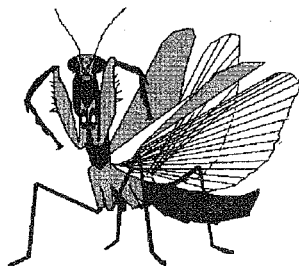


Imbalances between the sexes in *Mantis religiosa* populations

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Rezumat

Dezechilibrul dintre sexe în populațiile de *Mantis religiosa*

Însumând rezultatele cercetărilor conduse timp de 17 ani într-o arie experimentală din Budapesta, am fost surprinsă de raportul inegal dintre sexe la *Mantis religiosa*. Cauza principală este dată de partenogeneza specifică acestei specii, iar cauza secundară, de mortalitatea crescută a descendenței masculine.

Introduction

After investigations of the space-time dynamics of *Mantis religiosa* populations—on which reports were given in two earlier publications (HIDEG 1991, 1994)—survey is now presented of the structure of the populations and on the reasons for the shifts in the balance of the sexes, which becomes increasing pronounced from one month to the next.

Methods and material

Examination of a *Mantis religiosa* population was conducted in the southern part of Budapest, on a 9 ha typical loessial grassland plot divisible into 3 parts of different degrees of exposure: a southern, 18°, slope (Zone A), a northern, 22°, slope (Zone C) and the ditch-like strip stretching between the two (Zone B).

Up until 1972 a *Mantis religiosa* population of very small density lived on the plot and therefore 200 cocoons were introduced, into Zone B of the plot.

Later on, what happened to introduced population was closely monitored.

Estimation of the density of the population and the determining of the ages of individuals, were conducted using the mark-release-recapture and bait-stick methods. The individual marking of the animals meant that their occurrence on the plot could shown with great accuracy.

Results

The male animals achieved adulthood earlier the females, generally in the last week of July, after the six moulting (Figs. 1, 2). The sexual instincts of the males emerge only on the thirteen day after moulting. By the time the number of ♀♀ individuals reaches its peak, the number of ♂♂ individuals is already starting to decline. The primary reason for this can be attributed to the greater-than-average cannibalism among the females which is observable in September. Since the males lose their fertilising capability after 1 and 1/2 month, productive copulation are limited not only by



disproportionateness in the number of males and females, but also by restrictions of time.

Observations show that the overwhelming majority of copulation occur in the first half of August, when the ratio between the sexes is the most favourable. This is reflected in the high number of hatchings characterising cocoons laid in the middle of August: on average 186 individuals. At this time generally both sexes were represented in the offspring. On the other hand, from the majority of the cocoons laid at the end of August and beginning of September (the number of hatchings was small: an average 64 individuals) there were only female offspring.

The first proof of parthenogenesis among *Mantis religiosa* is provided by the observation of individuals. From one-third of the egg batches of female animals born in captivity and reared completely separately from the others because of irregularities in moulting, there hatched offspring, admittedly in numbers smaller than the average. However, the three day survival percentage of these was the same as that of their fellows from fertilised eggs, and in the course of the moultings they achieved a small lead.

Parthenogenesis has great significance in the shifts in the balance of the sexes, since as early as the time of hatching 63% of the total number of individuals consisted of female animals, and a further 1% in favour of the females was added to this in the course of the development of individuals.

Study of the sex distribution of individuals in autumn shows that the numerical proportions of female animals increased by a further 22%. The primary cause of this in *Mantis religiosa* is the cannibalism increasingly manifest by the stronger female sex towards the males. The aggressivity of the females reaches its height in September; this is reflected in the unexpected increase in R values: $R=1.8$ (Fig. 2).

On the basis of what is been described, it is understandable that female individuals made up 73% of *Mantis religiosa* populations in August, 83% in September, 86% in October and 100% in November.

Compared to the April values, the survival rate of male adults in August was a total of 3.1%. By September this fell to 2.1% and by October to 1.2%. During the 17 years not one single male animal was observed in November (Fig. 3).

To sum up, it may be said that one cause—and at the same time, a consequence—of the disproportionate distribution of the sexes is the general occurrence of parthenogenesis. Increased mortality among male offspring leads to further disproportionateness.

