THE 1987 PRESIDENTIAL ADDRESS—PART 2
A PRELIMINARY ACCOUNT OF THE BEETLES OF THE RSPB LOCH GARTEN RESERVE

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Most of what you heard this evening so far has been about happenings of the past 12 months. I have chosen for the second part of my address to tell you about something which has been going on for the past 10 years — a survey of the beetles of the Loch Garten RSPB Reserve. The work is still going on but I thought it would be of interest at this stage to provide an interim report.

The Loch Garten Reserve

The Loch Garten RSPB Reserve lies at the western edge of the Abernethy Forest — the largest semi-natural woodland area in Britain and one of the major remaining areas of Caledonian pine forest. It is on the Spey Valley, a little to the east of Aviemore. About 80% of the Reserve is pine forest. Besides this, there are Loch Garten and Loch Mallachie, formed as 'kettle-holes' at the end of the last ice-age some 10 000 years ago. There is also an expanse of moorland with some open birch woodland and a very small hill farm. Much of the pine forest has been planted at one time or another but the greater part of the planted area is on the site of earlier pine woods so that the area has probably been the site of pine forest for the last 8000 years. The Reserve lies at an altitude of 200–350 m (600–1000 ft) and is, for Scotland, a relatively dry area with a rainfall of 30–35 inches a year. The air temperature can reach 25°C in summer and −20°C in winter. Frosts have been recorded every month of the year.

The original part of the Reserve, amounting to about 1500 acres, was bought by the RSPB in 1957 to offer protection to the osprey which had returned to breed in Scotland after a lapse of some 50 years. Since then, two major additions have been made — firstly the area to the north west, known as Garten Wood and more recently, an area to the south east known as Tore Hill. These purchases gave the Reserve a total area of nearly 3000 acres.

Besides the osprey, many bird species occur in the area. About 150 species have been recorded of which some 75 species have bred, though not all every year. The birds include Scottish crossbill, our only endemic bird, the crested tit, black grouse and capercaillie. Golden eye nest near the lochs. Red squirrels, roe deer and wood mice are relatively plentiful, otters have bred on the islands in the lochs and wild cat and badger visit the reserve occasionally. There are common frogs, toads and lizards but no snakes have been recorded, as far as I am aware. Besides pine and birch, there are small stands of aspen and juniper and most of the plants characteristic of northern pine-woods and moorland, such as the common wintergreen (*Pyrola minor* L.), chickweed wintergreen (*Trientalis europae* L.), bitter vetchling (*Lathyrus montanus* Bernhauer), cowberry (*Vaccinium vitis-idaea* L.) and stag-horn clubmoss (*Lycopodium clavatum* L.).

The area is rich in insects. I will be telling you something about the beetles shortly. Many local and rare flies are known from around Loch Garten and Loch Mallachie, including at least 25 'Red Data Book' (RDB) species, such as *Blera fallax* (L.) and *Callicera rufa* Schummel. A previously undescribed phorid — *Megaselia gartensis* Disney — turned up during the survey among insects collected by a Malaise trap.

There are records from the Reserve for 19 species of butterfly including dark green, pearl-bordered and small pearl-bordered fritillaries, which are maintaining their numbers, and about 240 moths — some relatively common, some much more local. There are a number of rare aculeate Hymenoptera including *Osmia uncinata* Gerstaecker and its parasitoid *Chrysura hirsuta* (Gerstaecker), both RDB grade 2. Another rare aculeate, *Pemphredon wesmaeli* (Morawitz) makes its nests in the thick bark of standing pine trees. The reserve is home to 12 species of dragonfly including the local *Somatochlora arctica* (Zett.).

Methods employed in the survey

How do you set about recording the beetles of an area? There are many traditional procedures available to the coleopterist — looking under stones, looking under bark and in rotten wood, sweeping vegetation, beating foliage, using a water net and so on.

Searching blossom such as hawthorn is a very profitable way of finding beetles in the south, especially for beetles associated with dead wood but blossom (apart from pine blossom) is rare in pine woods. I have been unable to find hawthorn at Loch Garten but scrutiny of the blossom of rowan (*Sorbus aucuparia* L.) has produced a number of species not encountered elsewhere on the Reserve. Thistles and umbels attract the bee beetle *Trichius fasciatus* (L.) and the rare longhorns, *Leptura sanguinolenta* L. and *Judolia sexguttata* (L.).

Nests of the wood ant (*Formica lugubris* Zett.) have produced 14 species more or less confined to this specialized habitat. The nests also provide a cosy home for the larvae of the northern rose chafer (*Cetonia cuprea* F.) — vegetable debris in the nest provides food, metabolic heat from the ants provides warmth and the aggressiveness of the ants provides security. Another beetle associated with wood ants is *Clytra quadripunctata* (L). The female hangs on to a suitable twig or grass stem immediately above the ants nest and drops her eggs directly into the nest. There, the larvae build a case for themselves like a coleophorid larva, to give protection from the ants.

