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THE NEED FOR IMPROVED METHODS FOR SAMPLING MOSQUITO POPULATIONS

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Because of insecticide resistance, high cost of insecticides and the increased awareness of environmental contamination and pollution, there has been renewed interest in the biological control of mosquitoes. Within recent years there have been several attempts to use genetic methods for the control of mosquitoes (Davidson, 1974). I firmly believe that any successful genetic control programme must be built up from a sound foundation of ecological information. Many of the basic ecological parameters, such as the probability of a viable egg giving rise to an adult and the mean and maximum dispersal distances of both sexes of adults, should be determined before genetic control measures are implemented. Whereas in fact genetic control programmes have often been attempted with insufficient biological and ecological data. With genetic control it is even more important to understand the population dynamics of the species than for insecticidal control. I am much concerned about the paucity of relevant ecological data on the mosquitoes to be controlled, and the many difficult problems encountered in trying to sample their populations. The present short paper is intended to draw attention to just a few of the gaps in our knowledge.

Better techniques are required to both locate and estimate the egg population in the field so that the population "input" can be determined. For example, in some field trials evaluating the release of sterile male *Aedes aegypti* eggs produced by females mated with these are not laid in the habitats are used for oviposition by the natural population. Such behavioural changes in oviposition selections make it more difficult to estimate the percentage of sterile eggs in the population. There is also a very urgent need to improve techniques for sampling larval populations, especially the almost universal method of recording the number of larvae per dip. In most cases this merely measures larval

density which is of little value in indicating population size. For example, the same number of larvae may be present in large and small habitats, but the number per dip will be significantly greater for the smaller habitat, although the population size in both is identical. The distribution of larvae within even a more or less apparently homogeneous habitat is very rarely regular or random. Mosquito larvae usually exhibit a markedly patchy or clumped distribution (Service, 1971) and this results in great variations between the numbers caught in different samples. This necessitates the collection of a large number of samples if the data are to be meaningful. Other difficulties are the differences between the escape and alarm reactions of larvae of different species and also between different instars of the same species. For example, younger instars usually stay submerged for longer periods than older instars, and because of this will be underestimated by most sampling procedures. There should be comparisons between different sampling methods to enable the bias associated with each to be recognised and evaluated. It seems desirable that larval sampling should be based on at least two different techniques.

Mark-recapture techniques were originally designed to estimate population size, but with mosquitoes they are in fact more commonly employed to measure adult dispersal. The methods used however, are usually very inefficient. I think it inconceivable that handling and tagging mosquitoes whether by radionuclides or externally with paints or fluorescent powders, does not effect their survival or dispersal behaviour. With some insects there is evidence to suggest that marking procedures excite individuals to disperse further than normal, whereas other experiments have shown marked insects to enter a state of "shock" and seek shelter and protection soon after release. This reduces dispersal. Another very important problem is that usually less than 1% of marked mosquitoes are recaptured. That means that the dispersal behaviour of large field populations is extrapolated from the dispersal of a few marked adults, which may be exhibiting atypical behaviour. Most recapture procedures only catch individuals flying near ground level, there being no attempt to study vertical migration; consequently there is no information on mosquitoes that might be swept into the upper air and be transported considerable distances, possibly outside of the recapture area. Nothing is known of the fate of the large numbers of uncaught marked adults. Other questions that need to be answered are what effect does mass laboratory rearing have on survival rates, dispersal, mating competitiveness, and other behaviour patterns of adults released into the field.

It is also very important in genetic control programmes to obtain re-

liable estimates of adult population size so that computer models can be programmed to predict the number of sterile insects needed to be introduced into a population, and also over what period this is to be continued. There has been very little convincing work on mosquitoes which has given realistic estimates of population size. In fact when field experiments have been made to calculate population size by different methods conflicting results have often resulted. It is then usually difficult to know which estimate is the most realistic. The statistical reliance and error attached to different methods can sometimes be evaluated by simulation studies, in which different values for population size, numbers of marked individuals and recapture rates etc. are put into a computer programme. However, this will only demonstrate the most appropriate method under known conditions, and may be of limited use in selecting the best field method where there is no, or little, information on the values of these parameters.

In conclusion I would like to make a strong plea for a more ecological approach to mosquito control, including evaluating better methods for estimating the values of the important biological parameters.

LITERATURE

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O POTRZEBIE UDOSKONALENIA METOD POBIERANIA PRÓB Z POPULACJI KOMARÓW

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W ostatnich latach niejednokrotnie próbowano wykorzystać metody genetyczne do zwalczania komarów. Autor sądzi, że każdy program zwalczania metodami genetycznymi, jeżeli ma być skuteczny, powinien wynikać z trafnych przesłanek ekologicznych. Zanim się taki program wprowadzi w życie, należy uzyskać rozeznanie w podstawionych parametrach ekologicznych, takich jak prawdopodobieństwo, że zdolny do życia zarodek rozwinie się szczęśliwie aż do postaci dorosłej, lub takich, jak średnie maksymalne odległości lotu imagines.

Potrzebne są doskonalsze metody znajdowania i ilościowej oceny jaj złożonych w terenie, aby można było określić „przybór populacji" (population input). Istnieje również pilna potrzeba ulepszenia metodyki pobierania prób z populacji larwalnej.

W większości przypadków, podając liczbę larw przypadającą na 1 próbę, mierzymy raczej zagęszczenie larw, co ma zwykle niewielkie znaczenie.

Metody wypuszczenia egzemplarzy znakowanych i ponownego ich odławiania są powszechnie stosowane dla mierzenia dyspersji. Zazwyczaj są to jednak metody mało skuteczne. Trudno też wyobrazić sobie, aby dotykanie i znakowanie postaci dorosłych bądź to substancjami radioaktywnymi, bądź zewnętrznie proszkami lub farbami nie wpływało na okres przeżycia i na dyspersję. Co więcej, odławia się zazwyczaj mniej niż 1% egzemplarzy oznakowanych. Tak więc w zakresie dyspersji o zachowaniu się dużych populacji w terenie wnioskuje się drogą obserwacji nielicznych tylko znakowanych egzemplarzy, które ponadto prawdopodobnie zachowują się nietypowo. Są i inne niepokojące problemy, np. jaki jest los (często dużej liczby) egzemplarzy znakowanych i wypuszczonych, a nie odłowionych ponownie? Czy przeniknęły one poza strefę odłowów? Ponadto, do jakich skutków prowadzi masową hodowla laboratoryjna u owadów, które następnie wypuszczamy na wolność: jak kształtują się u nich, w porównaniu z dzikimi, wskaźniki długości życia, dyspersji, aktywności seksualnej i inne?