POPULATION DYNAMICS OF LARVAL STAGES OF *TAURIPHILA RISI* MARTIN AND *ERYTHEMIS ATTALA* (SELYS) IN PUNTA LARA GALLERY FOREST, BUENOS AIRES, ARGENTINA (ANISOPTERA: LIBELLULIDAE)*

A. RODRIGUES CAPÍTULO
Instituto de Limnología "Raúl A. Ringuelet", Universidad Nacional de La Plata, C.C. 712, AR-1900 La Plata, Argentina.

Received May 25, 1998 / Revised and Accepted May 10, 2000

Larval populations of the 2 spp. were studied in a lentic freshwater environment. 13 larval instars were recognized from plots of head width and length of wing-pads. Density, population dynamics, age structure, flying period and winter quiescence were analysed. Both uni- and semivoltine individuals were found. Microhabitat differences were found between the 2 spp. *T. risi* preferring *Pistia stratiotes* and *Hydrocotyle ranunculoides*, whereas *E. attala* preferred lemnaceas. A life table was constructed for *T. risi*, which showed mortality rate maxima at hatching and at 10 and 23 months.

INTRODUCTION

Larvae of *Tauriphila risi* and *Erythemis attala* occur in permanent ponds associated with the Río de la Plata river and which are dominated by *Pistia stratiotes, Lemna gibba* and *Hydrocotyle ranunculoides*. Other larvae of Odonata associated with these hydrophytes are *Aeshna bonariensis, Micrathyria ringueleti, M. hipodidyma, Perithemis mooma, Erythrodiplax nigricans, Lestes undulatus, Acanthagrion lancea, Cyanallagma cheliferum, Oxyagrion terminale, Ischnura fluviatilis* and *I. capreolus* (RODRIGUES CAPÍTULO, 1996).

Larval stages of *E. attala* Selys and *T. risi* Martin were described by RODRIGUES CAPÍTULO (1983, 1996). The abundance of *T. risi* and *E. attala* recorded in Punta Lara, a gallery forest near the Río de la Plata river was thought to deserve a deeper ecological analysis. Preliminary results of this study were communicated at the First Congress of Entomology of Argentina (RODRIGUES CAPÍTULO & MUZÓN, 1987). A population of *Telebasis willinki* Fraser (Coenagrionidae) was studied at the same time (MUZÓN et al., 1990).

* ILPA Scientific contribution No 346.

The aim of this paper is to assess the dynamics, density, age structure, annual cycle, emergence of adults, and demography of larval instars of the predominant species of Anisoptera in the lentic environment of Punta Lara marginal forest. The populations considered represent the southernmost extent of the studied species.

STUDY SITE

The study was conducted in a temperate zone of Argentina, in a permanent pond in gallery forest, at 34° 47'S, 58° 01'W. This site represents a relict area near Buenos Aires and La Plata cities. It is partially influenced by the tides of the Río de la Plata river and covered by different species of pleustonic vegetation, among which Lemnaceae, Salviniaceae, Araceae and Umbelliferae are predominant. These macrophyte species are used by larvae of Odonata as support or, in some cases, as oviposition sites. Water temperatures and hours of sunlight relevant to the study period are shown in Figure 1 (hours of sunlight were provided by meteorological statistics of the Observatory of La Plata: 1961-1970).