Nesting boxes for smaller birds have to be cleaned out each winter, in part to get rid of the fleas lying in wait for the birds to return to them next spring. I have had several parcels of old bird's nests sent south by post, with each nest initially securely wrapped in a polythene bag. Unfortunately, lepidopterous larvae in the nests eat holes in the bags allowing fleas to escape. When one parcel arrived by post at the door, it had dozens of fleas crawling and hopping all over the outside. Periodically the ospreys' nest at Loch Garten gets top heavy and has to be pruned in the 'off' season. I have been able to examine portions of it on several occasions and have found a variety of beetles. One these, the staphylinid *Haploglossa picipennis* (Gyll.) has been present in every sample of the nest examined. Sometimes over a hundred have been present in a small portion of nest. Away from nests of birds of prey, the beetle is very rarely encountered. Disused dreys of the red squirrel have provided other species.

The use of beetle traps

It will be obvious that most of the techniques I have mentioned for surveying a beetle fauna require the coleopterist to be on site. I have tried over the past 10 years to spend as much time as I could at Loch Garten but I have found that I rarely could manage more than 7 days all told there in any one year. This led me to think of using trapping techniques which would work unattended or with a minimum of attention from someone on site.

Some of the traps used have been baited using, as bait, anything suitable which came to mind — carrion, fermenting fruit, horse and deer dung and cut grass. Pails with chicken dung have been hung from trees to simulate birds nests. Setting out bunches of flowers such as rowan or umbels produced further species.

Other traps were not baited. Pitfall traps were set out in the pine woods and on the moor. With preservative such as 10% aqueous ethylene glycol, they work unattended for months especially in the winter. Malaise traps and an interception trap have caught flying beetles though it seems that beetles fly much less readily in Scottish pine forests than in southern areas, perhaps because it is simply not often warm enough for this activity. One trapping method which came about accidentally arose from the practice of setting out in the forest white plastic funnels to catch pine seed to monitor the annual seed production. Each funnel has a mesh bag tied to the spout allowing rain water to escape but keeping back pine seeds and beetles! A number of interesting species were caught in this way.

The effectiveness of different types of beetle traps as used out at Loch Garten is shown in Table 1. The carrion traps came out top catching almost one-quarter of the species recorded from the area. There is a predominance of predatory beetle species at Loch Garten compared with Britain as a whole and carrion is a good source of prey for these beetles. The exclusiveness of different traps is illustrated by the data in Table 2. About one-eighth of the total species were caught in one or other type of trap and by no other means throughout the survey.

I should perhaps mention that the rate of capture of beetles in traps is not as great as you might think. In summer, pitfall trapping caught only one or two beetles per cup per week, with the catch falling to under one per week in the winter months. The catch in the Malaise trap at Loch Garten never exceeded a rate of 50 beetles a month

Table 1. Yield of beetle species from different sorts of traps. The total number of species recorded in the survey was 807.

Type of trap	No. of species
Carrion	186
Pitfall	179
Malaise	116
Interception	109
Seed fall	76
Fruit	67

Table 2. Species found only by one collection mode.

Collection mode	No. of species
Carrion trap	36
Pitfall trap	26
Interception trap	5
Malaise trap	11
Seed fall trap	11
	89

Table 3. Beetle species taken in a pitfall survey at Loch Garten, April 1983 – March 1984. The 72 traps remained in the same position throughout.

No. of species	Specimens trapped
49	1
18	2
9	3
8	4
.....	.....
1	169
1	172
1	197
1	319
Total species 117	Total specimens 1944

(under two a day) whereas weekly collections from favourable areas in southern England can be up to twenty times this.

One of the features of insect faunas illustrated by trapping is the relative incidence of different species. Table 3 shows data from pitfall trapping; there were a few really common species but more than 66% of the species caught were represented by no more than three specimens.

I know that some entomologists express abhorrence at the idea of catching insects in traps but there seems to me little difference, at least in principle, between catching moving insects with a stationary device such as a Malaise trap and catching stationary insects with a moving device such as a sweep net. Trapping, indeed, has an important advantage over many methods of surveying insect fauna for, to borrow a term from physiologists, it is 'non-invasive' — the environment is essentially unharmed. Prising a portion of bark off a log permanently destroys that piece of microhabitat for, once it has been removed, you cannot get a piece of bark to go back on again as it was no matter how hard you try, even with hammer and nails. Even lifting a stone puts you in a quandary. If you don't put it back, you leave a micro-habitat exposed. If you do put it back even with care, you invariably squash a wood louse or a spider or destroy a system of micro-tunnels in the soil. Using traps avoids such problems. I would like to see the day when conservation bodies who commission surveys of insects faunas on selected sites encouraged the use of non-invasive collecting methods by supplying investigators with the necessary traps and discouraging the removal of bark and the destruction of rotten timber.

