THE IMPORTANCE OF USEFUL INSECTS IN INTEGRATED CONTROL POLICIES AGAINST OIL PALM LEAF-EATING INSECTS

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From the flowers to the roots, every oil palm organ can be attacked by insects. However, the leaves are the main food source for a very wide range of pests, most of which are Lepidoptera, but which also include several Coleoptera and a few Orthoptera species. There is generally a balance between these species and their environment, but outbreaks are far from rare, and even common in some cases, reflecting an environmental imbalance. The primary, but not the only factor governing this balance is the existence of a parasitoid and predator insect complex which plays a determining role in host population dynamics. The development of integrated control methods necessarily involves in-depth knowledge of this fauna, so as to consider additional introductions, protect the fauna as far as possible and even promote its development.

Depredatory species

In West Africa, the zone of origin of *Elaeis guineensis*, less than ten Lepidoptera species are observed on oil palm leaves, primarily belonging to the *Latoia* (Limacodidae) genus, along with two species from the Hesperidae family (Mariau *et al.*, 1981).

Other species such as *Leptonatada sjöstedti* Aurivillius or *Casphalia extranea* have only recently been seen on oil palm, probably having moved from other plants. *Coelaenomenodera minuta* Uhmann (Coleoptera Chrysomelidae Hispinae) causes substantial damage, and even affected wild oil palms, particularly in Benin (Cachan, 1957) before any commercial plantations were set up.

In Southeast Asia, around twenty Lepidoptera species attack oil palm, although a relatively small number have any significant economic impact, for example *Setothosea asigna* Van Eeck in Indonesia or *Mahasena corbetti* Tams in Malaysia (Mariau *et al.*, 1991).

In Latin America, there is a much wider range of Lepidoptera species: there are in fact dozens of them, many of which are major leaf eaters. They belong to very varied families, primarily Limacodidae (*Sibine* spp., *Euprosterna elaeasa* Dyan, etc.), but also to families as varied as Brassolidae (*Brassolis sophorae* L.), Megalopygidae (*Norape* sp.), Oecophoridae (*Peleopoda arcanella* Busk), Psychidae (*Oiketicus kirbyi* Guilding), Stenomidae (*Stenoma cecropia* Meyrick), etc. Furthermore, there are also numerous Coleoptera Chrysomelidae species from the following genera: *Spathiella, Alurnus, Hispoleptis*, etc. (Genty *et al.*, 1978). All these insects are a permanent threat, obliging growers to remain vigilant at all times.

Importance of useful insects

These insect depredators are associated with a large number of other parasitoid and predator insects. Six species of parasitoids have been seen on *C. minuta*, primarily one that affects the eggs (*Achrysorcharis leptocerus* Waterston) and another the larvae (*Pediobius setigerus* Kerrich), plus hyperparasitoids and predators, principally represented by several ant species and bugs.

Over 50 useful insect species have been identified in Indonesian oil palm plantations (Desmier de Chenon *et al.*, 1989), and even more in Latin America. These figures undoubtedly only account for a part of the total fauna, since little is yet known about the fauna associated with pests of secondary economic importance.

Sixteen species from the genus *Conura* (Hymenoptera Chalcididae) alone have been detected, half of them new (Delvare, 1993). Some of these parasitoid species seem to have a single host, for example *C. elaeidis* Delvare on *Oiketicus kirbyi* Guilding (Lepidoptera Psychidae) in Colombia or *Spinaria spinator* (Guerin) on *Setora nitens* Walker (Lepidoptera Limacodidae) in Indonesia. However, other species seem to be much more polyphagous, but on just one instar of the host; for example, *C. immaculata* has been seen in Colombia on at least five species, but always on the chrysalises, whilst *Chaetexorista javana* Brauer and Bergenstamm (Diptera Tachinidae) can attack the chrysalises of at least sixteen Limacodidae in Indonesia. Certain depredator species seem to be only slightly attacked by one or two species, whilst others have a particularly wide range of associated insects. For instance, *Peleopoda arcanella* Busk (Lepidoptera Peleopodidae) acts as a host for at least ten parasitoid species in Latin America. In a single plantation in Colombia, 56 parasitoid species were counted, belonging to six Hymenoptera families and three Diptera families (Delvare and Genty, 1992).

In addition, there are also many predator insects, including Formicidae, Hymenoptera, Coreidae and Pentatomidae Hemiptera and Carabidae Coleoptera.

To be truly complete, it is important to mention all the other depredators and their own range of natural enemies. All this fauna forms a highly complex whole, without which depredator population levels, even those that have never posed a threat, would probably be almost permanently out of control.