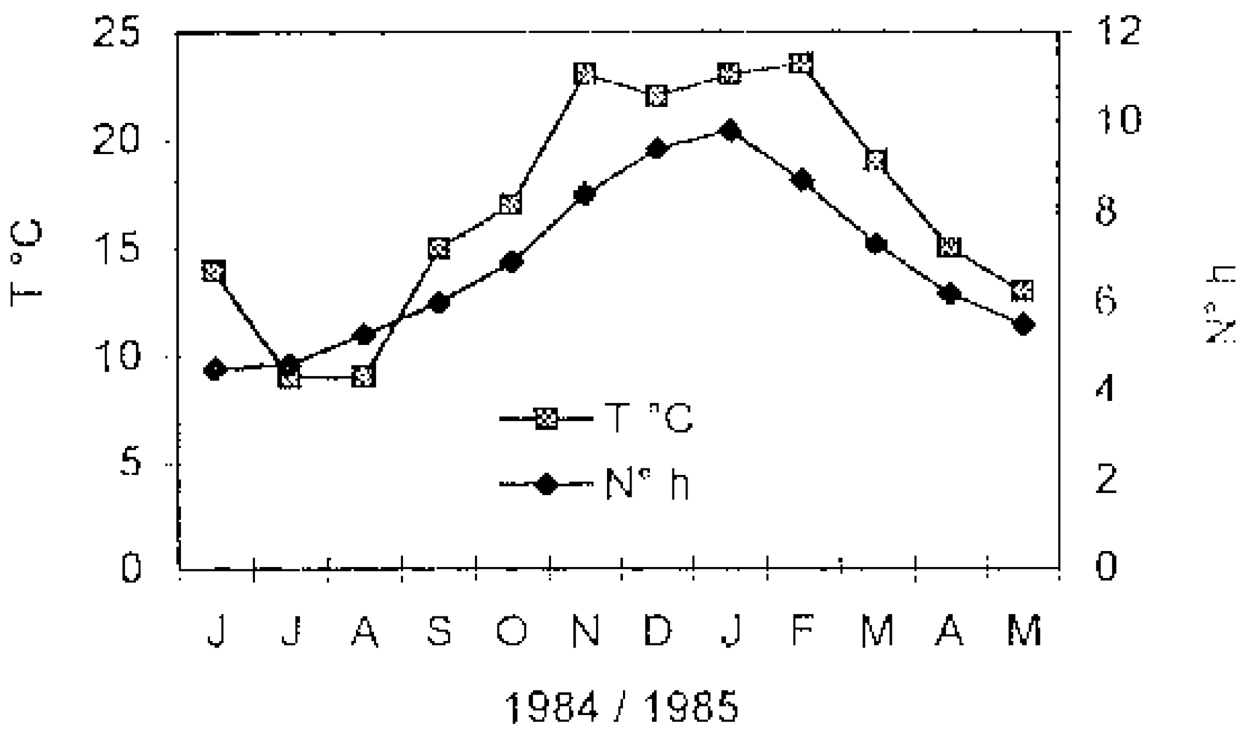

Fig. 1. Temperature of water sampling and number of effective hours of sunlight from June 1984 to May 1985. The values of effective sunlight are based on data from the Observatory of La Plata from 1961 to 1970.

MATERIAL AND METHODS

SAMPLING. – Samples were taken every fifteen days over the period June 1984-June 1985 in order to estimate density. A 900 cm² square screen with a 1.5 mm mesh was used. The screen was replicated 4 times and the mean was calculated. Samples were processed in the laboratory by shaking the vegetation in water and then placing the vegetation in "Berlesse" separators for 24 hours.

A net and 15 cm diameter colanders were used to collect qualitative samples. Two man hours were taken as the unit of effort. Additional samples of water were also taken in order to look for first-stage individuals (particularly after egg laying periods). Samples were filtered in an Earle concentrator (SERVICE, 1976).

Odonate material was fixed in 80% alcohol and measured with a Reichter binocular microscope (0.1 mm accuracy). Samples corresponding to inferior stages were measured with the aid of a micrometer ocular scale. Adults of the two species that emerged from larvae were identified according to RIS (1909-1919) and RODRIGUES CAPÍTULO (1992).

DATA TREATMENT. – Instars were determined by plotting head width against inner wing pad length (RODRIGUES CAPÍTULO, 1983; PICKUP et al., 1984). Kite diagrams were used to summarise the total cycle of the two predominant species of Anisoptera studied (NORLING, 1984a, 1984b).

LIFE TABLES. – Laboratory experiments were set up with 177 first stage larvae of *T. risi* from a female collected in Cardenas on 5 February 1985. They were brought up in individual glass containers

with vegetation from the same sampling site. The water temperature was maintained between 15-20°C. Larvae were fed in their earlier stages with microcrustacean (Cladocera and Copepoda), and with chironomids and oligochaete worms in advanced stages; all collected in the sampling area.

The results of survival (l_x), mortality (q_x 1000) and average life expectancy (e_x) were assessed, together with abundance and duration of every pre-imaginal stage. The life table was constructed according to POOLE (1974) and RABINOVICH (1978).

RESULTS

DENSITY. – Monthly estimates of density (m⁻²) are shown in Figure 2. *E. attala* showed maximum density values in the February-March 1985 period, reaching 230 m⁻²; values for the rest of the year were from 50 to 100 m⁻². *T. risi* showed a maximum value of density in the period July-August 1984 with a peak at 270 m⁻² in July. This value gradually decreased to 10-12 m⁻² by February; the minimum level coinciding with maximum abundance of *E. attala*.

