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**Locomotor activity patterns and feeding habits in the prawn *Palaemon xiphias* (Crustacea: Decapoda: Palaemonidae) in Alfacs Bay, Ebro Delta (northwest Mediterranean)**

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**Abstract** Diel activity rhythms of the prawn *Palaemon xiphias* Risso, 1818 from Alfacs Bay, Ebro Delta, were studied by time-lapse videorecordings. Activity displayed an endogenous circadian rhythm, with maximum activity at night. Feeding habits were studied by frequency of occurrence and by the points method. The food of *P. xiphias* consisted mainly of crustaceans; the remains of amphipods, isopods, mysids, copepods, decapods and ostracods were identified. The remaining items consisted of molluscs, polychaetes, ophiuroids, plant material, sand, and unidentified organic debris. The results indicate that *P. xiphias* is a predator of benthic invertebrates rather than a scavenger or detritus feeder. Diet composition changes with increasing size of the prawn.

**Introduction**

Little has been published to date on the biology of the prawn *Palaemon xiphias* Risso, 1818, although this species is distributed throughout the Mediterranean Sea (Zarriquey 1968) and is the object of commercial fisheries in several areas (Holthuis 1980). Data on the growth and reproductive cycle of *P. xiphias* in Alfacs Bay, Ebro Delta, Spain (40° 37'N; 0° 36'E) have recently been published (Guerao 1994). In this region, *P. xiphias* is abundant in shallow eel-grass meadows and is caught with trawl nets (Guerao 1993).

Previous accounts of the natural diet of this species have been mainly anecdotal. Fresi et al. (1984) referred to *Palaemon xiphias* as a carnivore and reported that crustaceans were the most common type of recognizable food in its stomach. Among these, decapods were a major item.

**Materials and methods**

**Study area**

The study site was in the Alfacs Bay, Ebro Delta (40° 37'N; 0° 36'E), on the Spanish Mediterranean coast. Sampling was carried out from a platform in the bay, where the bottom is covered by the eelgrass *Cymodocea nodosa* and the alga Caulerpaprolifera (Pérez and Camp 1986). Depth ranges from 0.5 to 2 m. Bottom temperature ranges from 10°C in February to 28°C in August, and salinity is 35 to 37‰.

**Activity**

*Palaemon xiphias* Risso, 1818 were sampled by trawl net over the *Cymodocea nodosa* meadow (Alfacs Bay) throughout autumn of 1991. The prawns were transported to the laboratory in plastic bags containing ambient sea water. The sea water used in the experiments was collected from the bay at the same time. Laboratory experiments were designed to monitor the activity of freshly-captured individuals in constant conditions. The pattern of locomotor activity was studied using a time-lapse videorecorder. The experiments were performed in a constant-temperature room maintained at 16°C ± 1°C. Salinity was maintained at 35‰, and pressure at the equivalent of 0.6 m of water above ambient atmospheric pressure (1 atm). The prawns were maintained in constant light conditions (infrared light) to allow the operation of the videocamera. A vertical-line reference was drawn in the middle of the tank; the number of actively-moving prawns that crossed this line were counted every 60 min (to obtain the percentage of maximum activity in any one 60 min period) over a period of 3 d. The data obtained in these experiments were analysed for rhythmicity using the method of periodogram analysis, following the procedure used in Williams and Naylor (1978).
Examination of natural diet

Monthly or bimonthly samples were taken at Alfacs Bay from February to December 1991. Individual *Palaemon xiphias* from 30 to 70 mm length were collected from *Cymodocea nodosa* meadows at dawn. Samples were taken by trawl net and immediately placed in 70% alcohol. The contents of each stomach were examined as soon as possible, and always within 3 wk of collection.

Total length and sex were recorded for each prawn. Approximate percentage fullness was determined visually for each stomach. Only prawns with stomachs more than half full of food were used in the calculations. The stomach of each prawn was dissected out and the entire contents washed onto a microscope slide. Analysis was performed under both stereo- and compound microscopes. Individual items were identified as precisely as possible. Most food found in the stomachs of the prawns had been broken into small fragments, and therefore could not be identified to species. Percentage occurrences of each food item, expressed in terms of the number of stomachs containing a particular food item (based on the total number of stomachs examined throughout the study period), were calculated. The points method (see Hyslop 1980; Williams 1981) was used to determine the percentage contribution of food items to the diet. Only frequency of occurrence was used for statistical analysis. Since there were missing data values, statistical comparison of dietary composition was performed with non-parametric tests. The Friedman test was used to detect differences in the frequency of occurrence of prey items between size classes; the Smirnov test was used to detect differences between sexes.

Results

Activity patterns

Fig. 1A shows the locomotor activity of a group of ten *Palaemon xiphias* freshly collected from the study zone. A clear circadian rhythm is evident, with maximum activity at the times of expected night at the site of capture. There is no evidence of any circatidal component. This interpretation is confirmed by the periodogram analysis of the data (Fig. 1B), which clearly shows a highly significant periodicity of 24.0 h.

Feeding habits

Of the *Palaemon xiphias* collected throughout the study period, < 20% had empty stomachs and a high proportion (60%) were >50% full. However, of the females collected in summer, 28% had empty stomachs.

A total of 178 stomachs was examined. Gammarid amphipods, isopods, gastropods, mysids (*Siriella clausii*), polychaetes and copepods were the most prevalent prey found (Fig. 2A). Gammarid amphipods remains occurred in 62% of the stomachs examined, and of these *Erichthonius* sp., *Dexamine* sp. and *Aora* sp. were the most frequent. The remaining isopods occurred in 39% of the stomachs examined, and of these *Cymodoce* sp. and *Dynamene* sp. were the most important. Gastropod remains, the third most important component, occurred in 23% of the stomachs and included *Rissoa* sp. and *Bittium* sp. Plant material was of minor importance in the diet of *Palaemon xiphias*.

The relative ranks of each food item determined by percentage of occurrence were compared with the corresponding ranks determined by the points method using the Spearman rank correlation coefficient, \( r_s \). A value of \( r_s \) of 0.8794 was obtained, indicating good agreement between ranks of relative importance \( (p \leq 0.01) \). Discrepancies between ranks obtained by the two scoring methods were usually more prevalent for food of lower rank and among less-common food types (Fig. 2B).

All samples of prawns were combined, and the stomach contents of the following size classes were then investigated: 30 to 39.9 mm, 40 to 49.9 mm, 50 to 59.9 mm and 60 to 70 mm. The frequency of occurrence of prey items differed significantly between size classes \( (p \leq 0.05) \) (Fig. 3). The frequency of occurrence of isopods, decapods, gastropods and polychaetes increased with increasing size of the prawns, while the frequency of mysids and copepods decreased with increasing prawn size. The gastropods eaten were extremely small, in the range of 0.7 to 2.2 mm shell height. There was a significant linear regression relationship between size of prawn and shell height of gastropod eaten (Fig. 4).