Outbreak factors

Pest outbreaks are essentially linked to two factors: an increase in the fertility of the insect or a lessening of the impact of mortality factors in general and parasitoids in particular.

As regards variations in fertility, in the case of the oil palm Hispinae *C. minuta*, the average number of eggs laid per female varies substantially. Within a few months, its fertility has been seen to leap from 72 to over 230 eggs per female. This abrupt 300% increase is naturally a major population destabilization factor (fig. 1).

Parasitoid population levels themselves also fluctuate widely, linked partly to host population dynamics and partly to their performance with respect to abiotic factors. In effect, during outbreaks of the pest, temporal population distribution is extremely heterogeneous. For several weeks in succession, it can be difficult to find a host insect egg on a leaf, whereas there could have been thousands a few weeks previously (fig. 2). This heterogeneity has a highly adverse effect on parasitoid development. For example, during the last cycle in 1971, the mean parasitism rate was just 2.5%, whereas it reached 57% from the 30th week of 1971 to the 8th week of 1972 (Mariau *et al.*, 1996).

For reasons that are often difficult to measure (hyperparasitoid development, reduced fertility due to adverse climatic factors, etc.), parasitoid population levels can slump, which can also trigger an outbreak (fig. 3).

Rational chemical control

Studies, even partial, of the fauna associated with pests, have clearly shown the very great complexity of the interactions between parasitoids, which are more or less selective, and their hosts. It is easy to imagine the disturbances to these often fragile equilibria that can be caused by chemical treatments, which have a dual effect: parasitoids are destroyed by synthetic chemical insecticides, which are more or less aggressive as regards these very fragile microinsects, and biological cycles are disrupted. The use of so-called biological insecticides or of pesticides that affect depredator biology by absorption (for example chitin inhibitors), has an indirect effect on parasitoids insofar as they can no longer find hosts as they have been destroyed by the pesticide. Outside outbreak periods, depredators can generally be seen, in small numbers, at every stage of their development, which is highly propitious to parasitoid multiplication. Treatments tend to promote the opposite situation, by eliminating all or part of the stage sensitive to pesticides, general the larval stage. It would appear that treating when population levels are not very high does not help natural control of depredatory insects (fig. 4). Treatments are always disruptive, particularly if aggressive insecticides are used, and they should only be applied if strictly necessary.

Promoting parasitoid development

On touring oil palm plantations, it rapidly becomes clear that for most leaf-eating insect species, smallholdings, surrounded by a more or less anthropogenic environment, and the edges of commercial plantations are much less severely affected than plots in the centre of large estates.

Two hypotheses can be put forward to explain this phenomenon:

- on the edge of plantations, there is a microclimate that has an adverse effect on pests or a favourable effect on their natural enemies. This hypothesis, which is not backed up by any biological observations, seems plausible for palms right on the edge of plantations, but is the climate different between a few dozen as opposed to a few hundred metres inside a plantation, the distance at which the "border effect" becomes less evident? In short, this hypothesis seems unlikely.

- commercial oil palm plantations are extremely simplified environments, limited to two plants for a good number of years: the oil palms themselves and the cover crop. Given its abundant growth, the cover crop prevents the development of all other plants. Little by little, pests become established, along with their natural enemies, mainly represented by the very varied range of microhymenoptera mentioned above. The adults of some of these insects feed on the haemolymph of the larval hosts of their offspring, which they sting before egg-laying. They primarily feed on the sugary substances secreted by the hairs or extra-floral nectaries of different plants. These plants only very slowly naturally become established in the plantations, whereas they often develop on the edge, for example in unbroken hedges of *Urena* sp. It has often been seen, particularly in Colombia, that old plantations aged 15 to 25 years were much less severely attacked by leaf-eating insects than during the first 10 to 15 years. This observation is probably at least partly linked to diversification of the flora within the plantation itself.

These sugar-secreting plants attract a large number of parasitoids. For example, thousands of specimens from 16 Hymenoptera families have been captured primarily on *Solanum* spp., (Solanaceae), but also on *Urena lobata* (Malvaceae), *Croton* spp. (Euphorbiaceae), etc. (Delvare and Genty, 1992).

In Peru, a large commercial plantation (Palmas del Espino) has embarked upon the large-scale multiplication of several nectariferous plants, including *Croton* sp., *Urena* sp., *Chromolaena* sp., *Solanum* sp., etc. The plants were set up in sunny areas on the edges of plots, in the spaces left by missing palms and along streams. A similar operation has been carried out at a Colombian plantation. Such operations are bound to promote parasitoid development, and observations under way should confirm this.