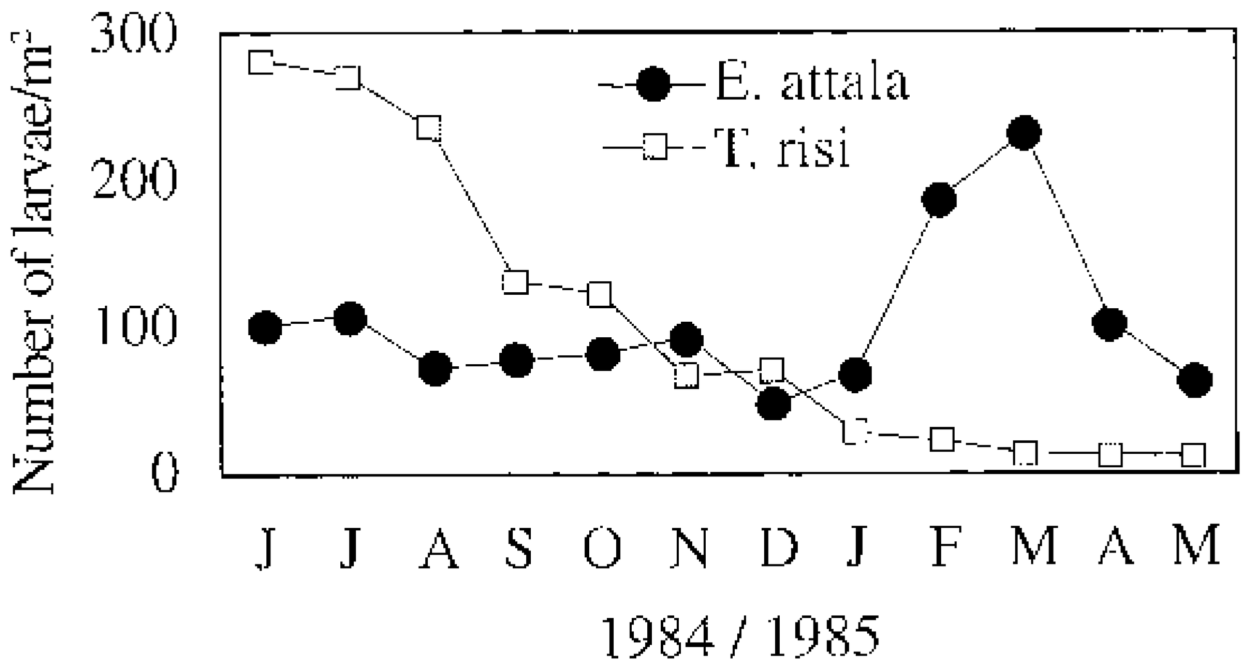

Fig. 2. Density of *Erythemis attala* and *Tauriphila risi* larvae from June 1984 to May 1985.

LARVAL STAGE DETERMINATION. – Larval stages of *E. attala* and *T. risi* were determined following descriptions of RODRIGUES CAPÍTULO (1983, 1996). Twelve groups were delimited for the different larval stages of *T. risi* (Fig. 3). For the first six stages only maximum head width was considered since wing pads appear only after the F-6 stage.

The following is the best equation for the relationship between wing-pad length (WP) and head width (HW):

$$WP = 0{,}032 \times HW^{[illegible]}$$
$$\ln WP = 3{,}427 + 2{,}98 \times \ln HW$$
$$(n = 104, r = 0{,}98)$$

DEMOGRAPHY. – Data obtained from samples of the two species over the period 18 June 1984 to 29 May 1985 were organized in the Kite diagrams (Fig. 4). The use of a logarithmic scale for head width helped to visualise the size range for each instar so that each individual could be assigned reasonably accurately to its instar.

