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ASPECTS OF THE BIOLOGY OF CARABID BEETLES OF AHURIRI BUSH SCENIC RESERVE BANKS PENINSULA

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ABSTRACT

Pitfall trapping for carabid beetles was carried out in a remnant forest reserve on Banks Peninsula. Fourteen species in 11 genera were caught but only six species (3 genera) were common. Seasonality, distribution (habitat preference), sex ratio and female reproductive status were determined for the more common species. All were most frequently captured between November and March. Generally the pterostichine carabids favoured well littered areas, whereas the specimens of the single broscine indicated a preference for litter-free areas within the bush. Sex ratios revealed more males in the overall carabid population although two species had fewer males. Three species were reproductively active during summer and one species laid eggs in autumn.

INTRODUCTION

As an adjunct to a taxonomic study of the genus *Holcaspis* (Coleoptera : Carabidae) a series of pitfall traps was placed in Ahuriri Bush Scenic Reserve near the Summit Road on the western slopes of Banks Peninsula (172° 37'E, 43° 40'S; grid reference NZMS1 S84 990396) (Fig.1).

THE SAMPLE AREA

Ahuriri Bush was considered by Kelly (1972) to be the best remnant of the forest formerly covering the Port Hills. He described it as a "mahoe-fuchsia mixed broadleaf forest with scattered surviving matai and kahikatea imports, with a light but improving undergrowth". In the more open areas there is a secondary growth of *Fuchsia-Comprosma-Pseudowintera* with a bracken-pasture species association, which is heavier around the bush edge. Scattered silver tussock, *(Poa* sp.) and various introduced grasses occur in the clearings, especially on the lower slopes of the gully. Blackberry *(Rubus* sp). and native nettle *(Urtica ferox)* occur throughout and are very dense in places.

MATERIALS AND METHODS

The pitfall traps consisted of 7 cm diameter plastic pottles sunk into the ground so that their tops were flush with, or slightly below, the ground surface. The trapping fluid was a saturated solution of picric acid. Metal rooves, placed 3 cm above the traps, provided some protection from rain and...

TABLE 1. A SUMMARY OF HABITATS AT THE VARIOUS TRAP SITES.

SITE	HABITAT
A*	amongst rocks in grass at the bush edge.
B	under *Pittosporum* and *Urtica* bushes.
C	between *Fuchsia* roots in deep leaf litter.
D	unlittered ground in a patch of crown ferns *(Blechnum* sp).
E	unlittered ground in an open area of bush.
F	unlittered ground alongside a fallen tree.
G	in deep leaf litter below a cabbage tree (*Cordyline* sp).
H*	in the open amongst bracken.
I	unlittered ground under *Ripogonum* and *Rubus*.
J*	beside fallen tree at bush edge.
K	at base of a deep gully with little leaf litter.
L*	under *Pittosporum* at bush edge.
M*	in long grass near *Pittosporum* and a fallen tree.
N*	introduced grasses and *Rubus*, at bottom of gully.

* open areas not in bush.

