JOURNAL OF THE LEPIDOPTERISTS' SOCIETY

Volume 13 1959 Number 2

A TRANSPARENT LIGHT TRAP FOR THE FIELD COLLECTION OF LEPIDOPTERA

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In recent years significant advances have been made in the design of insect light traps, especially by ROBINSON and ROBINSON (1950). The superiority of the Robinson trap to the Rothamsted trap (Williams 1948) for the collection of the larger Lepidoptera was demonstrated by WILLIAMS (1951). Traps constructed to the Robinson specifications are now widely used and are available commercially.

Field use of a portable trap of this kind during the summer months in Australia indicated that Coleoptera, particularly Scarabæidæ, frequently predominated in the catches. When beetle catches were high, the Lepidoptera were often so severely damaged that identification was greatly impeded. A transparent trap has therefore been designed which tends to exclude Scarabæidæ, and automatically segregates from the remainder of the catch most of those which do enter the trap. In practice this trap has proved to be extremely efficient for the collection of most insect Orders, excepting Coleoptera, and the quality of the specimens collected has been consistently high.

FEATURES OF THE TRAP

As in the Robinson trap, the transparent trap (Fig. 1) is operated on the ground with the light source completely visible from above. However, sloping transparent "Perspex" sides and funnel (A) enable the light to be seen from all sides as well. For convenient use, the dimensions of the trap have been kept small. At the same time, the slope of the funnel is steep, ensuring that few insects come to rest in it without entering the trap. To achieve this, the funnel is an inverted truncate cone, 10 inch in diameter above and 5½ inch in diameter below. The lower opening has centered within it a small opaque cone (D) upon which the lamp holder is mounted. This prevents the escape of insects once they have entered the trap. The electric lead to the lamp passes through the bottom of the trap and up through a central cylindrical core to the lamp holder, thus eliminating shadows. Provision is made for rain water to be drained through the trap, but a transparent hood (G) can be fitted above the trap during heavy rain to protect both the lamp and the catch.

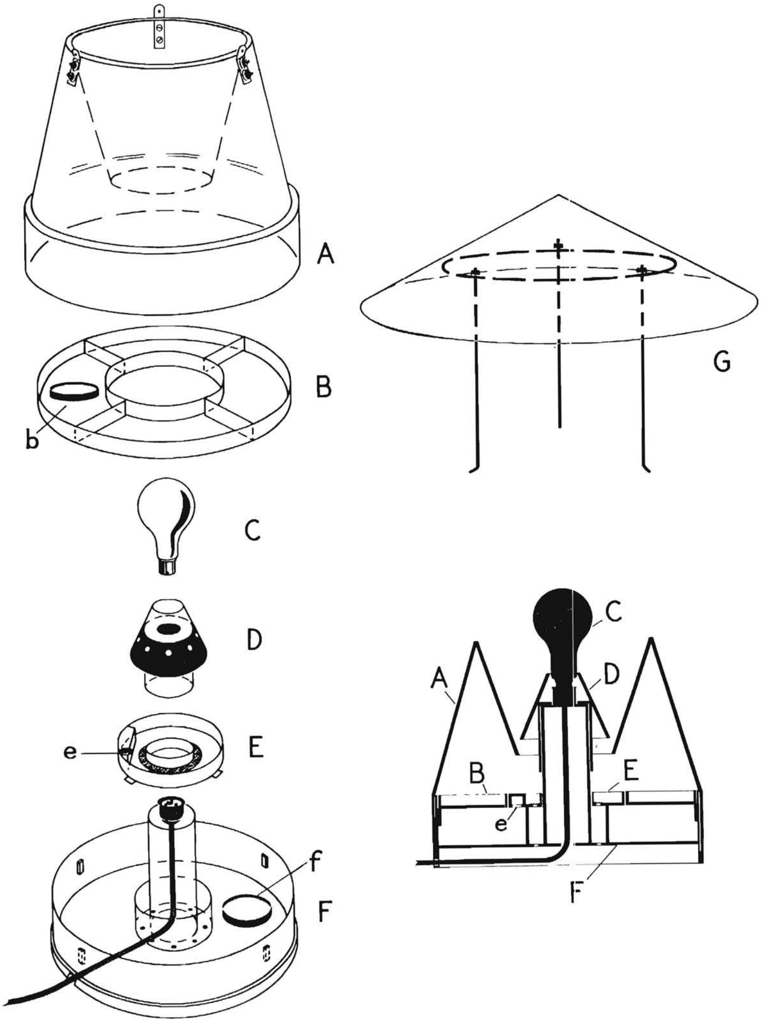

Fig. 1. Exploded view and vertical section of the transparent light trap.

In order to segregate the Scarabæidæ from the Lepidoptera, the trap is divided horizontally into an upper and a lower chamber by two shallow ring-like trays surrounding the central core of the trap. Upon entering the trap, all insects drop into the inner tray (E), but advantage is then taken of the behaviour of most scarabs to crawl rather than to fly. Whereas other insects tend to fly immediately after entering the trap, the scarabs crawl around the side of the inner tray and drop into the lower chamber (F) through the one (e) or two access holes provided. Most of the other insects, including Lepidoptera, remain in the upper chamber and drop into the outer tray (B).

The removable outer cover and the attached funnel are constructed of ⅛ inch colourless "Perspex." The remainder is made of 1/16 inch celluloid. The trap is transported when completely assembled, but can readily be dismantled to extract the catch, to charge two plaster of Paris blocks (b, f) with the killing agent, tetrachloroethane, or to clean the trap. In the field, it is normally operated with the 125 watt mercury vapour discharge lamp (c) recommended as a light source by ROBINSON and ROBINSON (1950).