Discussion

Prior to the present author's investigations, no comprehensive studies were made relating to the shifting balance of the sexes in *Mantis religiosa*. Therefore, only partial results independent of each other and studies on the development of individuals can be referred to. Reports on these have been given by a number of authors in the last decades (MALDONADO 1970, MATSURA and HOSOMI 1975, HURD 1978).

GIGLIO (1932) gives no account whatever of the occurrence of parthenogenesis in the case of mantids. On the other hand, GÜNTHER (1968) makes mention of this reproductive method, but regards it as a phenomenon generally just producing unviable offspring.

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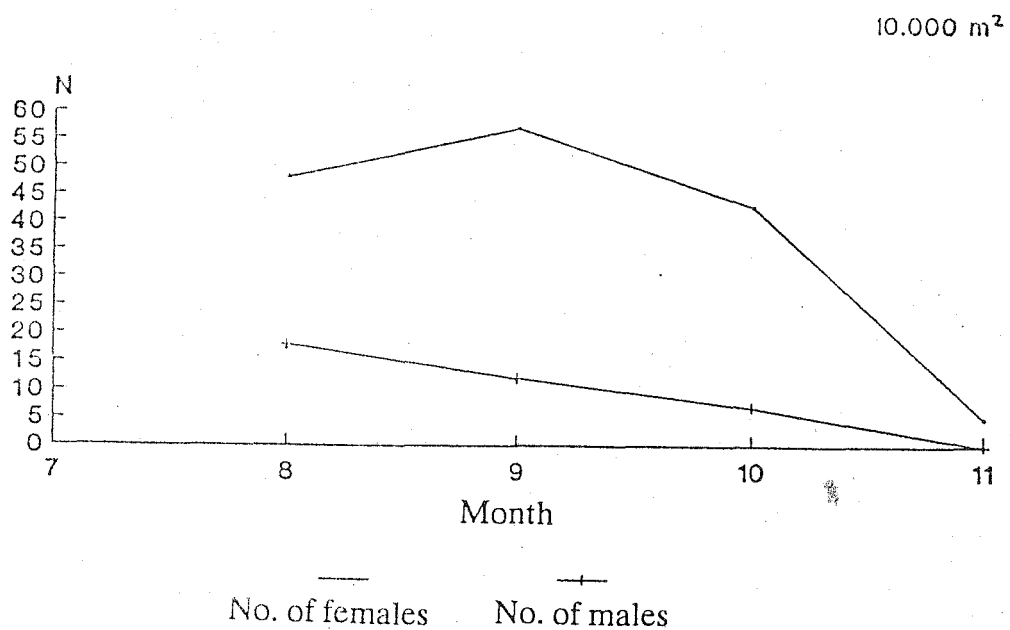


Fig 1/a. Monthly distribution of female and male adults (17 year average)

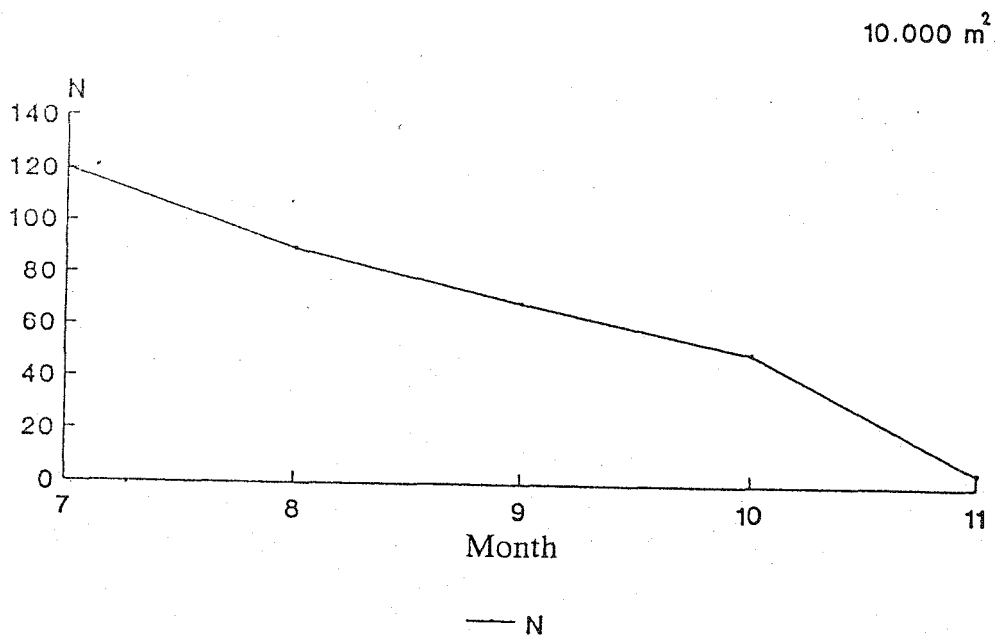


Fig. 1/b. Σ number of adults in Months VII-XI (17 year average)