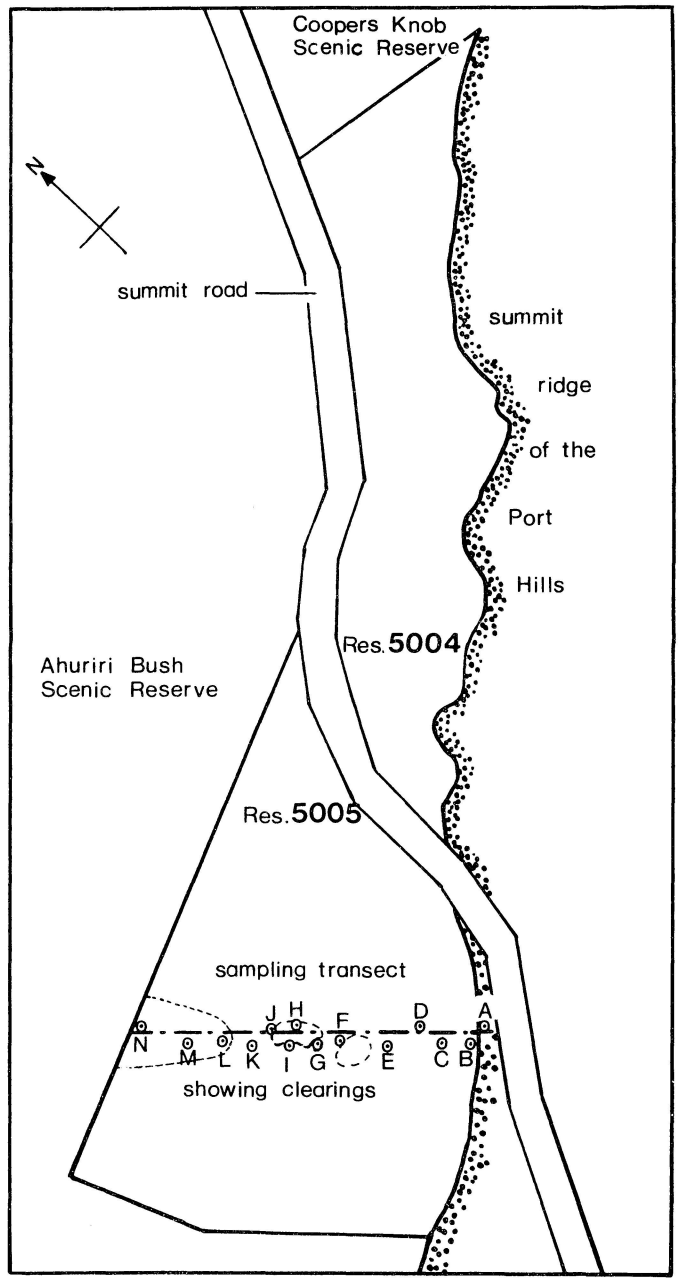

Fig. 1. The sampling area showing Ahuriri Bush Scenic Reserve (Res. 5005) and its relative location to Coopers Knob Scenic Reserve (Res. 5004).

birds. The traps were emptied every two weeks and all carabids and other insects were counted. Fifty six pottles were arranged in 14 groups of four along transect A-N (Fig. 1). The 14 sites were chosen to give the widest coverage of habitat types in the reserve (Table 1).

On seven occasions between 22 December 1977 and 11 April 1978 females of the 4 most common carabids *(Mecodema oregiode, Holcaspis suteri, H. subaenea* and *H. elongella)* were dissected to determine their reproductive status. Depending on availability, up to five females of each species were dissected. If eggs or mature oocytes were found the individual was judged to be in reproductive condition. Owing to the two-week interval between samplings greater precision was not possible due to breakdown of the internal organs of some specimens. *M. oregoide* is difficult to sex externally so specimens were dissected until at least five females were found, if numbers permitted.

RESULTS AND DISCUSSION

Annotated list of species trapped:

In the absence of comprehensive distribution data for most species of Carabidae in New Zealand the general distribution data given are based largely on observations of the authors.

Broscinae

Mecodema oregoide Broun

This was the commonest species, and was collected at all sampling sites though exhibiting a preference for the sites in dense bush. It is a small shiny *Mecodema* endemic to Banks Peninsula where it occurs in most patches of native forest, except perhaps those in the valley bottoms.

Zolinae

Oopterus laevicollis Bates

Only two specimens of this Canterbury species of the widespread genus *Oopterus* were caught in the present study although the species is not uncommon in bush remnants on Banks Peninsula.

Pterostichinae

The dominant subfamily of ground-dwelling carabids at Ahuriri Bush. Five of the six species of ground beetle regularly trapped belong to this subfamily.

Megadromus antarcticus (Chaudoir)

This familiar, large iridescent green ground beetle was the largest of the carabids caught. It was collected regularly but never abundantly (Fig.3) in the present study. It is common in bush remnants in the foothills surrounding the Canterbury Plain and on Banks Peninsula. It is also encountered in suburba gardens and in non-arable farmland where there is some shelter. The other Banks Peninsula species of *Megadromus, M. australasiae* (Guerin), was not encountered at Ahuriri Bush; it is apparently more eastern in distribution.

Holcaspis suteri Broun

This was the most numerous pterostichine, and one of the larger *Holcaspis* species at 17 mm long. It is apparently restricted to the remaining pockets of bush on Banks Peninsula and like the following three species of *Holcaspis* is not common in pasture land.

Holcaspis subaenea (Guerin)

Of a similar size to *H. suteri* and found in a similar habita although it tends to tolerate grass sward as cover more than does *H. suteri.* It is restricted to Canterbury between the Waipara and Rakaia Rivers, including Banks Peninsula.

