fairy prions and other small petrels, which were usually beheaded; and chocolate biscuits (a dubious record). Fragments of the native frog *Leiopelma hamiltoni*. confined to a very small area near the island's summit, have been found in one scat from there (Newman, 1977).

Tuatara will eat carrion. One large male was seen to return to the carcass of a fairy prion on several consecutive nights, and other birds were found that appeared to have been posthumously gnawed by tuatara.

Items conspicuously absent from diet

Several animal species, conspicuous in the field, were notably rare or absent in the tuatara faeces. They include the large ground beetles (Carabidae), which are common on Stephens Island and similar to the darkling beetles *(Mimopeus* spp.) which form a major part of the tuatara diet: they are probably distasteful (certainly they smell repulsive to humans). Captive tuatara when fed these ground beetles Quickly rejected and subsequently avoided them. Ants, shield and cinch bugs, and possibly woodlice, may be protected in the same way.

Cave wetas, sandhoppers, skinks and geckos, although abundant where tuatara live, form only a small part of the tuatara diet. Prey motility is the simplest explanation: the hunting approach by tuatara is too slow and deliberate to catch these rapid-moving animals often.

Adult burrowing seabirds, although potentially furnishing tuatara with a bountiful food source, are probably too pugnacious to be regularly killed, even by large males which have tremendous strength and stamina of jaw muscles. A few birds of the smaller species were occasionally found beheaded, but none occurred in the scats.

The scarcity of cannibalism amongst tuatara is probably a product of the extreme toughness of the

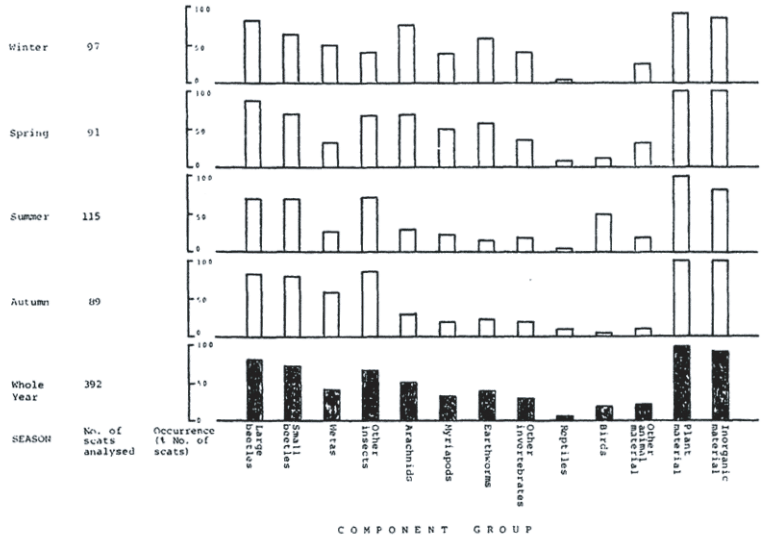

FIGURE 3. *Seasonal composition of tuatara scats: occurrence of component groups as a percentage of the number of scats analysed.*

adults and the cryptic coloration and behaviour of the juveniles.

Relationships of faecal components and potential prey

Of the component groups within tuatara scats, invertebrates accounted for a large proportion, and of these, insects, particularly beetles. formed the majority (Fig. 3). Plant and inorganic material occurred most often. Winter and spring patterns were very similar, with all invertebrate groups making important contributions to the scats. During summer and autumn though, insects occurred much more frequently than other invertebrates, and only during summer did birds (mainly fairy prion eggs and chicks) commonly occur.

Frequency of occurrence alone does not give a complete picture of the dietary significance of each item, as it does not account for the proportion of each item within each scat. Nor does scat composition necessarily reflect the abundance of dietary items in the field. Using the relative abundance data for groups of scat components and potential prey, as mentioned, a comparison is possible (Fig. 4).

Of the prey groups, large beetles were by far the most conspicuous in the tuatara diet, especially in winter, spring and autumn. They appeared to be preferentially selected, since their relative abundance in scats exceeded that in the field. Small beetles and wetas were less important, but formed an almost constant dietary component and also appeared to be preferentially selected. For all other groups, their relative abundance in scats was lower than that in the field, where some were at times very conspicuous (eg, lizards in the scrub habitat; birds in spring and summer).

Fairy prion eggs and chicks assumed dietary importance during spring and summer, being taken throughout the prion breeding season. A detailed study (Walls, 1978) of the tuatara-fairy prion relationship in burrows in the forest habitat showed that tuatara were directly responsible for the loss of more than one quarter of the prion eggs and chicks, by predation and interference in the nesting chamber.