Species diversity

The total number of beetles species recorded from the Reserve was on the last count 807 — about one-fifth of the total for Britain. Of these, all but about 20 were recorded for the first time during the current survey. I suspect, however, that there are still many additions to be made to the list. Firstly, as shown in Table 4, the rate at which species have been recorded over the past 10 years has not yet tailed off. I have sat down and listed all the beetles not yet found at Loch Garten but recorded from nearby sites in Speyside or from similar pine wood areas further away. My 'yet-to-be-found at Loch Garten' list currently exceeds 300 species. Actually, we know so little about so many British beetles that predicting what species will turn up in a particular area is fraught with difficulties. For example, this year (1987) 24 species turned up at Loch Garten for the first time but one-third of these were not on the 'expected' list at the start of the year. Several of the species encountered in this

Table 4. Rate of recording of beetle species at Loch Garten.

Year	Accumulated no. of species
1978	95
1979	334
1980	372
1981	434
1982	517
1983	591
1984	650
1985	712
1986	780
1987	807

Table 5. Frequency of recording different species during 10 year period. A record means the occurence of a species in a Reserve compartment on an occasion. Several examples of a species, occuring in the same compartment at the same time, constitute one record of that species.

No. of records	No. of species
1	292
2	123
3	105
4	51
5	49
6	40
7	31
8	17
9	21
10	18
11 or more	59

The maximum no. of records for a species was 33.

survey do not appear previously to have been found in Highland Scotland and one (*Corticaria abietorum* Motschulsky) is new to Britain.

Secondly, as shown in Table 5, 35% of species were recorded on one occasion only. This, too, suggests that there are many species present on the Reserve but not yet recorded.

My estimate is that the final total of beetle species at Loch Garten will reach 1200, though not necessarilly all will be present simultaneously. The Reserve is a relatively small place and many beetles come and go. They may breed in an area for a year or two and then move on. Nevertheless, I suspect that there are many more resident species to uncover.

The beetle fauna of Loch Garten compared with elsewhere

To provide an overall view of the sort of beetles which occur at Loch Garten and to enable comparisons to be made with beetle faunas elsewhere, I have provided in Table 6 a breakdown of various beetle faunas into major groups. The largest group in Britain are the staphylinids (rove beetles); next come the curculionids (weevils), then the carabids (ground beetles) and then the chrysomelids. Together, these four

Table 6. Major groups of beetles at Loch Garten compared with those elsewhere. Data represent the percentage of species in each family.

Family	Britain	Loch Garten	Richmond Park	Box Hill	Outer Hebrides	Shetlan
Carabidae	9.0	7.8	7.8	7.8	12.9	16.1
Dytiscidae	3.2	4.2	3.1	0.0	8.2	8.3
Staphylinidae	25.3	37.8	33.7	22.4	37.2	37.5
'Heteromera'	4.4	1.9	5.3	5.4	0.2	0.0
Chrysomelidae	6.5	3.2	3.7	13.0	3.9	2.1
Curculionidae	13.0	6.7	6.4	17.6	8.4	9.2
Scolytidae	1.6	1.7	1.3	1.0	0.0	0.0
Total species (approx.)	4000	800	1000	650	600	350
Source of data	1	2	3	4	5	6

Sources: 1 Pope (1977); 2, this survey; 3, Hammond, P.M. & Owen, J.A. (unpubl.); 4, Owen, J.A. (unpublished compilation from published and published records); 5, Waterston *et al.* (1981); 6, Bacchus (1980).

families account for more than 50% of the British beetle fauna. The staphylinids, the carabids and the dytiscids are mainly predatory — the weevils, the chrysomelids and scolytids are almost exclusively phytophagous.

Comparing the Loch Garten data with that for Britain as a whole, there is at Loch Garten an excess of staphylinids and water beetles and deficits of weevils, chrysomelids and 'Heteromera'. Almost certainly the reason for these differences is the relatively small number of flowering plants on the reserve, with consequently a diminished proportion of the phytophagous groups, and automatically an increased proportion of the predatory groups. The detritus associated with carrion and with the nests of birds and mammals provides a ready home for the smaller invertebrates, including insect larvae, on which the predators live. The British carabids are also mainly predatory but they are essentially an insect group of open country and this probably is the reason why they fail to show at Loch Garten the excess shown by staphylinids. The 'Heteromera' also are down, for while they are chiefly insects of dead wood, they are associated mainly with deciduous trees rather than pine trees.