Holcaspis elongella (White)

The second smallest *Holcaspis* species found; it favours dense cover. Its range extends south from Motanau Island, inland to Lake Coleridge and south to Temuka. A very closely related undescribed species occurs in north Marlborough and Nelson.

Holcaspis angustula Chaudoir (= *longiformis,* Britton 1940)

The smallest and least often collected *Holcaspis* in the study (Fig.3). It occurs from Leithfield to Moeraki, and inland as far as Craigieburn and Lake Tekapo.

Conversion of the Canterbury Plains to pasture appears to have had a detrimental effect on beetles of the genus *Holcaspis,* as on a distribution map the plains are ringed with collection sites but very few sites occur on them.

'Omaeseus' pantomelus Blanchard

This small pterostichine was probably the most interesting carabid species trapped. It is very distinct from all other New Zealand Pterostichinae and not at all closely related to the northern hemisphere members of the genus *Omaeseus.* It was originally collected in Akaroa by members of the French South Polar expedition. It was completely unknown to later authors, including Britton (1940) but has recently been rediscovered in several forest remnants on Banks Peninsula (P.M. Johns pers. comm.). The species needs redescribing and will be placed in a

new genus. The seven specimens collected in the present study more than double the number previously known.

Agoninae

Agonum sp.

Only a single specimen of *Agonum* was collected although the genus is not uncommon in damp situations in forest remnants on Banks Peninsula.

Zabronothus striatulus Broun

Zabronothus Broun is a small genus of compact agonines found on the eastern side of the South Island. *Z. striatulus* is a Banks Peninsula endemic widespread in bush remnants; it was represented in the Ahuriri Bush study by three specimens.

Licininae

Dicrochile subopaca Bates

The genus *Dicrochile* needs revising in New Zealand. The Banks Peninsula species belongs to a complex of forms found throughout Canterbury, usually in relatively damp habitats at bush margins. Five specimens were captured in Ahuriri Bush.

Harpalinae

Anisodactylus binotatus (F.)

A widespread European species first reported from New Zealand at Christchurch by Pilgrim (1963) where it has evidently been since 1938 at least. The specimen from Ahuriri Bush and others recently collected at Mt. Algidus suggest it has continued to spread and may now be found widely in Canterbury, both in modified and native habitats.

Hypharpax australis Dejean

This widespread species appears to have been introduced from Australia in the early days of settlement. It is often found in disturbed habitats and is one of the few ground beetles found in pastoral situations in Canterbury. Only one specimen was collected during this study.

Lecanomerus sp.

Another introduced Australian species that has succeeded in becoming established in a variety of modified and native habitats. Ten specimens of this small ground beetle were collected from November to March.

Seasonality.

The four *Holcaspis* species, *M. antarcticus* and *M. oregoide* were present throughout the survey although they all were more numerous between November and March than at any other time.

Ahuriri Bush has a westerly aspect and is to some extent sheltered from cold, wet easterly and south-easterly winds but is subject to strong, hot north-westerlies from November to March. A rise in numbers during October/November coincided with the seasonal increase in ambient temperature (Anon.). A corresponding decrease in numbers of beetles occurred 10-12 weeks prior to the seasonal decrease in temperature in March (Fig.2). This was probably because of the high intensity of the north-westerly winds drying out the top soil and leaf litter Jones (1979) indicated that extreme desiccation of small animals will occur about 50% relative humidity, but in soil crevices the RH rarely falls below 98%. The decline in carabid numbers is probably related to this drying factor, the beetles remaining in crevices which would make them 'unavailable' for capture. The decline in numbers continued until April and then stayed relatively constant until spring (August-September). It is widely recognised that pitfall trapping gives a measure of the activity of the insects caught (Thiele, 1977) and that activity is regulated in poikilotherms, by ambient temperature (Marshall and Hughes, 1967). Except for the period from early February until late May, (Fig.2) when catches are thought to have been depressed by low levels of humidity, this graph depicts the classical relationship between ambient temperature and activity.

Relative abundance and distribution within the reserve.

