PHENOLOGY OF *ELDANA SACCHARINA* WALKER IN NATAL AND USE OF LIGHT TRAPS TO MONITOR DISTRIBUTION AND ABUNDANCE

By P. R. ATKINSON

South African Sugar Association Experiment Station, Mount Edgecombe 4300

Abstract

Based on light trap catches, the phenology of the moth *Eldana saccharina* Walker is described. There appear to be three periods of marked abundance: September; November/December; March-May. By contrast, larvae in sugarcane reach maximum intensities between May and July. At the latitude of Amatikulu, the insect overwinters mainly as slowly developing larvae which pupate in September. Light traps constitute a cheap but effective way of monitoring eldana populations over wide areas and in different kinds of habitat. In future it may be possible to draw conclusions about the quality of the habitat and to predict infestation levels for coming mill seasons.

Introduction

In the South African sugarcane industry the incidence of eldana borer (*Eldana saccharina* Walker) has been assessed in consignments of cane at the mills (Carnegie[5, 6]; Carnegie, Leslie and Hindley[7]; Carnegie and Smaill[8]; Smaill[12]; Smaill and Carnegie[13]). These mill surveys constitute the only basis for long-term comparisons of the levels of eldana throughout the industry. However, for two reasons the mill data have not been used to assess seasonal changes in eldana numbers and the phenology of the insect has never been investigated. First, the mills do not operate in late summer when eldana might be expected to reach its maximum numbers. Secondly, there has been doubt about the interpretation of the mill survey results within each season. For example, the high intensities of eldana at mill opening might simply be due to a tendency to mill the most heavily infested cane first; while the trough in intensity around August each year might be due to a change from out-of-season cane to seasonal cane being milled.

Although counts of eldana larvae have been done monthly in a few cane fields ever since the pest was first detected (Atkinson, Carnegie and Smaill[4]), the seasonal fluctuations in eldana numbers have been obscured by the cane cutting cycles and the sample is too small to reflect the overall population changes.

In 1979 a light trap grid (Figure 1) was established in Natal to investigate the distribution, seasonal fluctuation and possible migration of eldana moths. This grid has since been extended to include traps in Malawi, Swaziland and the Transvaal. In this paper, light trap data have been used, in conjunction with mill surveys and available data from extensive field surveys, to elucidate the phenology of eldana at the latitude of Natal; and to show that light traps are a cheap, reliable way of monitoring eldana numbers.

Methods

The light trap grid consists of 21 Robinson traps (Robinson and Robinson[11]). Two traps in Malawi and two in the Transvaal are not shown in Figure 1. Most traps have 100 W tungsten filament globes. Traps 7 and 10 (Figure 1) are battery operated and have 12V 60W incandescent globes. The traps in the Transvaal and the one at Big Bend, which are run by independent organisations, have mercury vapour globes. In light-source trials, relatively dim tungsten filament lamps attracted more eldana moths than did the intense mercury vapour lamps (Atkinson[2]). Traps are emptied daily as far as possible and the catches sent to the Experiment Station at the end of each month for indentification and counting. Insecticide (Nogos 50) in the traps is renewed thrice weekly.