Conclusion

Oil palm is affected by a wide range of leaf-eaters, particularly from the Lepidoptera order, which includes a large number of species belonging to around twenty families. These species are associated with a highly complex parasitoid fauna which, along with predators and entomopathogenic diseases, plays a crucial role in regulating pest population levels. These populations are often difficult to manage, particularly in many areas of Latin America where the fauna is particularly varied. Maximum efforts should be made to promote the development of the auxiliary fauna whilst keeping pesticide use to a minimum and remembering that even biological insecticides can destabilize populations, not the target populations, since the disequilibrium has already occurred for them, but those of all the other potential pests. If population levels are to be maintained in plantations, adult parasitoids need suitable hosts for their offspring, but they also need food plants, and the artificial multiplication of such plants is bound to promote the host-parasitoid balance.

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Leaf-eating insects are the most damaging oil palm pests in Asia, Africa and Latin America. Parasitoid Hymenoptera, particularly *Chalcidoidea* and *Ichneumonoidea*, and some *Tachinoidea* Diptera play an important role in regulating pest population levels. To optimize chemical control, which is sometimes required when the natural balance is disturbed, it is important to identify these parasitoids and their regulatory role.

In some cases, it has proved necessary to complete existing parasitoid reserves with introductions, but this is a delicate undertaking. However, indigenous parasitoid activity can more easily be stimulated by facilitating the growth of the various plants on which they feed. Many predators, particularly bugs and ants, also play a substantial role.

Figure 1 : Variations in *Coelaenomenodera minuta* fertility.