Comparing the Loch Garten beetle fauna with that of other parts of Britain we find (Table 6) that the Hebrides and Shetland similarly show excesses of staphylinids and water beetles but in these two areas, carabid species are relatively more numerous, probably because there is more open country and, in particular, coastal habitats. Box Hill, in contrast, has more phytophagous species and fewer staphylinids. Richmond Park is somewhat anomalous as a southern area in that it has relatively few flowering plants and, consequently, relatively few phytophagous species.

Now I don't want to give you the impression that Caledonian pine wood beetles are all aggressive predators. There is the mainly phytophagous group of native pine-wood species, beetles which are — or perhaps more correctly were — mainly confined to long-established native pine woods. I say 'were' because many beetles originally found only in native Scottish pine-woods are progressively taking to plantations, including those in the south of England. Scots pine grows relatively quickly, rots relatively quickly when it falls or is felled and most plantations have a fair amount of dead wood. Native pine-woods are a romantic idea to naturalists but they appear to be nothing very special to most pine wood beetles, many of which take quite readily to plantations. This makes compilation of a list of native pine-wood

beetles a matter for debate. Most people would agree, however, that less than 50 species warrant the term 'native pine-wood' beetle. I have a working list of 44 species of which 33 are recorded from Loch Garten, moreover, more than half of these are to be found in the section known as Garten Wood which is essentially a plantation, though in part planted on the site of an older natural pine wood. Another six pine-wood beetles are recorded from other nearby sections of Abernethy Forest and almost certainly wait to be discovered in the Reserve, leaving only five native pine-wood beetles with no suggestion that they may be present in the Reserve.

I should make the point that not all native pine wood beetles are actually phytophagous. There are pine associated lady-birds which eat aphids, pine associated Cryptophagidae living on moulds and, as I have mentioned, beetles which live in nests of creatures such as birds or wood ants living in pine woods.

Loch Garten as a site for nationally important beetles

It is fashionable, these days, to compute the entomological value of an area in terms of the number of rarities present, especially now that the *British Red Data Book No. 2 Insects* has been published. How does Loch Garten score? Not, I may say, all that well, as is indicated by the data in Table 7. Out of nearly 500 beetle species awarded RDB status, only 15 have been recorded for Loch Garten. The reason for the relative deficit of RDB beetles at Loch Garten lies, perhaps, in the fact that there are relatively few RDB species dependent on conifers of any type. Only 16, i.e. 3.7% qualify. Ironically, there are more conifer-dependent RDB species in the Windsor area than have yet been recorded at Loch Garten.

Another classification of beetles used for scoring areas is their ability to act as indicators of ancient pasture-woodland. Here again, Loch Garten does not score highly, as is shown in Table 8.

I should like to finish by referring to a few pine-wood beetles, their associates and something of their biology. One of the most spectacular, is the longhorn, the timberman (*Acanthocinus aedilis* L.) (Fig. 1). The larvae develop immediately beneath the bark of pine logs, burrowing deeper into the wood when they come to pupate and plugging the hole behind them with thin strips of wood obtained while excavating the pupal chamber. The longhorn, *Rhagium inquisitor* (L.) (Fig. 2) has

Table 7. Nationally rare beetles at Loch Garten compared with those elsewhere. Data represent the no. of 'Red Data Book' species at each locality.

Grade	Britain	Loch Garten	Windsor	Richmond Park	Box Hill	Outer Hebrides	Shetland
RDB 1	146	0	28	3	9	1	0
RBD 2	83	5	19	9	2	0	0
RBD 3	262	10	37	15	22	5	3
Totals	491	15	84	27	33	6	3
Source of data	1	2	3	4	5	6	7

Sources: 1, Shirt (1987); 2, this survey; 3, Owen, J.A. (unpublished compilation from published and unpublished records); 4, Hammond, P.M. & Owen, J.A. (unpubl.); 5, Owen, J.A. (unpublished compilation from published and unpublished records); 6, Waterson *et al.* (1981); 7, Bacchus (1980).

Table 8. Ancient pasture-woodland species at Loch Garten compared with those elsewhere. Data represent the no. of indicator species (Harding & Rose, 1987) at each locality. Sources of data as in Table 7.