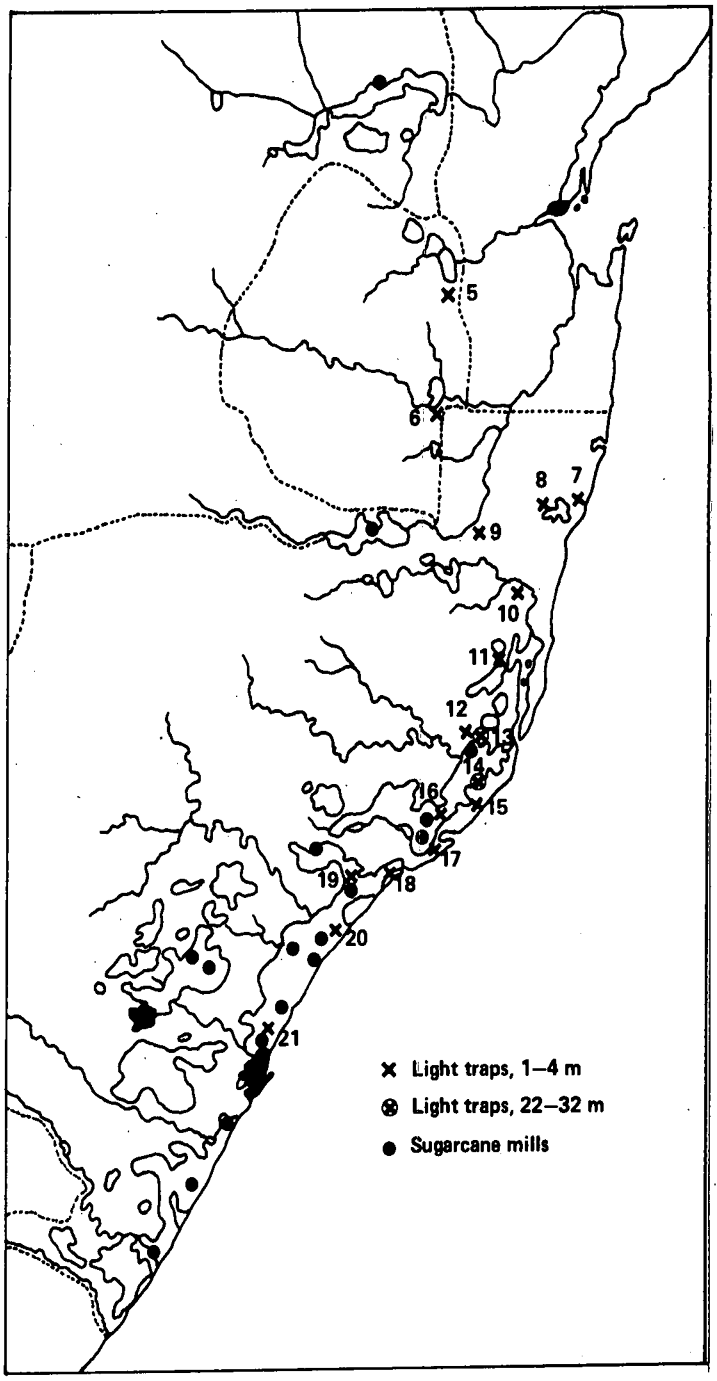

FIGURE 1 Light trap sites in Swaziland and Natal, and sites of sugarmills.

In mill surveys, 20 stalks / consignment are examined from as many consignments as possible each day, and the numbers of larvae and pupae recorded. In 1979, extensive field surveys were instituted in the worst-affected mill areas in an attempt to relate field infestations to soil types and cultural practices, and as a service to growers. Larvae and pupae are counted in 100 stalks/ha taken at 10-pace intervals along several transects in each field.

Phenology of Eldana in Sugarcane

Eldana moths emerge gravid and ready to fly and most females probably mate during their first night (Atkinson[3]; Girling[9]). Females predominate in catches made outside their breeding habitat and seem more inclined to disperse than males (Atkinson[3]; Girling[9]). Furthermore they give rise to future infestations, and so in this paper all trap catches show the numbers of female moths only.

Mean catches per week for 21 traps numbered from north to south are shown in Table 1. It is evident that eldana moths are widespread, and have been caught almost wherever light traps have been sited, even 20 m above the ground. Exceptions are Mkuze, where the lamp is 12V, 60W and battery operated with very limited charging hours and may not have been illuminated throughout each night; and Groblersdal trap, which has run for less than four weeks.

In Table 1, the mean moth catches shown are much higher from sugarcane than from natural hosts. This may be because of nutritional differences between the two kinds of host plants or because predation or parasitism is higher in the natural habitat (generally Cyperaceae) than in sugarcane. Greater numbers of macro-arthropods have been recorded in *Cyperus immensus* (C.B.Cl.) than in sugarcane (Leslie[10]), suggesting that predation may be higher in the sedge.

Mean moth catches (Table 1) generally increase from north to south, both in sugarcane and in natural hosts. There are no statistically significant differences in the numbers of macro-arthropods recorded between north and south Natal (Leslie[10]), suggesting that mortality due to causes other than predation may be higher in the north. Eldana does not seem to be such a serious pest of sugarcane outside Natal, nor indeed outside the rainfed areas of Natal where the problem is most severe.