Forest and scrub habitats appeared to provide the greatest quantity and variety of potential tuatara food, especially the large beetles that they evidently favour. By comparison, pasture seemed rather impoverished, particularly with regard to invertebrates.

Seasonally, the predominant features were a rise in the apparent field presence in spring and summer of some insects, reptiles and birds, and the major appearance of birds in the tuatara scats. A seasonal shift in tuatara diet is indicated, related to, but not completely dependent on, the changes in potential prey availability.

DISCUSSION

The tuatara on Stephens Island is an opportunist,

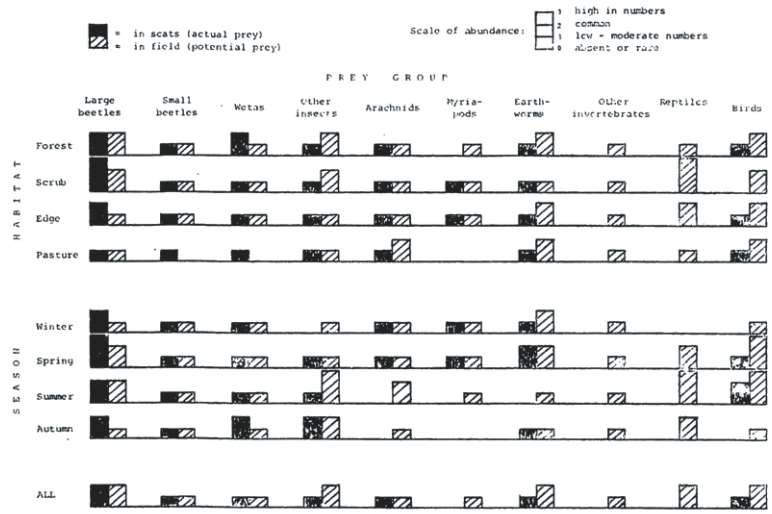

FIGURE 4. *Comparison between abundance of tuatara prey groups in scats and in the field, with respect to habitats and seasons.*

feeding on a wide range of animal groups. Its diet is related to what is potentially available, with the qualifying criteria of ease of capture and specific desirability. Any animal that moves into the vicinity of a tuatara, is of the right size, has no noxious characteristics and is too slow to escape, may be eaten. In this respect it differs little from other carnivorous reptiles (Schoener, 1968; Bellairs,]969; Sexton, Bauman and Ortleb, 1972). Histological investigations (Gabe and Saint Girons, 1964) have shown the tuatara to have a muscular, generalised digestive system adapted for a varied carnivorous diet, not too different from that of other reptiles.

The capture of prey and feeding method of tuatara was invariably as already described by other authors (Buller, 1878; Falla, 1935; Dawbin, 1953). That visual signals are primarily responsible for initiating feeding behaviour is undoubted, but the eating of carrion and petrel eggs substantiate the hypothesis that olfaction can also be important in attracting tuatara to food. Large, slow-moving insects are abundant on Stephens Island. Feeding experiments showed that tuatara respond to stimuli produced by such insects more readily than to any other in feeding, which alone could account for the abundance of them in the reptiles' diet.

The seasonal shift in diet, in particular the use of eggs and chicks of small burrowing petrels during late spring and summer, appears to have direct survival value. At that time, metabolic demands are highest, and moisture most scarce, and the birds' eggs and chicks may furnish a critical need, especially for breeding tuatara. The similarities of tuatara diet in different habitats, despite considerable apparent differences in available prey (Fig. 4) indicate a preference by tuatara for prey characteristic of the forest habitat. This could be expected, since the island was once mostly covered by forest.

Stephens Island possesses a wealth of fauna suitable as food for tuatara and it has been suggested (Dawbin,]962; Crook, 1975) that the presence of myriad burrowing seabirds and the absence of mammalian predators and competitors are responsible. For an animal which hunts in a passive fashion, waiting until prey approaches, this wealth would appear to be the reason that the island maintains such a high tuatara population.

The density of tuatara on the island is very high (Crook,]975). However, the reptile is not considered to pose a threat to the survival of any of its prey species, particularly those that seem most vulnerable, such as large beetles, wetas and fairy prion eggs and chicks, and those that are unusual and rare, such as the native frog, since it does not feed exclusively on anyone, and is not a very efficient hunter.

The findings of this study are important for future management of tuatara in several ways. Since the grazed pasture habitat appears to be a poor source of food, maximum retention and restoration of the coastal broad leaf forest cover, which seems to provide tuatara with the best food, shelter and hunting conditions, are seen to be desirable. A

knowledge of the range of natural diet and the seasonal changes in it will enable captive tuatara to be fed accordingly. It will also aid the possible future selection for colonisation and management of sites that do not at present have tuatara.