APW category	Britain	Loch Garten	Windsor	Richmond Park	Box Hill	Outer Hebrides	Shetland
1	69	0	52	23	4	0	0
2	34	3	24	10	7	0	0
3	90	16	47	64	29	1	0
Totals	193	19	123	97	40	1	1

larvae following the same life style but instead of burrowing into the wood to pupate, the larvae surround themselves for protection with a kind of corral also made from thin strips of wood. Subcortical beetle pupae need protection because of the presence in northern pine woods of the fly *Xylophagus cinctus* (Degeer) whose larvae (Fig. 3) do not live up to its name but rather live under bark of fallen pine trees or their branches preying on the pupae and larvae of longhorn and other beetles.

Another beetle developing immediately under bark is *Pytho depressus* (L.), a peculiarly flattened beetle with flattened larvae as an adaptation to living under bark. Before pupating, the *Pytho* larva makes a really stout 'fence' around itself (Fig. 4), presumably also as protection against the dreaded *Xylophagus* larva.

Longhorn larvae play an important role in the natural recycling of timber. Larvae of *Rhagium bifasciatum* (F.) are content to live in dead heart wood — not so nutritious as the subcortical layers, but perhaps a safer environment against the predations of *Xylophagus*. Holes made by emerging adults allow fungal spores to gain access to stumps facilitating recycling of the timber.

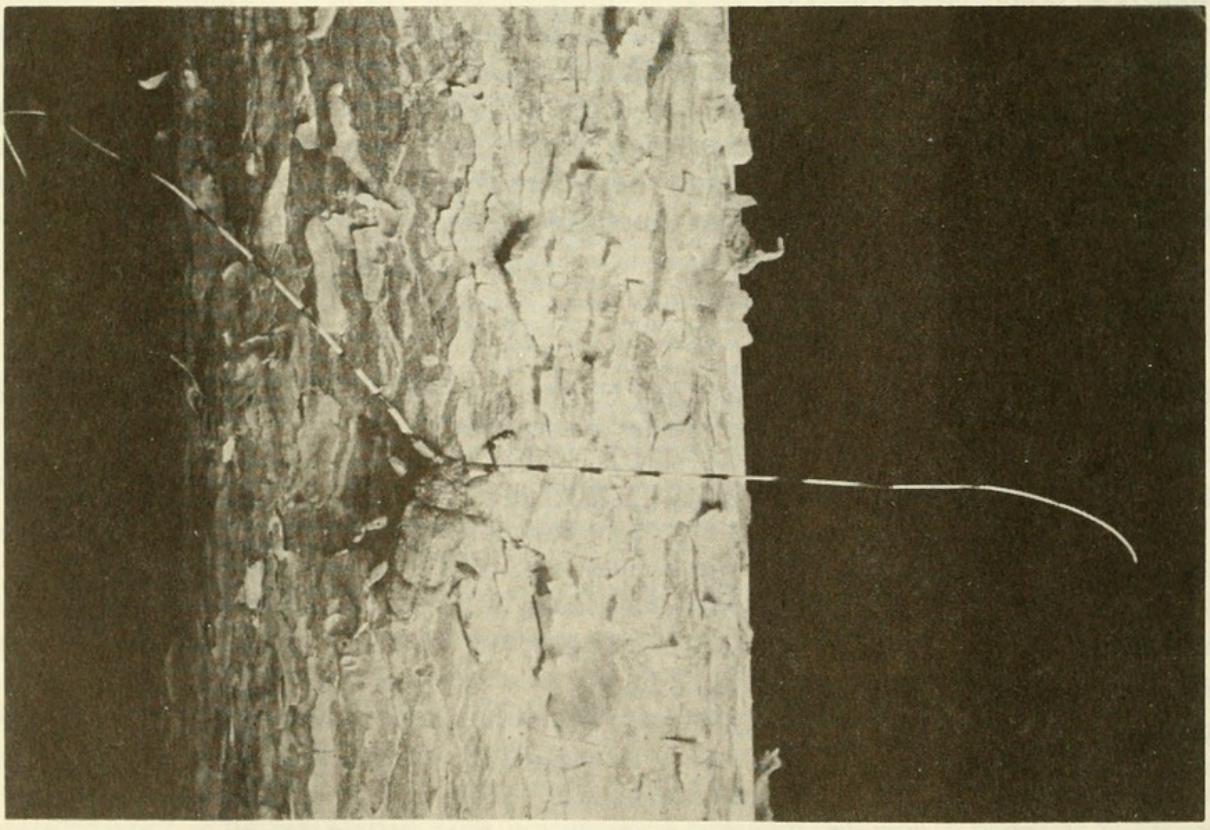

Fig. 1. The timberman *Acanthocinus aedilis* (L.), showing antennae extended.