In Figure 2, the catches from traps which sample sugarcane in the most severely affected areas (Empangeni to the Tugela River) have been grouped in "standard weeks" (Taylor and French[15]) and averaged to show the mean seasonal periods of flight. A logarithmic plot has been used to illustrate the true relative fluctuations; for example, there would be the same vertical interval if moth numbers doubled from 5-10/week as from 50-100/week. There appear to be three periods when eldana moths are markedly abundant at this latitude: September; November/December; and March-May. This conclusion could alter as more data accumulate.

In Figure 3, moth catches from traps sampling sugarcane in Natal are compared with intensities of larvae + pupae/100 stalks (E/100) recorded at the nearest mills. The data are plotted as logarithms. Mean E/100 intensities generally decline from the opening of mills in autumn to their closure in summer, but there is sometimes an increase in intensity during summer. On the other hand moth catches tend to move in the opposite sense, being lowest in winter with a sharp increase during September and October, when E/100 intensities reach their minima. There is very little moth activity in winter, such as there is being confined to the first hour of the night (Atkinson[3]).

During the winter, eldana larvae accumulate in the sugarcane, very few pupating and emerging as adults. For example, if the percentages of pupae are calculated for eldana recorded in mill surveys (Figure 4), it is evident that there are very few pupae in winter and that pupae reach maximum numbers each season around September. On this evidence, solid arrows are shown in Figure 3 to illustrate the transition in spring from larvae, through pupae, into adults. The duration of the pupal stage is relatively short, ranging from 7-20 days depending on temperature (Atkinson[1]), and taking about seven days at Amatikulu in September. Hence, one reason for the seasonal minima in E/100 intensities around September is the vacation of cane by larvae as they complete their life cycle.