E. attala. – In June, the larval population of *E. attala* comprised seven stages (F-6 to F), of which F-1 and F-4 were the most numerous. This age structure remained unchanged until August, when winter quiescence ended. During September and October only individuals from stage F-1 to F-1 were observed. The absence of individuals in the final instar (F) in this period can be attributed [illegible]

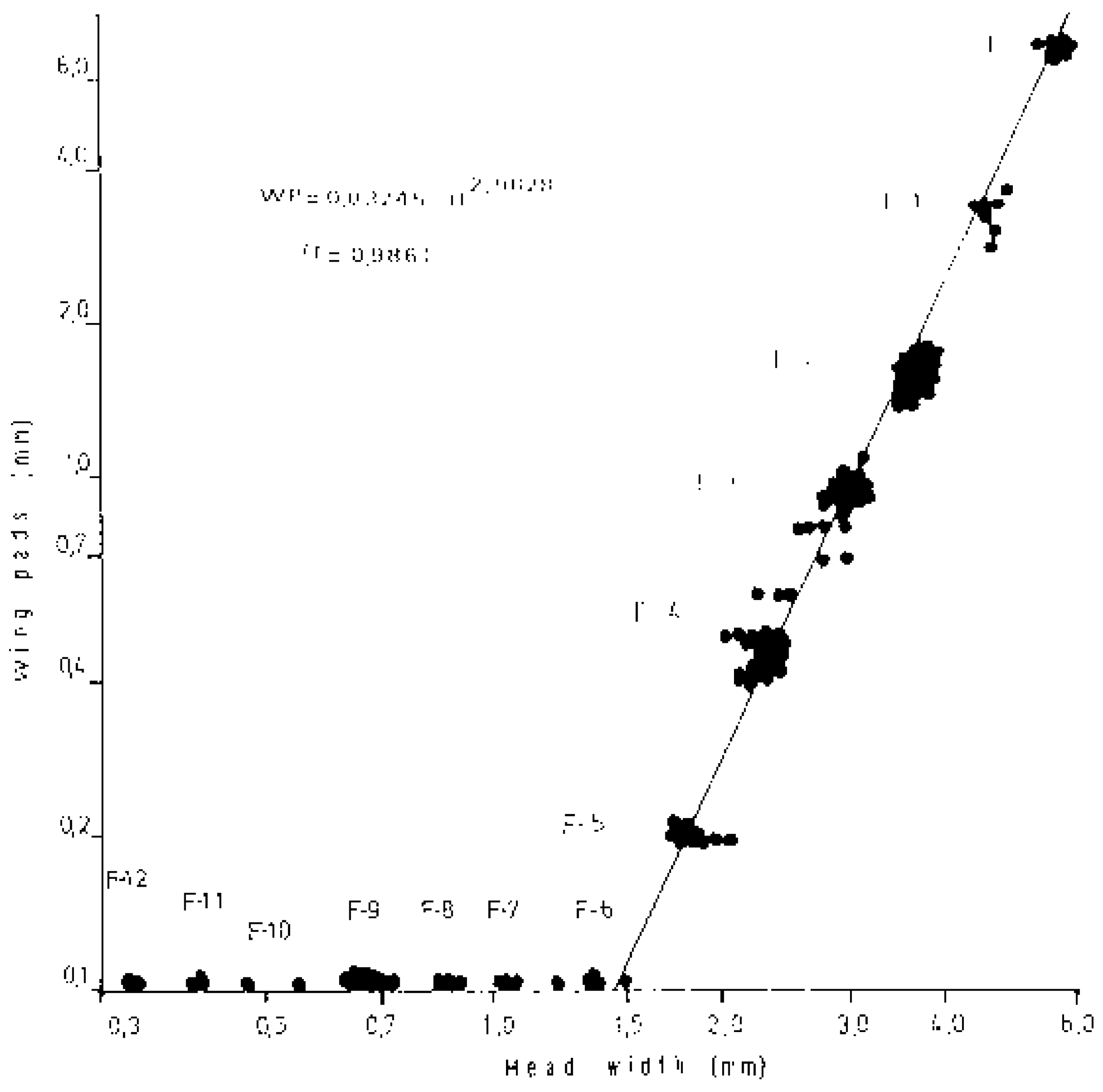

Fig. 3. The relationship between wing pad length and maximum head width of *T. risi*; F to F-12: larval instars.

to an early emergence of adults. However it might have been caused by sampling error due to the earlier low density of stage F individuals. The highest proportion of final instar larvae occurred in November and December, corresponding to the beginning of the flying period (Fig. 4A). Younger larval instars (F-12 to F-7) were observed from January. The highest diversity of stages was observed in February and March. The summer is a period of rapid growth and by April the smallest larvae were in instar F-9. A very small number of individuals were in the F-1 instar at this time.

The data shown in the Kite diagram (Fig. 4A) appear to indicate semivoltine individuals emerging at the beginning of the flying period, and univoltine individuals, which emerge immediately after the beginning of that period. Thus from February to November two different cohorts coexist.