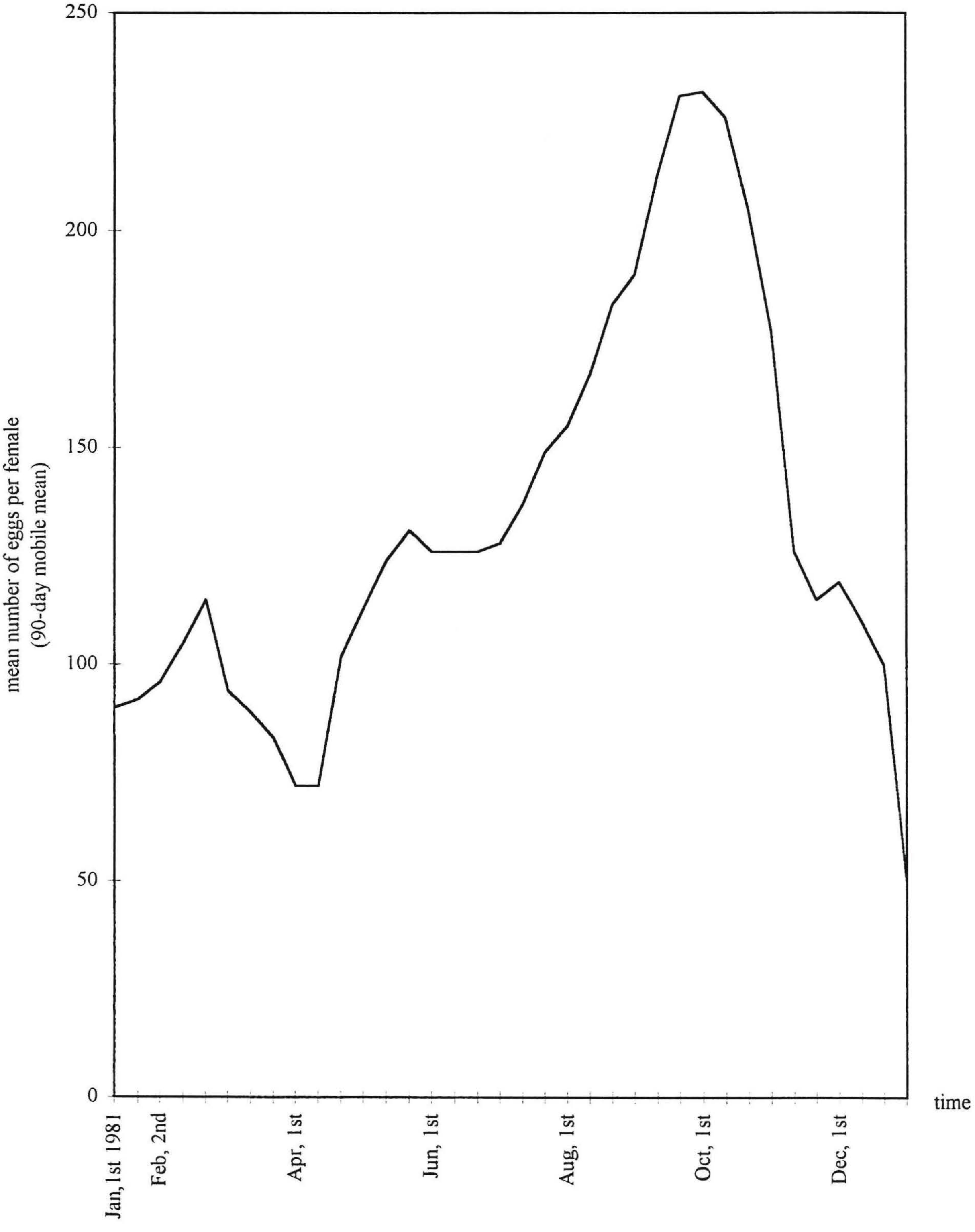

Figure 2 : Population dynamics of *Coelaenomenodera minuta* and of its parasite *Adrysocharis leptocerus*.

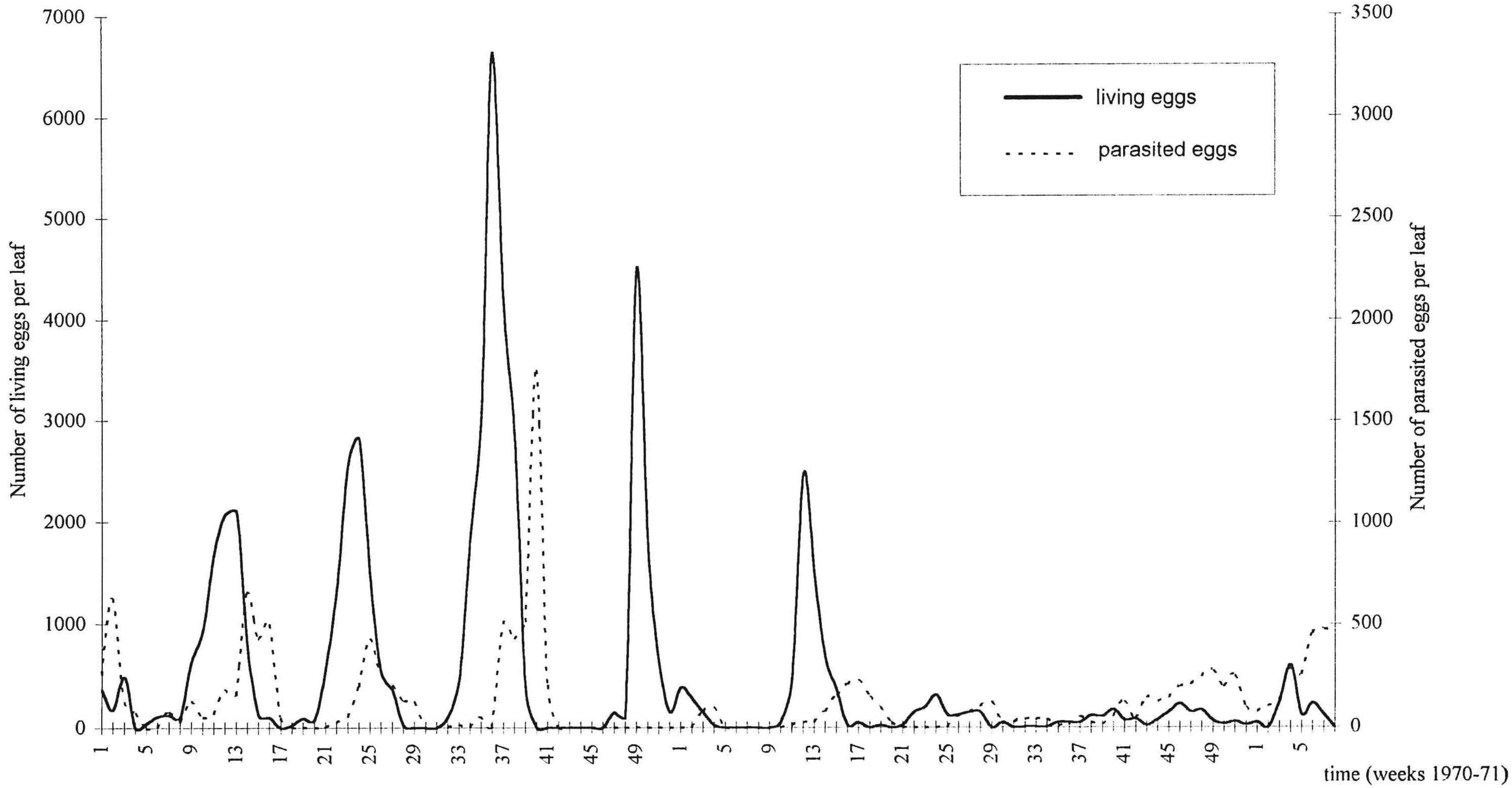

Figure 3 : *A. leptocerus* population dynamics (rate of parasitism).