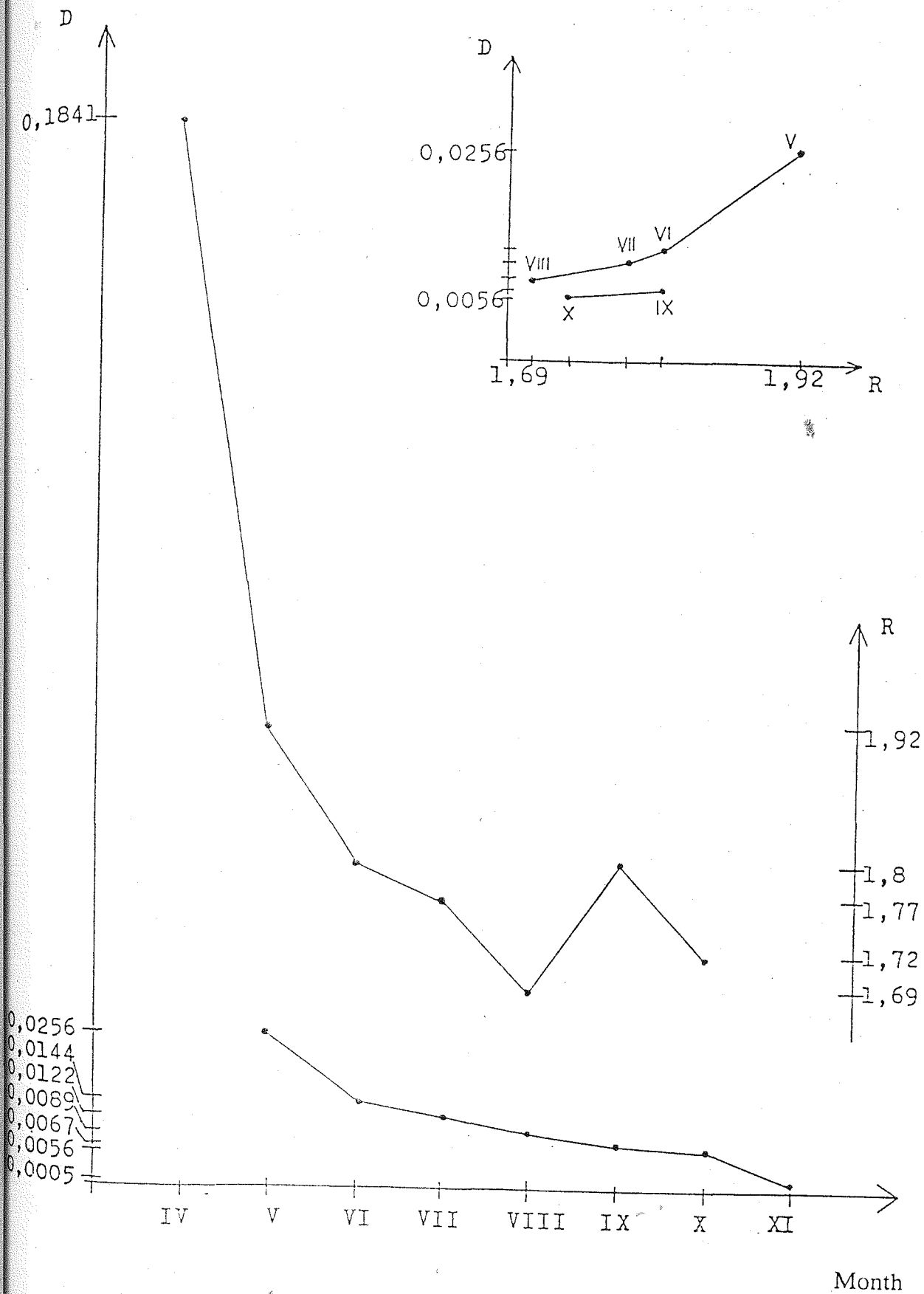


Fig. 2. Relatedness of D and R values in Months V-XI