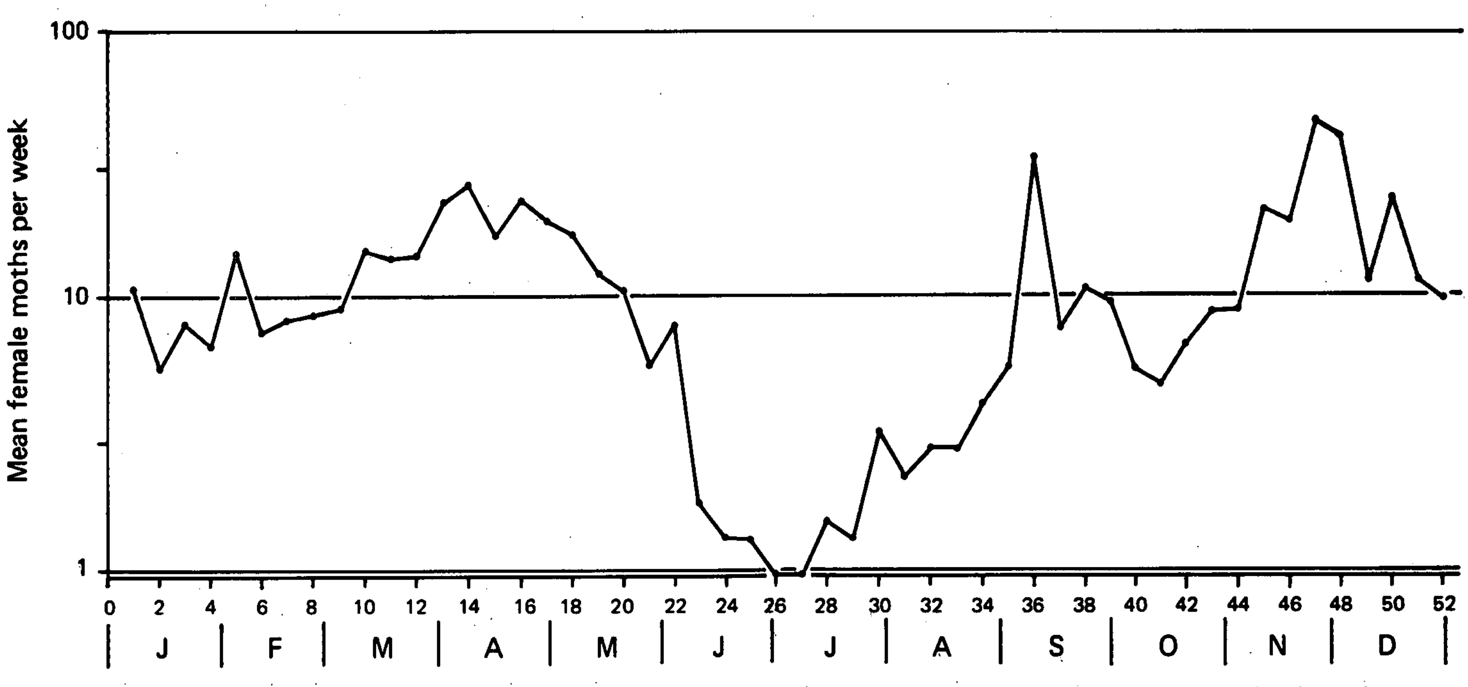

FIGURE 2 Mean seasonal cycle of catches of female moths/week from traps 16 (Empangeni), 18 (Mtunzini), 19 (Amatikulu) and 20 (Tugela River). Data are plotted as log (mean + 1) on Rothamsted 'standard weeks' (Taylor & French[15]).