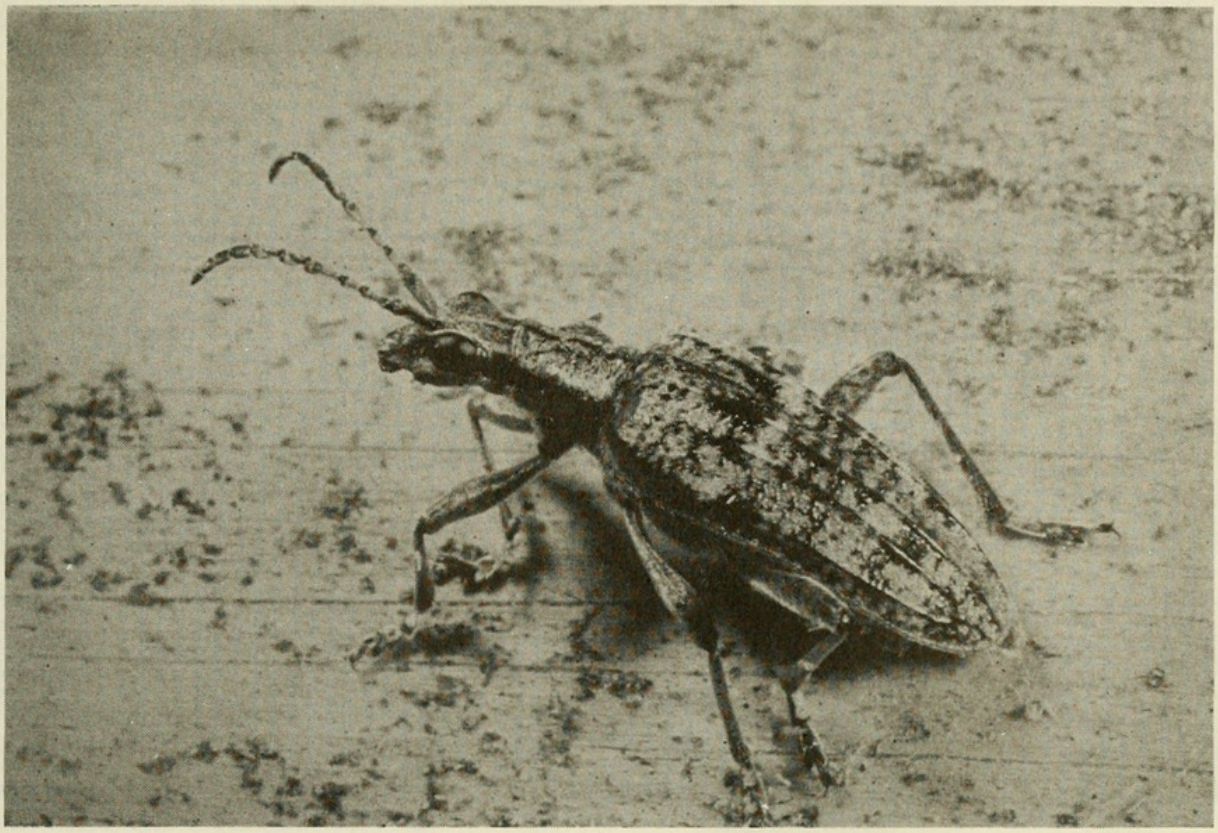

Fig. 2. *Rhagium inquisitor* (L) on pine log.