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APPENDIX 1

MATERIAL FOUND IN TUATARA SCATS, AND OCCURRENCE BY SEASON

Animal material: adult only unless otherwise stated.

* = not regarded to be prey.

Seasons (with number of scats analysed): W = Winter (97), Sp = Spring (91), Su = Summer (115), A = Autumn (89), ALL = All year (392).

Constituent type	Occurrence W	Sp	Su	A	ALL
INSECTS					
LARGE BEETLES (0. Coleoptera) (> 1 cm in length)					
Darkling beetles (F. Tenebrionidae)					
Mimopeus opaculus	35	42	29	20	126
M. elongatus)					
M. buchanani)	44	46	54	59	203
Chafer beetles (F. Scarabaeidae)					
Odontria nesobia)					
O. sp. aff. *autumna/is)*	42	30	21	30	123
Ground beetles (F. Carabidae)					
Mecodema c costellatum)					
Holcaspis sp. c.f. *odontella)*					
Others (unidentified)	6	9	2	0	17
Click beetle (F. Elateridae)					
Elatichrosis sp.	0	1	0	0	1
Weevil (F. Curculionidae)					
Phaedrophilus sp.	4	2	2	2	10

APPENDIX 1. (continued)

Constituent type	Occurrence W	Sp	Su	A	ALL
SMALL BEETLES (O. Coleoptera) (<1 cm in length)					
Weevils (F. Curculionidae)					
Brachyolus festucae)					
Sympedius bufo)					
Others (unidentified))	54	48	51	49	202
Darkling beetles (F. Tenebrionidae)					
Artystona rugiceps	0	0	4	4	8
A. erichsoni	0	7	3	0	10
Ground beetles (F. Carabidae)					
Amarotypus edwardsi)					
Others (unidentified))	11	31	50	40	132
Chafer beetles (F. Scarabaeidae)					
At least 2 species (unidentified)	1	6	9	9	25
Rove beetles (F. Staphylindae)					
*Unidentified species	5	2	4	3	14
Ladybirds (F. Coccinellidae)					
Unidentified species	0	1	2	2	5
Leaf beetle (F. Chrysomelidae)					
Unidentified species	0	0	6	2	8
Click beetles (F. Elateridae)					
*Unidentified species	1	0	1	0	2
Others (unidentified)					
*At least 3 species	3	1	17	16	37
WETAS (O. Orthoptera)					
Tree weta (F. Stenopelmatidae)					
Hemideina crassidens	21	8	9	19	57
Ground weta (F. Stenopelmatidae)					
Deinacrida rugosa	11	6	8	6	31
Soil weta (F. Stenopelmatidae)					
Hemiandrus anomalis	15	9	5	21	50
Cave weta (F. Rhaphidophoridae)					
Pachyrhamma fascifer	2	10	9	7	28
OTHER INSECTS					
MOTHS (O. Lepidoptera)					
Adults: several unidentified species	0	8	49	47	104
Large caterpillars (>1 cm long): several unidentified species	4	12	3	1	20
Small caterpillars (<1 cm long): several unidentified species	10	8	3	1	22
Pupa: unidentified species	0	0	0	1	1
Beetle larvae (O. Coleoptera)					
Darkling beetles (F. Tenebrionidae)					
Mimopeus opaculus)					
M. elongatus)					
M. buchanani)	13	28	20	2	63
Ground beetles (F. Carabidae)					
Mecodema c. costeilatum	2	0	0	0	2
Chafer beetles (F. Scarabaeidae)					
Odontria spp.)					
Others (unidentified))	3	1	3	0	7
Others (unidentified)	0	0	2	0	2
Flies (O. Diptera)					
Blowflies (F. Calliphoridae)					
Adults: at least 2 species (unidentified)	0	3	32	25	60
*Larvae: at least 2 species (unidentified)	0	4	4	7	15
Craneflies (F. Tipulidae)					
Adults: unidentified species	1	2	0	9	12
Larvae: unidentified species	2	1	0	0	3
Pupa: unidentified species	1	0	0	0	1
Others (small <5 mm long, unidentified)					
Adults: several species	1	7	6	3	17
Larvae: several species	1	2	0	0	3
Bugs (O. Hemiptera)					
Shield bug (F. Pentatomidae)					
Cermatulus nasalis	0	3	0	1	4
Others (unidentified)					
At least 3 species	7	14	44	25	90
Cockroach (O. Blattodea)					
Celatoblatta pallidicauda	2	3	4	0	9
Earwig (O. Dermaptera)					
Anisolabis littorea	0	5	4	4	13
Ants (O. Hymenoptera, F. Formicidae)					
At least 2 species (unidentified)	1	0	13	12	26
Stick insect (O. Phasmida)					
Micrarchus sp.	0	0	1	0	1
Caddis-fiy (O. Trichoptera)					
Adult (unidentified)	1	0	0	0	1
Larvae (unidentified)	1	3	6	1	11
*Unidentified eggs					
At least 3 species	6	0	2	1	9
ARACHNIDS					
Spiders (O. Araneae)					
At least 3 species (unidentified)	75	56	22	24	177
Harvestmen (O. Opilionida)					
At least 3 species (unidentified)	1	13	2	1	17
Mites and ticks (O. Acarina)					
*Small mites (unidentified)	6	0	0	0	6
Tuatara tick *Aponomma sphenodonti*	4	16	13	7	40