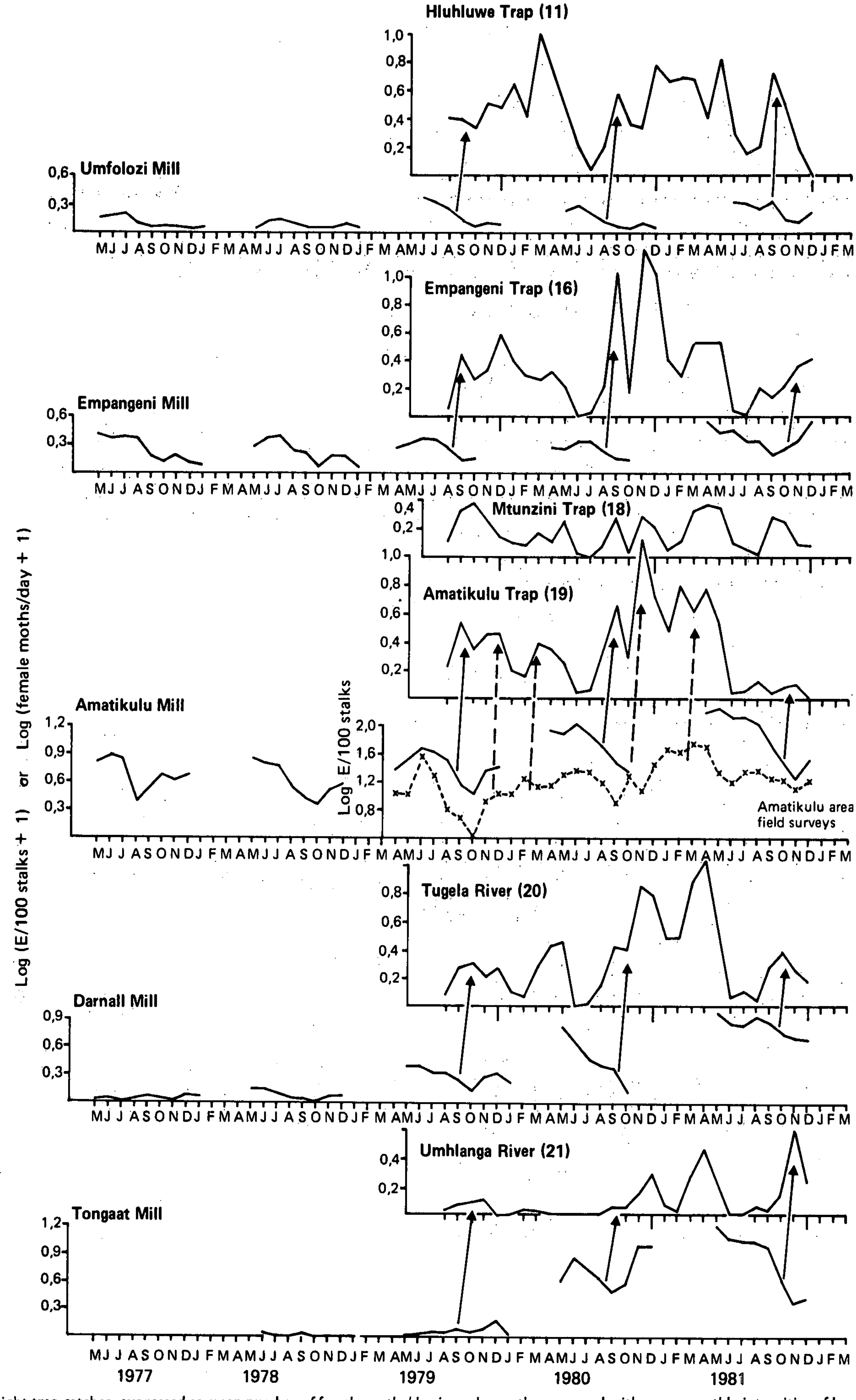

FIGURE 3 Light trap catches, expressed as mean number of female moths/day in each month, compared with mean monthly intensities of larvae + pupae/100 stalks (E/100) in mill-surveys; and, at Amatikulu, with E/100 intensities in extensive field-surveys. Data are plotted as log (mean + 1).