Although *Megadromus antarcticus, Mecodema oregoide* and the four *Holcaspis* species were ubiquitous (Fig.3) there were local differences in abundance. *M. oregoide* was both the most numerous species overall and the most numerous species at nearly half the sites (C, D, E, F, H and I). *H. suteri* was the next most abundant species being most numerous at sites A, B, J, K, L, M. *H. subaenea* was generally found in much lower numbers although there were some noticeable exceptions (sites G, K and N). *H. elongella* was less common again although it approached or exceeded *H. suteri* in numbers at sites G, I, J and N, whilst *H. angustula* was recorded in consistently low numbers at all sites *M. antarcticus* was found in low numbers at all sites with the exception of H where it was three times as abundant as at any other site.

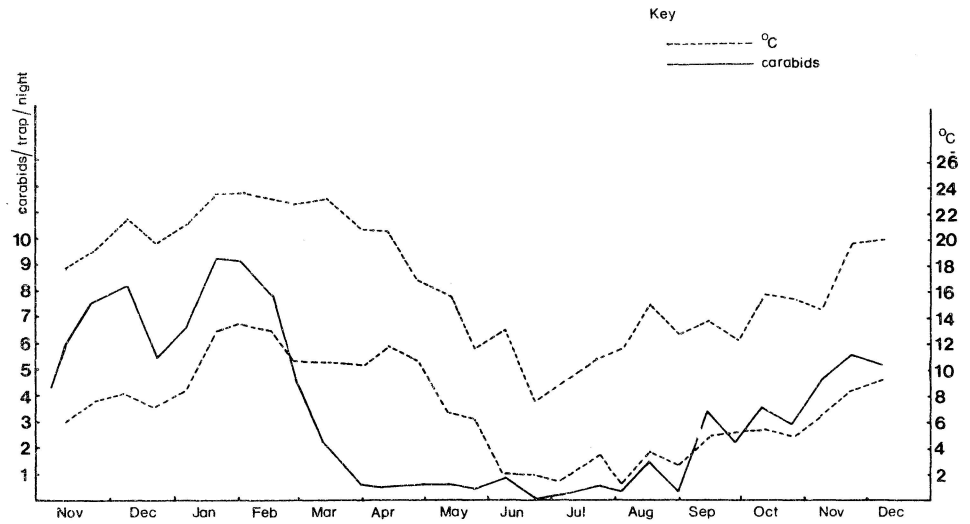

Fig. 2. Carabid numbers/trap/night in relation to mean maximum/minimum temperatures* for the trapping periods.

*Temperatures for each period were averaged and plotted on the last day of that trapping period. Temperatures were taken from the closest meteorological station, that at Lincoln College.

It is noteworthy that all the sites at which *M. oregoide* was the most numerous species, with the exception of H, were within the bush and generally were in relatively litter free areas. The *Holcaspis* species tended to be the most common group of species at sites in clearings or where there was a mat of leaf litter on the ground (B and G). Site H appeared to be somewhat anomolous because of its high number of *M. antarcticus* and in spite of being a clearing *M. oregoide* was the most common species. At site H the dense cover of bracken and its position at the edge of the clearing, overhung with trees, may to some extent explain this anomoly.

Another noticeable feature is that overall more carabids were caught in the generally more open lower half of the transect (sites G-N).