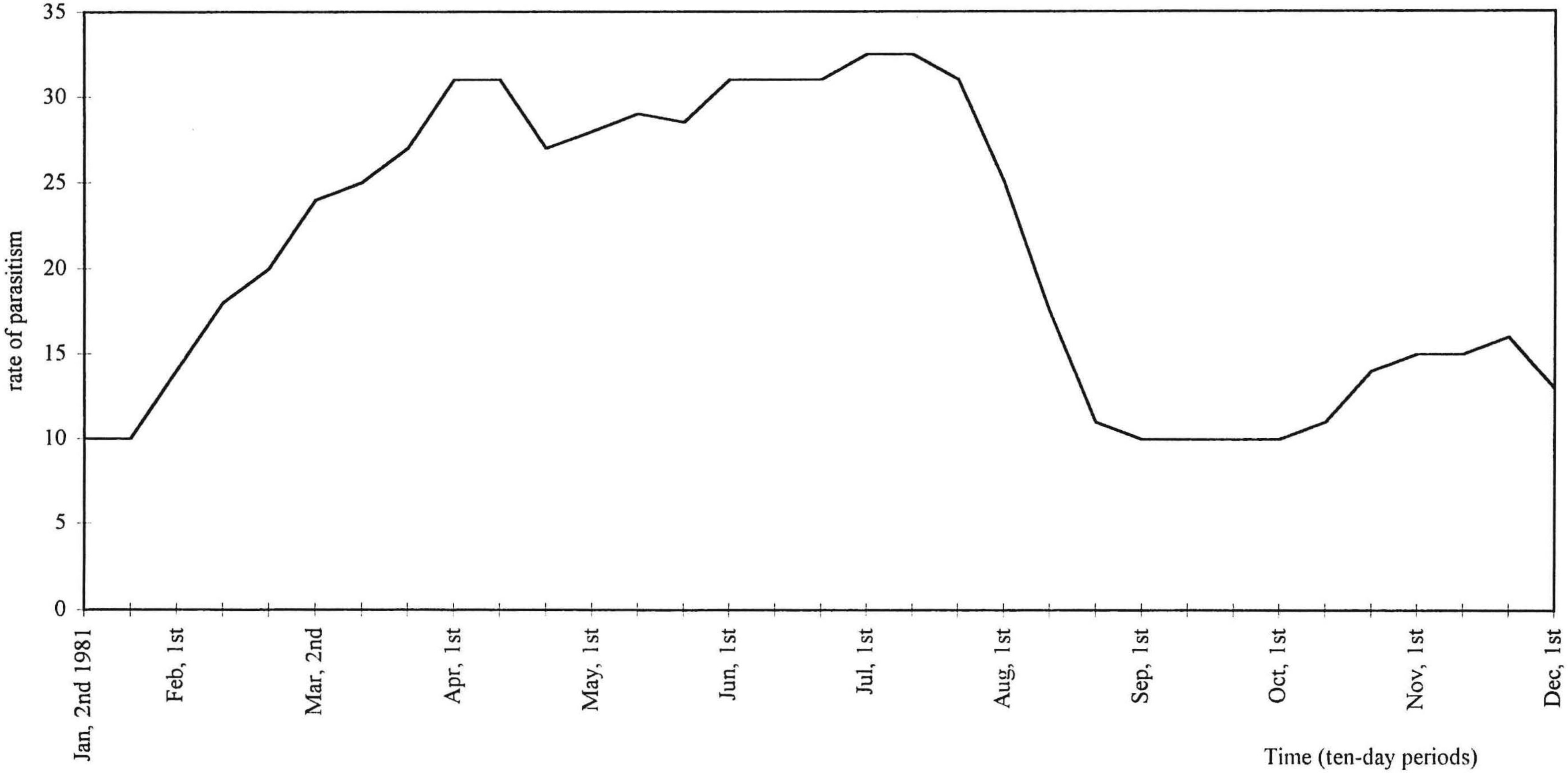

Figure 4 : *Euprosterna elaesa* population dynamics in two plots, treated and untreated.