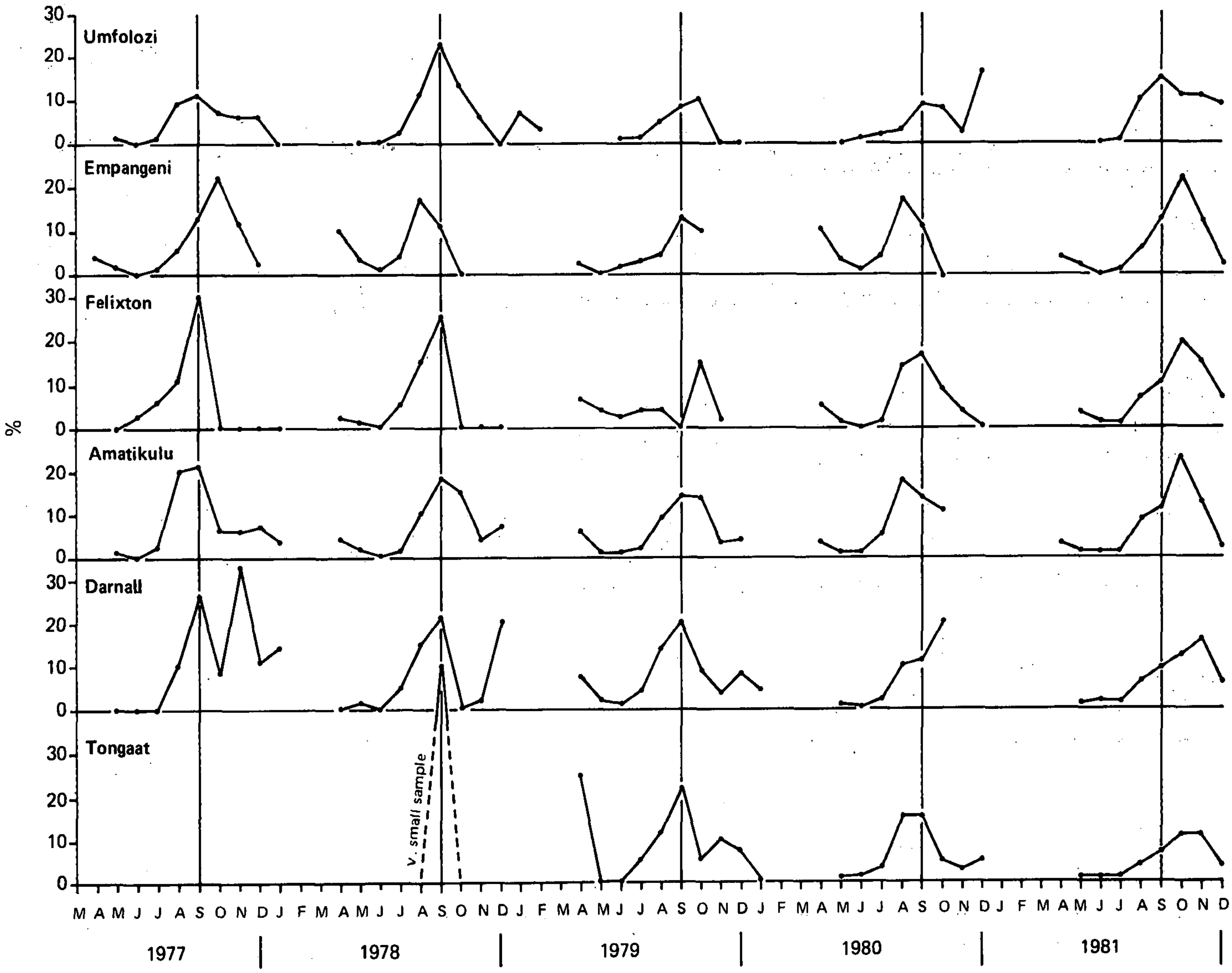

FIGURE 4 Percentage of eldana which were pupae in surveys from six mills. Vertical lines are drawn at September (spring) in each year.

Thermal constants for the stages of the life cycle are: 73D° > 10°C for the egg; 145D° > 10°C for the pupa; and for the larva (feeding in sugarcane) 500-1 000D° > 15°C (Atkinson[1]). There is uncertainty about the thermal constant of the larvae in sugarcane (Atkinson[1]) but, assuming 750D° > 15°C and using mean maximum monthly temperatures at Amatikulu mill, then moths emerging on 1 September would have been laid as eggs late in May. In Figure 2 there is a prolonged peak of moth activity from March to May which, presumably, represents several late-summer generations of moths that give rise to the larvae developing slowly through winter.

The mill surveys are discontinuous so it is less easy to account for the origins of the summer (November/December, Figure 2) and the autumn (March-May) peaks of moths. However, for the Amatikulu mill area, data are available from extensive field surveys since 1979 (Figure 3) and the trends of E/100 intensities agree well with those of the mill surveys. The probable origins of the summer and autumn peaks of moths are shown by broken arrows (Figure 3).

Despite reservations about interpreting mill survey results, the data probably provide a good measure of eldana density on the ground. The insect tends to infest older sugarcane. Furthermore, its numbers in cane are higher than in natural hosts (Table 1) and in Natal cane must now be the most abundant host-plant. Hence the bulk of the larval population in Natal would tend to be in older sugarcane. As this cane was milled during a season, the population density of larvae would fall, particularly when out-of-season cane became scarce. Finally, the larvae would pupate around September and emerge as moths, at which time the larval population in Natal would be at its minimum.

At Empangeni, Amatikulu and Darnall there seems to have been high mortality of moths in spring 1981/82. Although E/100 intensities at these mills reached their highest levels ever in winter 1981 (Figure 3), there have been no comparable peaks of moths the following spring and early summer.

Monitoring Eldana Populations

Light traps are cheap to operate. The cost of the whole grid in Natal is estimated to be R500/month, whereas the survey teams at one mill alone may cost R1 000/month and field survey teams rather more. On the other hand, light traps, even at greater density, could not provide the detail given by the ground survey methods.

Light traps can monitor eldana populations in different habitats, or different countries, on the same basis. If the present grid were extended much could be learned about the distribution and seasonal abundance of the pest over large areas. For example, conclusions have been possible even from the simple comparisons in Table 1. The egg complements of eldana moths, and whether or not they have mated, are recorded from light trap catches, and should indicate the nutritional quality of the habitat in which the insects developed. Although we do not know how far the female moths move, it is assumed that the traps on the whole sample local populations. It would be useful to know how favourable different habitats are to the insect.

Light traps concentrate insects which are sparsely distributed in the air, so that meaningful numbers can be sampled. It is not clear why nocturnal insects come to light but it is known that their reaction to light varies with their physiological condition, age and sex, and also with the weather conditions and moonlight. These factors contribute to the variation in the catch data, which are otherwise assumed to reflect numerical changes in the ground population of the insect. Nevertheless, the justification for light trapping is not that it is ideal but that it is feasible (Taylor[14]). Here it has been shown that light trap catches of eldana reflect the existing measures of the ground population sufficiently well to continue with the method. As more data accumulate, it may be possible to predict the infestation levels for a coming season from the sizes of the peaks of moths between September and May. This could be useful if, for example, chemical methods of control are devised.