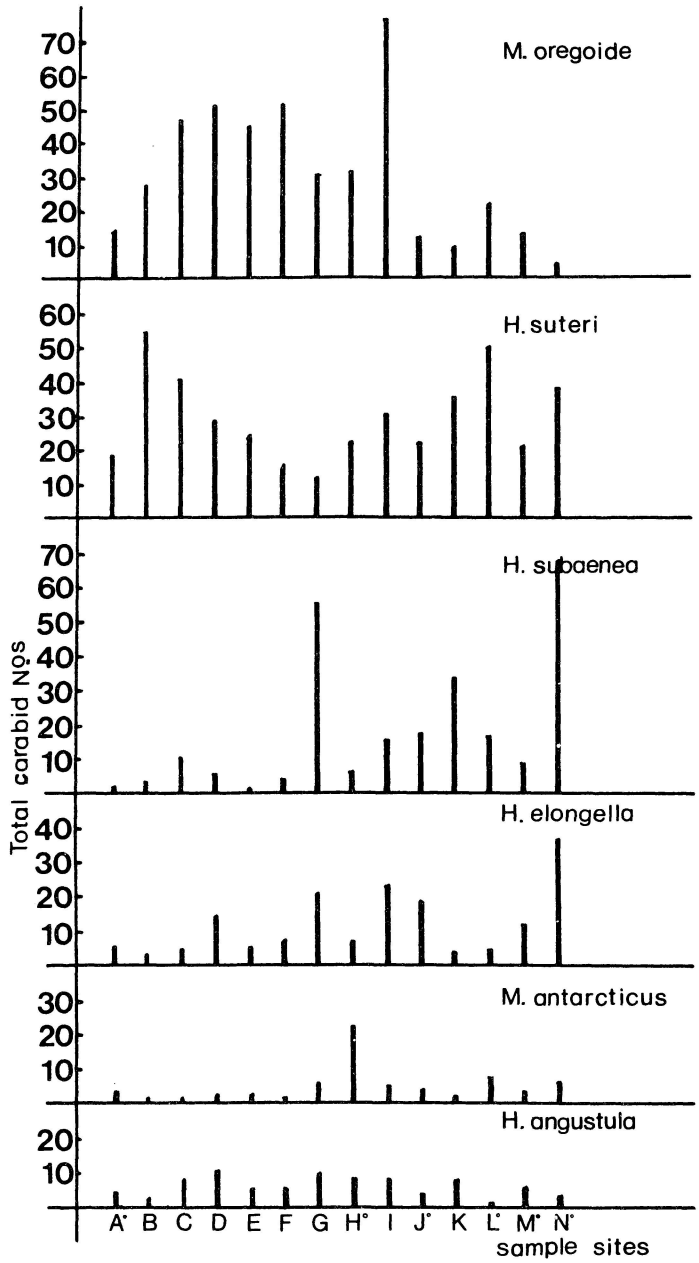

Fig. 3. Total numbers of the six most common carabids caught per site over the 13 months of trapping.

°Open areas not enclosed in bush.

Sex ratios.

Sex ratios were determined for several species (Table 2). *Mecodema* could not be sexed externally and thus no data were regularly collected for it but an estimate was made on the basis of dissected individuals.

TABLE 2. SEX RATIOS FOR THE MOST COMMON CARABIDS

SPECIES	SEX RATIO ♀ : ♂	N
Holcaspis suteri	1 : 0.88	415
H. subaenea	1 : 2	242
H. angustula	1 : 3.4	78
H. elongella	1 : 2.25	166
Megadromus antarcticus	1 : 2.35	60
*Mecodema oregoide**	1 : 0.8	51

* estimated from a dissected sample of the specimens caught rather than the total catch.

Female reproductive status.

The data are somewhat limited owing to the irregular availability of specimens but several trends are apparent (Table 3).

The three species of *Holcaspis* were reproductively active during the summer whereas *M. oregoide* appeared to be an autumnal egg layer. Interestingly, by June, when another six females of *M. oregoide* became available, none had eggs or mature oocytes. Particularly noticeable also were the number of young adults in the April sample, recognisable by their full complement of undamaged setae, microsculpture not blocked by soil and general 'new' appearance.

CONCLUSIONS

The majority (11) of carabid species caught in this survey (14) are native to New Zealand and five are endemic to Banks Peninsula; *M. oregoide* Broun; *H. suteri* Broun; *'O' pantomelus* Blanchard; *Z. striatulus* Broun and *O. laevicollis* Bates. *H. angustula* Chaudior has its type locality on the Peninsula (Akaroa).

TABLE 3. THE PROPORTION OF FEMALES IN EACH SPECIES IN REPRODUCTIVE CONDITI(

Species \ Sampling Date	22.12.1977	4. 1.1978	19. 1.1978	1. 2.1978	16. 2.1978	16. 3.1978	11. 4.1978
M. oregoide	0/7	2/5	-	0/5	1/9	0/5	5/5
H. suteri	3/5	5/5	4/5	3/5	5/5	5/5	3/3
H. subaenea	3/4	4/5	5/5	4*/5	2*/5	-	2/2
H. elongella	3/3	-	5/5	5/5	3*/5	-	-

* In each of these samples one of the individuals had been rendered sterile due to heavy parasitism by nematode worms.

Most species were found in close proximity to bush, the others in very heavy grass sward reverting to bush. Habitat preferences of the species trapped indicate a close relationshi with bush and hence a need to preserve the forst remnants on Banks Peninsula. In particular, this study indicates that the continued preservation of Ahuriri Bush is important because it contains populations of a number of carabid species endemic to Banks Peninsula including the rare *'O' pantomelus*.

ACKNOWLEDGEMENTS

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