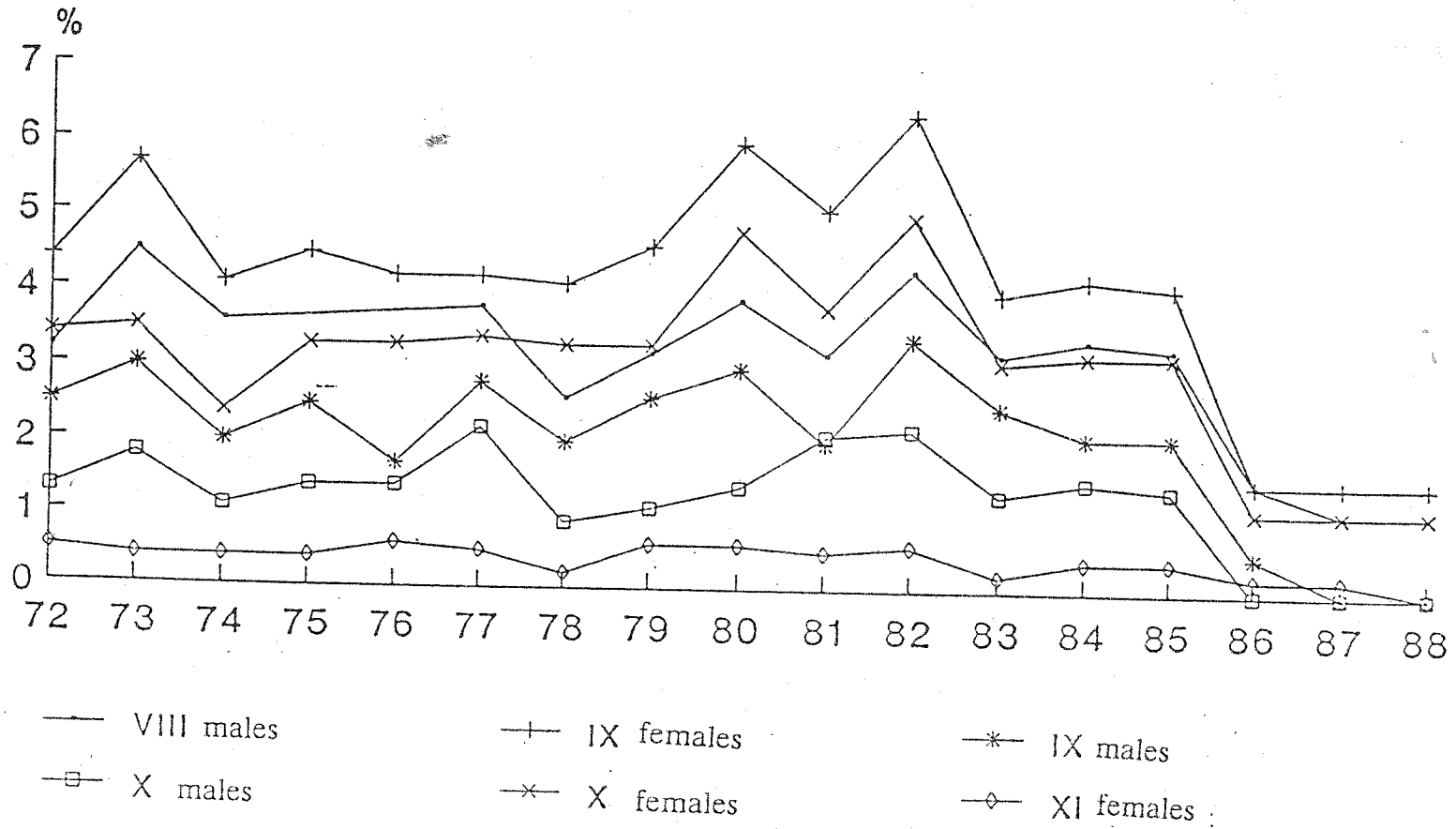


Fig. 3. Survival rates of female and male adults in comparison with the populations in April.