TABLE 1

Mean catch of female moths/week for each trap in the grid, together with the number of weeks of operation. Traps are numbered from north to south. Catches in brackets refer to those traps which probably sampled both kinds of habitat.

Trap No.	Site	No. of weeks of operation	Mean catch/week in habitat shown: Natural hosts	Mean catch/week in habitat shown: Sugarcane
			Low-level traps (1-4 m above ground)	
1	Dwangwa (Malawi)	62	0,32	—
2	Nchalo (Malawi) ..	57	0,53	—
3	Groblersdal (Tvl) ..	<4	0,00	—
4	Letaba (Tvl)	4	0,08	—
5	Simunye (Swaziland)	18	—	0,35
6	Big Bend (Swaziland)	124	—	(0,57)
7	Lake Sibayi (coast)	103	0,05	—
8	Lake Sibayi (inland)	82	0,10	—
9	Makatini flats.. ..	124	0,50	—
10	Mkuze	45	0,00	—
11	Hluhluwe	112	—	(7,40)
12	Mtubatuba	72	—	0,72
15	Lake Nhlabane ..	101	1,72	—
16	Empangeni	122	—	4,98
17	Lake Cubhu	124	0,64	—
18	Mtunzini..	120	—	2,02
19	Amatikulu	123	—	5,00
20	Tugela River	123	—	5,03
21	Umhlanga River ..	126	—	1.03
			High-level traps (>20 m above ground)	
13	Mtubatuba fire tower (22m).. ..	91	—	0,11
14	Kwambonambi fire tower (30m).. ..	58	—	(0,05)

REFERENCES

1. Atkinson, P. R. (1980). On the biology, distribution and natural host plants of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *J ent Soc sth Afr* **43**: 171–194.
2. Atkinson, P. R. (1980). Light-source tests for trapping *Eldana saccharina* Walker moths. *SASTA Proc* **54**: 151–153.
3. Atkinson, P. R (1981). Mating behaviour and activity patterns of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *J ent Soc sth Afr* **44**: 265–280.
4. Atkinson, P. R., Carnegie, A. J. M. and Smaill, R. J. (1981). A history of the outbreaks of *Eldana saccharina* Walker, in Natal. *SASTA Proc* **55**: 111–115.
5. Carnegie, A. J. M. (1977). Current situation regarding the borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *SASTA Proc* **51**: 24–26.
6. Carnegie, A. J. M. (1981). Combating *Eldana saccharina* Walker: a progress report. *SATSA Proc* **55**: 116–119.
7. Carnegie, A. J. M., Leslie, G. W. and Hindley, M. E. O. (1976). Incidence and spread of the borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *SASTA Proc* **50**: 34–39.
8. Carnegie, A. J. M. and Smaill, R. J. (1980). The incidence of moth borers in South African sugarcane during the 1979/80 season. *SASTA Proc* **54**: 154–157.
9. Girling, D. J. (1978). The distribution and biology of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) and its relationship to other stem borers in Uganda. *Bull ent Res* **68**: 471–488.
10. Leslie, G. W. (1981). The macro-arthropod community of sugarcane fields and *Cyperus immensus* stands. *SASTA Proc* **55**: 120–126.
11. Robinson, H. S. and Robinson, P. J. M. (1950). Some notes on the observed behaviour of Lepidoptera in flight in the vicinity of light sources together with a description of a light trap designed to take entomological samples. *Ent Gaz* **1**: 3–15.
12. Smaill, R. J. (1978). Millyard surveys of lepidopterous cane borers *Eldana saccharina* Walker and *Sesamia calamistis* Hampson. *SASTA Proc* **52**: 139–142.
13. Smaill, R. J. and Carnegie, A. J. M. (1979). The situation regarding *Eldana* borer (*E. saccharina* Walker) during 1978/79 and assessments of crop loss. *SASTA Proc* **53**: 108–110.
14. Taylor, L. R. (1974). Monitoring change in the distribution and abundance of insects. Rothamsted Experimental Station. Report for 1973, Part 2, 202–239.
15. Taylor, L. R. and French, R. A. (1973). Rothamsted insect survey. (Fourth Report). Rothamsted Experimental Station. Report for 1972, Part 2, 182–211.