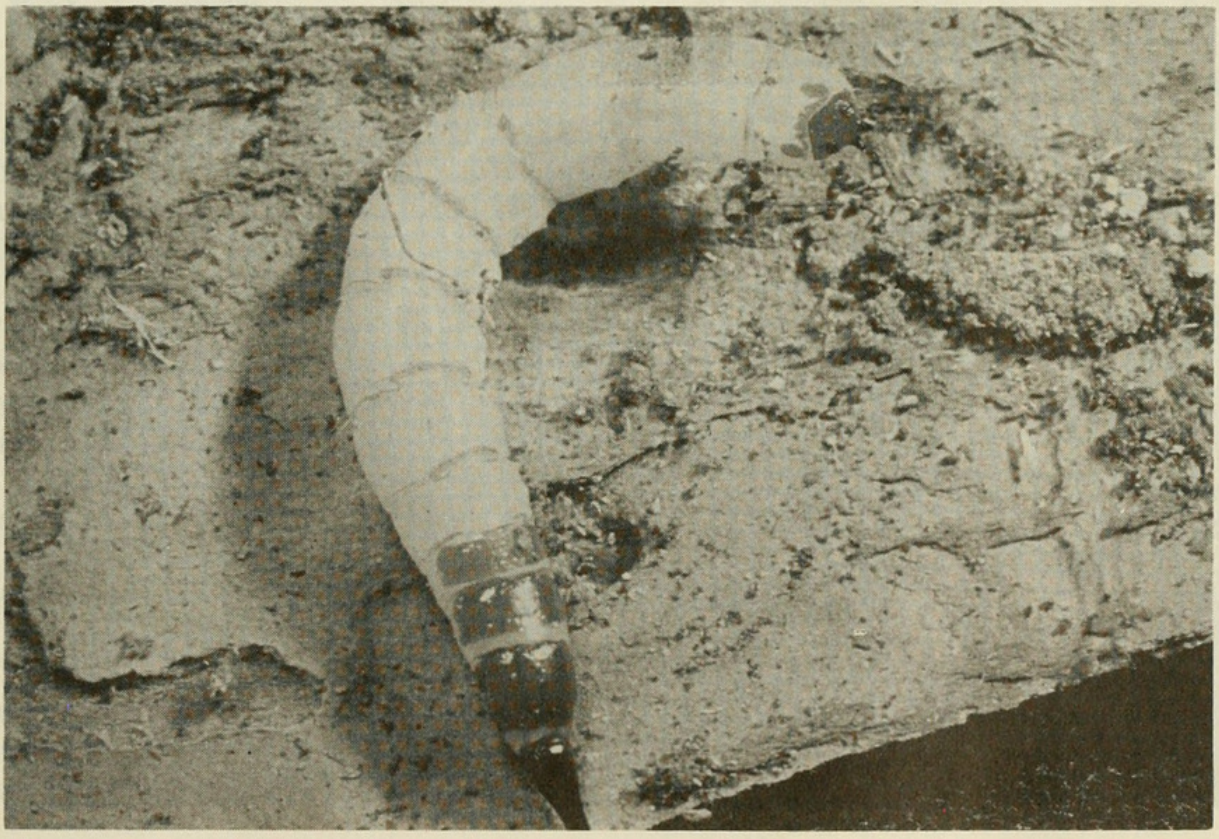

Fig. 3. Larva of *Xylophagus cinctus* Deg. showing the 'beak' which it inserts into the soft skinned larvae of longhorn and other subcortical species.