APPENDIX 1. (continued)

Constituent type	Occurrence W	Sp	Su	A	ALL
Pseudoscorpions (O. Pseudoscorpionida)					
Unidentified species	0	3	1	1	5
MYRIAPODS					
Millipedes (Cl. Diplopoda)					
Unidentified species	25	21	6	1	53
Huttoniella sp.	3	19	19	10	51
Centipedes (Cl. Chilopoda)					
Unidentified species	13	15	7	5	40
EARTHWORMS					
At least 2 species (unidentified)	55	52	18	20	145
OTHER INVERTEBRATES					
*Springtails (O. Collembola)					
Unidentified species	8	2	1	0	11
Woodlice (O. Isopoda)					
Unidentified species	1	8	16	9	34
Sandhoppers (O. Amphipoda)					
Unidentified species	1	0	0	0	1
Slugs (O. Pulmonata)					
Unidentified species	2	1	0	1	4
Snails (O. Pulmonata)					
Small unidentified species	10	8	3	2	23
Rhytida stephenensis	0	0	0	1	1
*Hookworms (O. Strongylida)					
Unidentified species, internal parasite	23	15	3	8	49
*Threadworms (O. Strongylida?)					
Unidentified species, internal parasite	3	0	0	0	3
REPTILES					
Tuatara, *Sphenodon punctatus*	0	0	0	1	1
Skinks (F. Scincidae)					
Green skink *Leiolopisma lineoocellatum*	1	0	0	0	1
Unidentified (at least 2 species)	1	2	3	4	10
Geckos (F. Gekkonidae)					
Hoplodactylus maculatus	2	5	3	2	12
BIRDS					
Petrels (O. Procellariiformes, F. Procellariidae)					
Fairy Prion *Pachyptila turtur*					
Chick	0	0	38	2	40
Egg	0	11	16	2	29
Fluttering Shearwater *Puffinus gavia*					
Chick	0	0	1	0	1
Sparrows (O. Passeriformes, F. Ploceidae)					
?House sparrow *Passer domesticus*	0	0	1	0	1
OTHER ANIMAL MATERIAL					
*Bird feathers					
From at least 3 species, mainly Fairy Prion *Pachytila turtur*	23	31	22	8	84
*Reptile skin (sloughed)					
Tuatara and/or lizards (unidentified)	0	2	1	2	5
*PLANT MATERIAL (A = adventive, N = native)					
Leaves					
Clover *Trifolium* spp. (A)	3	4	0	0	7
Thistle *Carduus* sp. (A)	0	3	0	0	3
Wandering Jew *Tradescantia fluminensis* (A)	0	1	0	0	1
Pigeonwood *Hedycarya arborea* (N)	0	1	0	0	1
Mahoe *Melicytus ramiflorus* (N)	1	1	1	0	3
N.Z. Spinach *Tetragonia trigyna* (N)	1	0	0	0	1
Pohuehue *Muehlenbeckia complexa* (N)	0	3	1	0	4
Pigweed *Rhagodia triandra* (N)	0	1	0	0	1
Taupata *Coprosma repens* (N)	6	14	4	0	24
Unidentified: several species (A, N)	18	18	26	23	85
Flowers					
Dandelion *Taraxacum officinale* (A)	0	1	0	0	1
Seeds					
Taupata *Coprosma repens* (N)	1	0	0	0	1
Twigs					
Several tree species, unidentified (N)	2	3	7	0	12
Grasses (leaves, stalks, seeds)					
Several species, unidentified (A, N)	84	77	93	73	327
*INORGANIC MATERIAL					
Soil	81	91	92	89	353
Small stones	3	3	1	2	9