T. risi. Larvae of this species showed an age structure similar to that of *E. attala* (Fig. 4B). They differ from the latter in that individuals are at stages F-7 to F-1, over the winter period, with those in ages F-3 and F-2 dominant. The final instar was recorded over the period November-February, which is coincident with the flying period of the species. Again, the implication from these data is that semivoltine and univoltine individuals occur.

SURVIVAL LIFE TABLE OF *T. RISI*

The majority of larvae hatched in the second week of February 1985. The duration of each larval stage (Fig. 5) indicates a series of rapid moults initially and by April 1985 most larvae had reached F-7. The frequency of moulting tended to decrease after this. The first F-1 larvae occurring in March 1986 and final stage [illegible] in October 1986. The first emergence occurred at the end of January 1987, [illegible] months after the first larvae hatched.

[illegible] hyperbolic relationship with time (Type III [illegible] 1000) [illegible]

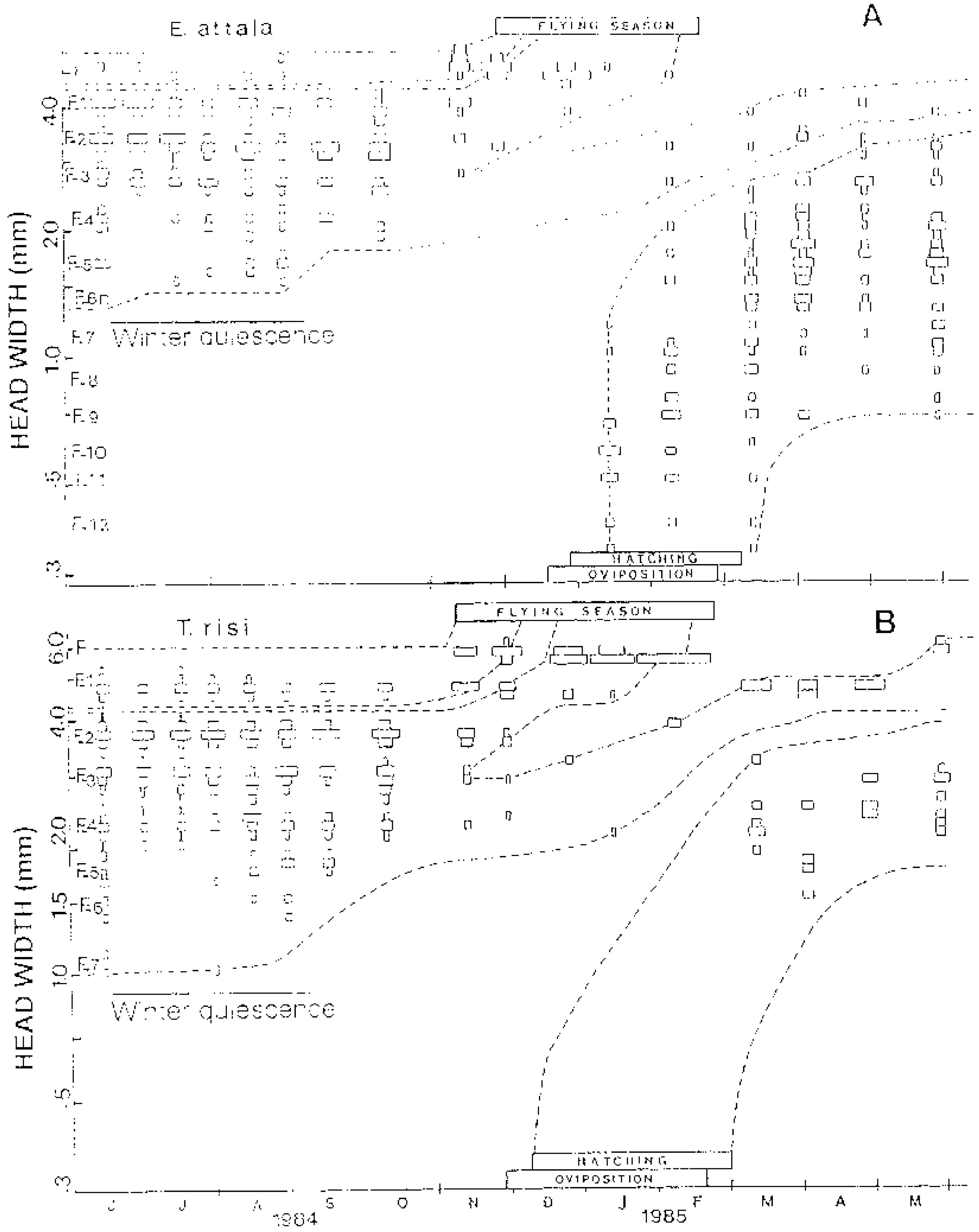

Fig. 4. Kite diagrams showing head width frequency distributions during the sampling period. The areas enclosed by broken lines show the probable development of (A) *E. attala* and (B) *T. risi* cohorts.