PERFORMANCE

Preliminary testing of the transparent trap suggested that the catches of Scarabæidæ were considerably lower than those in a Robinson trap with an opaque funnel, but that the catches of other insects were still satisfactory. The performance of the transparent trap was therefore compared experimentally with that of a similarly constructed opaque trap, using the method recommended by WILLIAMS (1951).

The two traps were operated for two hours immediately after dark on each of eight nights, each trap being tested four times in each of two comparable positions about 75 yards apart. The first four tests were on nearly consecutive nights in December, while the second four were on nearly consecutive nights in January. A Philips 160 watt blended lamp, which incorporates both a mercury vapour discharge tube and an incandescent filament, was used as the light source in each trap.

Table 1. GEOMETRIC MEANS OF INSECT CATCHES IN A TRANSPARENT AND AN OPAQUE TRAP.

	Transparent	Opaque	Significance
Total insects	942	1406	n. s.
Coleoptera	177	672	n. s
Scarabæidæ	77	475	$P < .05$
Total Lepidoptera	468	414	n. s
Microlepidoptera	324	237	n. s.

As might be expected, the catches in both traps varied greatly and, in order to avoid the overwhelming effect of very high individual catches, logarithms of the observations were used in the statistical analyses (see Williams 1951). The important difference between the two traps (Table 1) is shown in the catches of Scarabæidæ which, in the opaque trap, were so high on most nights that the softer-bodied insects were seriously damaged. The total catches of all insects in the opaque trap were higher than in the transparent, this difference being due to the Coleoptera. The difference between the catches of all Coleoptera approached significance at the 5 per cent level. The statistical analysis indicated that interchange of the position of the traps had no effect on the relative numbers of any insect group caught in the two traps.

The proportion of insects finding their way into the lower chamber varied significantly and markedly between insect groups. For all groups there was a significant increase in this proportion when two holes instead of one gave access to the lower chamber. Thus where Scarabæidæ are plentiful, two access holes are desirable to ensure a high quality in the bulk of the Lepidoptera, whereas one is sufficient where scarabs are less common. About 72 per cent of the Lepidoptera remained in the upper chamber when two access holes were provided, and this figure rose to about 87 per cent when one of these was closed. The percentage of scarabs remaining in the upper chamber similarly increased from 16 per cent with two access holes to 35 per cent with one access hole.

Table 2. GEOMETRIC MEANS OF INSECT CATCHES IN THE UPPER AND LOWER CHAMBERS OF A TRANSPARENT TRAP.

	One access hole			Two access holes		
	Upper	Lower	% in upper	Upper	Lower	% in upper
Total insects	939.7	203.7	82.2	479.0	307.6	60.9
Coleoptera	107.4	66.4	61.8	48.9	125.3	28.1
Scarabæidæ	16.4	30.4	35.0	19.2	104.2	15.6
Lepidoptera	533.3	82.3	86.6	257.0	97.7	72.5

DISCUSSION

In explaining the merits of the Robinson trap, ROBINSON (1952) pointed out that the shadow cast by the opaque funnel materially increased the insect catch. He stated that, as insects are positively phototactic only when their eyes are in the dark-adapted condition, those which fail to enter the trap on first approaching the light soon become light-adapted and no longer sensitive. Many of these settle in the area of shadow surrounding the trap, where their eyes again become dark-adapted. When further flight is attempted, these insects once more approach the light and are likely to be caught. Theoretically, this procedure may be repeated indefinitely until all the insects which approach the light source are captured.

This explanation might easily be true for Scarabæidæ and for some of the rapid-flying Lepidoptera. However, the efficiency of the Robinson trap for capturing the slower-flying Lepidoptera has been questioned both by BRETHERTON (1951) and by BEIRNE (1951). BEIRNE recognised that most slow-flying Lepidoptera approach a light source close to the ground and concluded that a box-type trap was more efficient than a funnel-type trap for these species. The great disadvantage of the box trap, like the Rothamsted trap, is that the light source is not visible from above. It therefore tends to exclude rapid-flying Lepidoptera altogether.

The present observations have shown that, when it is warm and windless, many Lepidoptera first land on the ground in the vicinity of the transparent trap and then approach it either at once or in a series of short flights close to the ground. When a light wind is blowing, they approach the trap chiefly up wind, in a series of short flights close to the ground or even by crawling along the ground. Most Scarabæidæ likewise usually land on the ground in the vicinity of the transparent trap and then usually crawl to the base of the trap, or approach it with a rapid low, somewhat circular flight. Most of the latter individuals usually strike the sloping sides of the trap and drop to the ground at the base. Seldom do they take to sustained flight again, but continue to crawl around on the ground at the base of the trap. When moths reach the base of the trap, they either crawl or flutter up the sloping surface and, once within the steep funnel, rapidly enter the trap. Some rest on the outside, but later are often disturbed by other crawling and fluttering insects and once more move up the slope towards the light source. Under all conditions, of course, some become immobilized in the vicinity of the trap, as observed by ROBINSON (1952).

The device described above for segregating Scarabæidæ from Lepidoptera can readily be adapted to the insect container of any light trap. It has been used successfully at Canberra for several years in a cylindrical celluloid container below a simple funnel-type trap.

ACKNOWLEDGMENTS

The author is indebted to Mr. W. J. RAFFERTY and Mr. P. FOX for assistance in constructing the trap, to Mr. R. STRAATMAN, Mr. M. S. UPTON and Miss L. JAMES for assisting in the sorting and counting of insect catches, to Mr. L. A. MARSHALL who prepared the line drawings, and to Mr. G. A. McINTYRE for the statistical analysis.

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