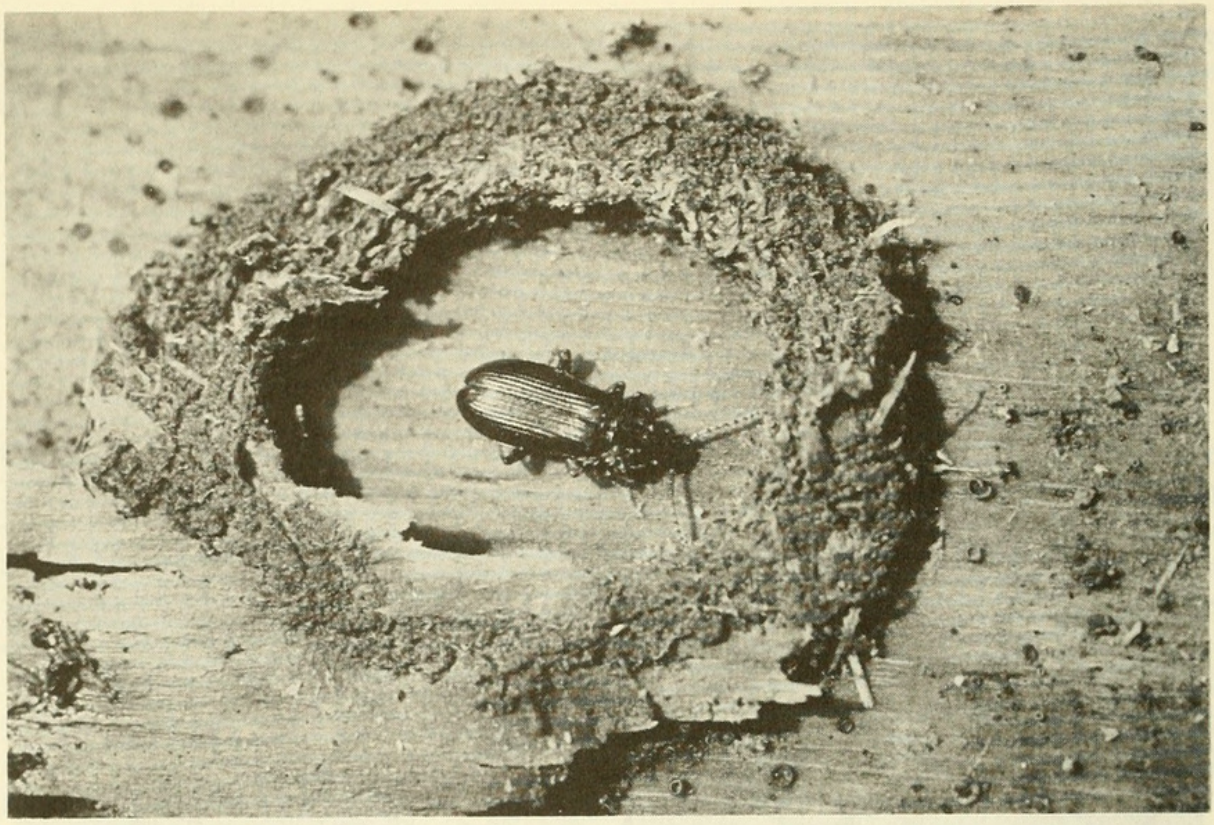

Fig. 4. Pupal chamber with adult of *Pytho depressus* (L.) revealed by removing bark from a pine log; the protective 'corral' was made by the larva.

Fig. 5. The lycid, *Dictyoptera aurora* (Herbst).

Fig. 6. The clerid *Thanisimus formicarius* (L.) looking for scolytids.

In case you come to think that pine wood beetles lack colour, the bright red lycid *Dictyoptera aurora* (Herbst) (Fig. 5) may be seen sometimes flying among the pine trees in the evening sunshine. It is a close relative of the glow-worm as can be seen from the appearance of its larvae, which live in rotten pine. Also brightly coloured are the pine lady birds, such as *Neomysia oblongoguttata* (L.), living on pine aphids, the wood ant associate *Clytra quadripunctata* (L) and the clerids *Thanisimus formicarius* (L) (Fig. 6) and *T. rufipes* (Brahm) which mimic wood ants while they run over pine bark in the sunshine looking for lunch in the form of the bark beetles. More sombre is the elaterid *Selatosomus impressus* (F.) whose immature stages have not yet been discovered — a challenge for pine wood entomologists. I suspect it may live in the soil at the roots of pine stumps.

Now if I have counted properly, I still have 792 beetles to deal with. I think, however, that I have said enough at this point to give you some idea of the RSPB Loch Garten Reserve and its flora and fauna and in particular its beetles. I will tell you, if you wish, about the rest of the beetles on some other occasion.

As the retiring President, there remains one more thing for me to do. As the Chinese might say, we have tonight come to the end of the 'Year of the Beetle' and are about to enter the 'Year of the Fly'. It is my most pleasant duty to welcome into office your new President. I wish him, his Office bearers and all the Society's members every good wish for the forthcoming season.

Acknowledgements

You cannot carry out a survey such as I have described on your own. No one has helped more in this work than the warden of the Reserve, Mr Stewart Taylor who has

never failed to provide information and guidance for my explorations of the Reserve. He has looked after many of the traps, collected material from nests of birds and mammals and, not infrequently, caught the beetles themselves. I should express thanks also to the many others who have helped me, including my wife, who many times has trudged round the forest in the snow helping me set various traps and to those many colleagues who have helped me look for beetles on the Reserve or have provided me with lists of their own captures. I had much help too from my son David with the production of the photographs. Last but not least Mr A.A. Allen, Dr M. Cox, Mr P.M. Hammond, Mr C. Johnson and Dr M. Luff have each helped me more than once in the identification of some of the beetles discovered and I thank them for their assistance.

Appendix: *Material and methods*

The Malaise trap was of standard design as supplied by Marris House Nets, Richmond Park Avenue, Bournemouth BH8 9DR.

The interception trap comprised a piece of black nylon net 2 m long by 1 m high, held vertically between two poles, with its lower edge just touching the rims of flat plastic trays holding water to which had been added a little household detergent.

The carrion trap was home built, comprising an open wooden box 65 × 45 × 15 cm, with a hole 6 cm in diameter in the floor at one end below which was fitted a plastic jar containing some 70% ethyl alcohol. The trap was charged from time to time with whatever carcases were available, mostly of rabbits or hares which had been victims of road traffic.

The fruit trap comprised a plastic net bag holding about 1 litre of fruit residues suspended over a plastic funnel 20 cm in diameter, to which was attached a plastic jar containing some 70% ethyl alcohol. The fruit residues were from domestic jelly making, mainly of plum and apple, fortified prior to use with cane sugar and baker's yeast.

Pitfall traps comprised slightly tapering plastic drinking cups 8 cm deep which were charged with different materials at different times but mainly with 10% aqueous ethylene glycol.

The seed fall traps were semi-translucent white plastic funnels 25 cm in diameter to the stem of which was attached a small net bag to catch falling pine seed. They were set out just above ground level beneath mature pine trees.

Beetle records were kept and analysed on a home computer. Each record comprised the beetle species (in the form of species number), the date, the Reserve compartment, the number of individuals taken or observed on that occasion, the mode of capture, the recorder and a comment up to 64 characters long.

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