ring at hatching, and at 10 and 23 months. Average life expectancy (e_x) increases slightly over the first 12 months and then shows a steady decline over the following 12 months (Fig. 6).

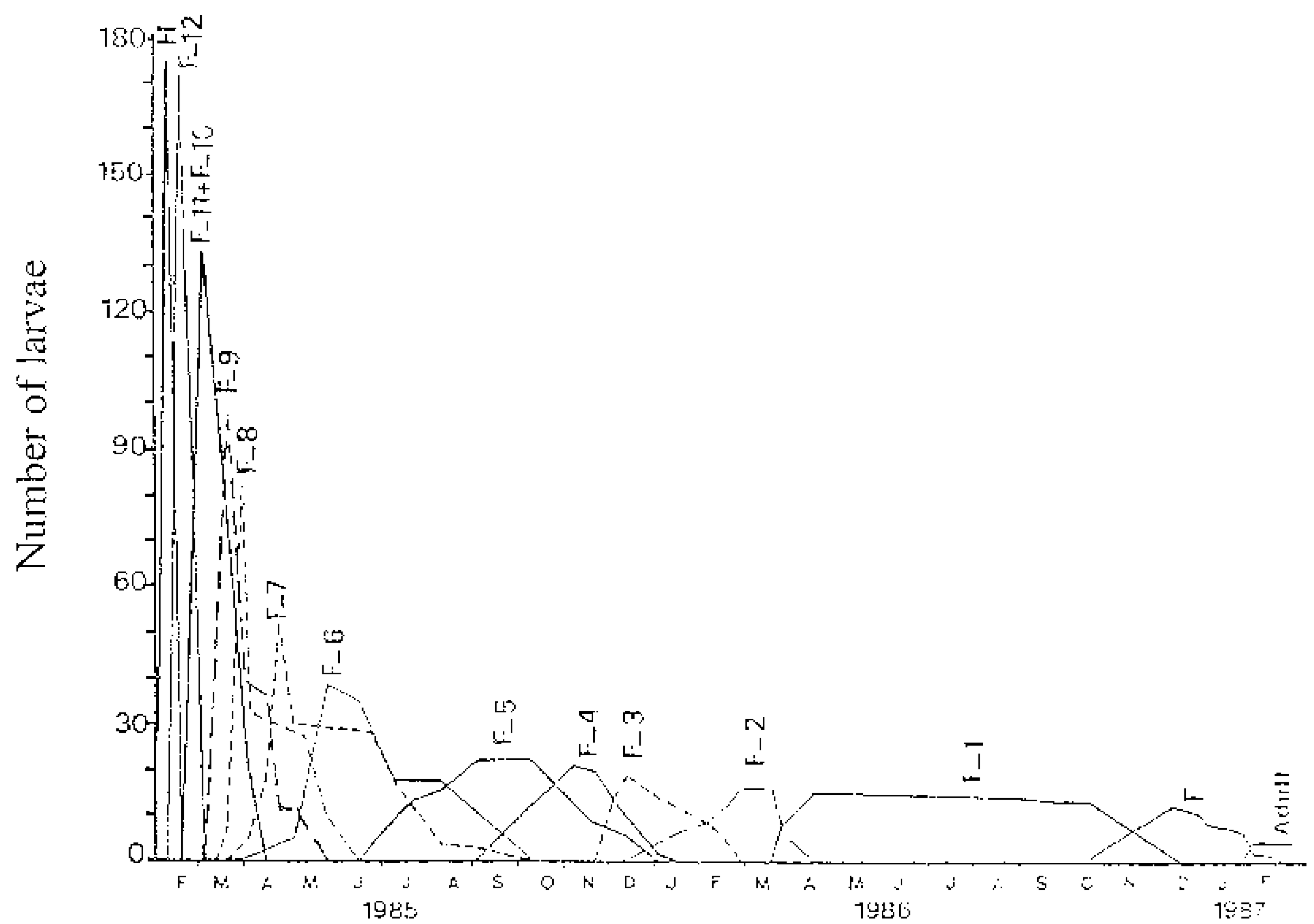

Fig. 5. Monthly abundance and duration of the pre-imaginal stages of *T. risi*.

DISCUSSION

(1) The biological cycle of *E. attala* and *T. risi* are similar in our study. The larval population of the two studied species contained some individuals with an annual cycle with only one winter quiescence period: the majority completed the cycle in two years with two winter quiescence periods (first: F-5 to F-2; second: F-1 to F). In the latter case, the emergence of the imagos took place at the beginning of the next flying period. Probably both species have a facultative diapause in order to regulate their larval and adult populations. 13 instars (not including prolarva) were found in both species (RODRIGUES CAPÍTULO, 1983). This number is frequent at other latitudes (JOHANSSON & NORLING, 1994).

(2) Initial stages of *T. risi* (F-12 to F-8) were not recorded probably due to the fact that they inhabit a different layer than the rest of the population.

(3) The flying and egg laying periods are the same in both species. Although imagos of *T. risi* were recorded by the end of September, these would have been immigrants from other populations, since at that sampling time there were no specimens in the last larval stage. There are no other studies of Anisoptera of South America to compare differences in life cycles. MUZÓN et al. (1990) described a larval population of *Telebasis willinki* and observed an annual cycle with a high rate of synchronisation and univoltine specimens.

(4) [illegible] in relation to that observed in this paper has also been found

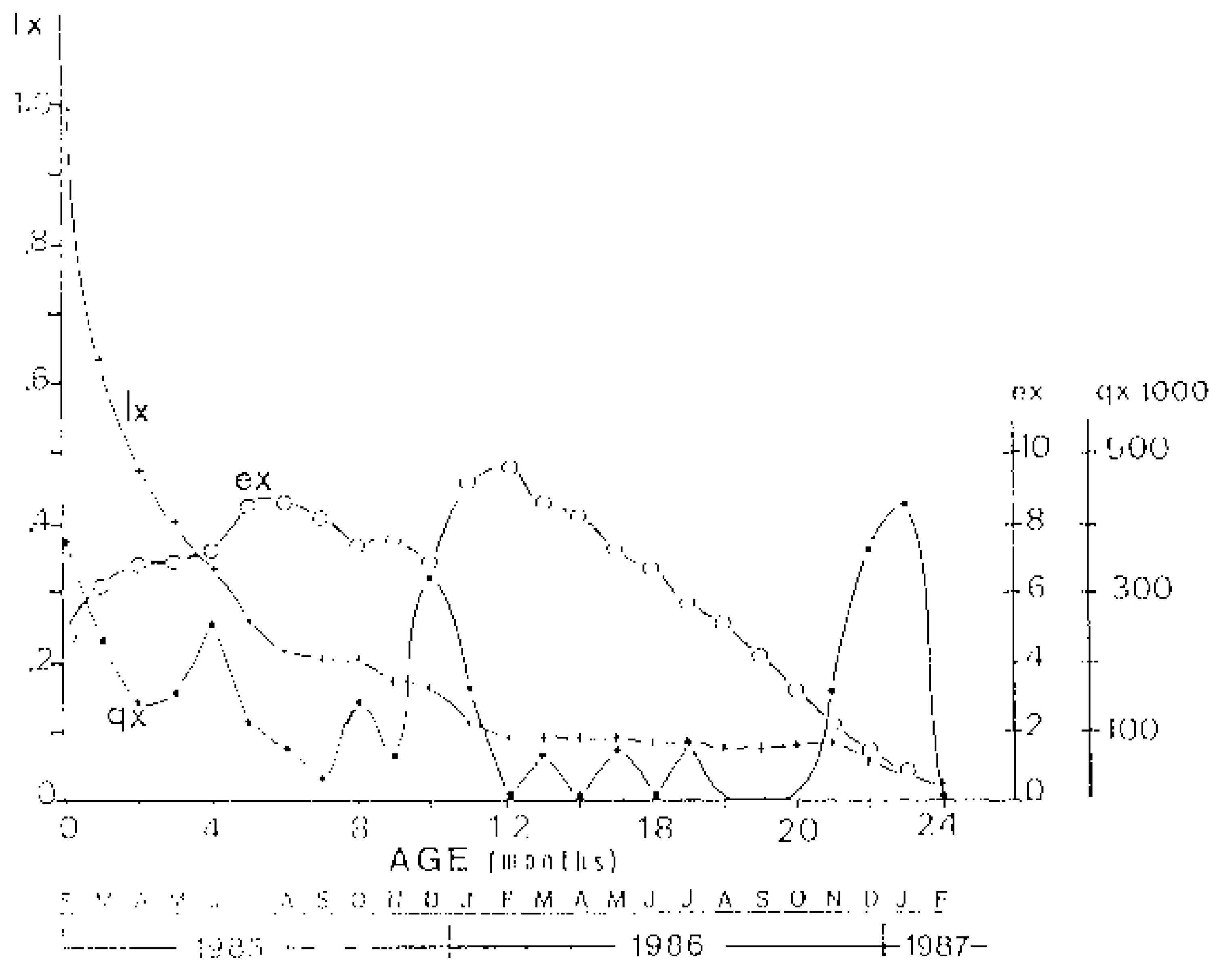

Fig. 6. Life table curves of the experimental population of *T. risi*; survivorship (l_x), average life expectancy (e_x) and mortality (q_x 1000).

in Chascomús pond (province of Buenos Aires, Argentina) where *E. attala* was found in lemnaceas while *T. risi* was found particularly in *Ceratophyllum demersum* RODRIQUES CAPÍTULO (1983). Probably the differences are the result of competitive interactions and permit the coexistence of the two species in the same area.

ACKNOWLEDGEMENTS

I am grateful to Dr G. JURZITZA, Dr A. MARTENS and Dr E. POLLARD for valuable comments on early drafts on this article. I thank Dr J. MUZÓN for assistance in the field.

REFERENCES

DEEVEY, E.S., 1947. Life tables for natural populations of animals. *Q. Rev. Biol.* 22(4): 283-314.

JOHANSSON, F. & U. NORLING, 1994. A five year study on the larval life history of Coenagrion hastulatum (Charpentier) and C. armatum (Charpentier) in northern Sweden (Zygoptera: Coenagrionidae). *Odonatologica* 23(4): 355-364.

MUZÓN, J., A. RODRIGUES CAPÍTULO & G. JURZITZA, 1990. Populationsdynamik von Telebasis willinki Fraser, 1948 im Galerie-Wald des Rio de la Plata bei Punta Lara, Argentinien (Odonata: Coenagrionidae). *Opusc. zool. flumin.* 53: 1-10.

NORLING, U., 1984a. Life history patterns in the northern expansion of dragonflies. *Adv. Odonatol.* 2: 127-156.

NORLING, U., 1984b. The life cycle and larval photoperiodic responses of Coenagrion hastulatum (Charpentier) in two climatically different areas (Zygoptera: Coenagrionidae). *Odonatologica* 13(3): 429-449.

POOLE, R.W., 1974. *An introduction to quantitative ecology.* McGraw-Hill-Kogakusha, Tokyo.

PICKUP, J., D.J. THOMPSON & J.H. LAWTON, 1984. The life history of Lestes sponsa (Hansemann): larval growth (Zygoptera: Lestidae). *Odonatologica* 13(3): 451-459.
RABINOVICH, J.E., 1978. *Ecología de poblaciones animales*. Org. Am. States, Washington, D.C.
RIS, F., 1909-1919. Libellulinen monographisch bearbeitet. *Collns zool. de Selys Longchamps* 9-16: 1-1278, pls 1-8 excl.
RODRIGUES CAPÍTULO, A., 1983. Descripción de los estadios preimaginales de Erythemis attala Selys (Odonata: Libellulidae). *Limnobios*, 2(7): 533-548.
RODRIGUES CAPÍTULO, A., 1992. Los Odonata de la República Argentina (Insecta). *Fauna Agua dulce Argent.* 34(1): 1-91.
RODRIGUES CAPÍTULO, A., 1996. Description of the larva of Tauriphila risi Martin (Anisoptera: Libellulidae). *Odonatologica* 25(4): 391-395.
RODRIGUES CAPÍTULO, A. & J. MUZÓN, 1987. Dinamica poblacional de estadios preimaginales de Odonata en ambientes lénticos de la selva marginal de Punta Lara (Prov. Buenos Aires). *Resúm. Congr. arg. Ent.*, Tucumán, p. 55.
SERVICE, M.W., 1976. *Mosquito ecology field sampling methods*. Appl. Sci. Publishers, USA.