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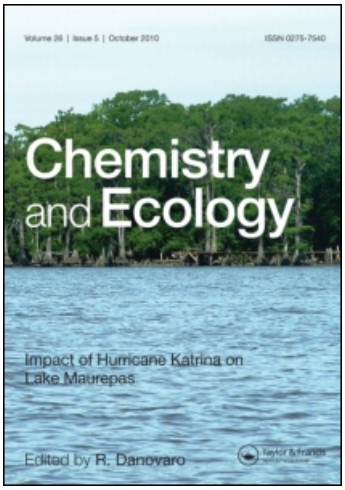

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Preliminary data on egg production rates of *Pseudocyclops xiphophorus* Wells, 1967 from the brackish lake Faro (north-eastern Sicily)

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Field and laboratory studies were carried out on the bentho-planktonic species *P. xiphophorus* Wells, 1967. This species was found in the Mediterranean Sea, in the brackish Lake Faro (north-eastern Sicily) for the first time. Specimens of *P. xiphophorus* were collected from November 2003 to September 2004. Immediately after sampling, all adult females were sorted and pipetted individually into 50 ml crystallizing dishes containing lake water and incubated at the same enviromental temperature, measured at the sampling time. After 24 h, the number of eggs produced by each female was counted to estimate in situ egg production rate. In the laboratory, groups of five couples of males and females were placed individually into 50 ml crystallizing dishes containing filtered sea water enriched with three phytoplankton species, *Tetraselmis suecica*, *Pavlova lutheri*, and *Isochrysis galbana*, given in excess concentrations. Groups of five replicates were incubated at three different temperatures, 16, 24, and 28 °C, for each replicate. Every couple was monitored daily during the entire life cycle to estimate egg production rate in relation to temperatures. In the laboratory, mean egg production rates per female per day for each group of couples exhibited a positive correlation with temperature that was recorded in in situ experiments as well.

Keywords: *Pseudocyclops xiphophorus*; Bentho-planktonic species; Egg production rate; Life cycle; Lake Faro

1. Introduction

Many field and laboratory studies on copepod egg production rates have been carried out in order to understand the mechanisms underlying seasonal variations in population size at sea. These studies refer only to the most common planktonic copepod species occurring in north temperate to polar regions [1]. To date, few of these studies concern the particular bentho-planktonic calanoid copepod group recently reported [2]. Species of this group live at the interface between the bottom and the overlying water column. *P. xiphophorus* was recently reported for the first time, in the Mediterranean Sea, in brackish water Lake Faro (north-eastern Sicily) [3]. Before this finding, this species was discovered by Wells [4], along the

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Inhaca Island coasts, in the Indian Ocean. In Lake Faro, *P. xiphophorus* was found attached to submerged ropes and mooring posts as a fouling organism.

In this paper, egg production rates of *P. xiphophorus* were studied in the field and laboratory at different temperatures.

2. Material and methods

The 'fouling' samples were collected manually, about every 15 d, from November 2003 to September 2004. They were poured into a plastic container and brought to the laboratory. Specimens of *P. xiphophorus* were counted and sorted from 'fouling' washing-water by a stereoscopic microscope and transferred to an aquarium with 100 ml of filtered sea water. The aquarium was placed in a thermostatic cell at 18 °C.

All adult females of *P. xiphophorus* were sorted and pipetted individually into 50 ml crystallizing dishes containing lake water filtered through 0.45 μm mesh net to remove all eggs and nauplii; females were then incubated at the same environmental temperature, measured at the time of sampling. After 24 h, eggs produced by each female were counted.

In the aquarium, specimens of *P. xiphophorus* were reared with a mixed diet constituted by three phytoplankton species: *Tetraselmis suecica*, *Pavlova lutheri*, and *Isochrysis galbana*.

Egg production was daily monitored for each couple of males and females placed individually into 50 ml crystallizing dishes containing filtered sea water enriched with the same diet given in excess concentrations.

Three groups of five replicates were prepared and placed at three different temperatures: 16, 24, and 28 °C.

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3. Results

In November 2003, mean egg production rates in situ showed a maximum of four or five eggs per female per day, when the surface water temperature was 17–18 °C. The egg production rate followed a drastic decline in winter until it completely stopped when the surface temperature dropped to 10–12 °C. In the second half of March, egg production began to increase with an increase in temperature ranging between 15 and 26.7 °C, at the end of August, when the maximal egg production (8.3 eggs female^{-1} day^{-1}) occurred (table 1, figure 1).

In the laboratory, the mean egg production rate per female per day for each group of couples was positively correlated with temperature (figure 2A). The daily mean egg production per female was 2.0 ± 0.2, 4.1 ± 0.7, and 4.7 ± 1.2 (mean ± S.D.) eggs female^{-1} day^{-1} at 16, 24, and 28 °C, respectively (figure 3).

Overall mean egg production rates per female increased with decreasing temperatures because the period of egg laying was longer at lower temperatures. Maximum overall mean egg production rates occurred at 16 °C (311 ± 43.9 eggs female^{-1}), whereas the minimum occurred at 28 °C (104.5 ± 44.7 eggs female^{-1}). Temperature affected the duration of egg laying, which was 144 ± 13.6 d at 16 °C, 45.4 ± 4 d at 24 °C, and 24 ± 4.2 d at 28 °C.

In the laboratory, hatching success was high (nearly 100%). Hatching time decreased with increasing temperatures: eggs hatched after 96 h at 16 °C, 48 h at 24 °C and 24 h at 28 °C.

Longevity was inversely correlated to temperature (figure 2B) and increased with decreasing temperatures: 168.8 ± 27.1, 48 ± 7.3, and 24 ± 4.2 d at 16, 24, and 28 °C, respectively.

Table 1. Daily mean egg production of *P. xiphophorus* in situ and relative temperatures.

Days	Mean egg number	Temperature (°C)
06/11/2003	5.1	18.5
25/11/2003	4.0	16.9
09/01/2004	0.0	10
27/01/2004	0.0	11
18/02/2004	0.0	10.7
04/03/2004	0.0	12.03
17/03/2004	1.0	15
15/04/2004	2.8	15
11/05/2004	3.5	18.4
07/06/2004	2.0	23.5
28/07/2004	4.0	27.2
11/08/2004	5.0	27.6
26/08/2004	8.3	25.8
23/09/2004	3.3	22.6

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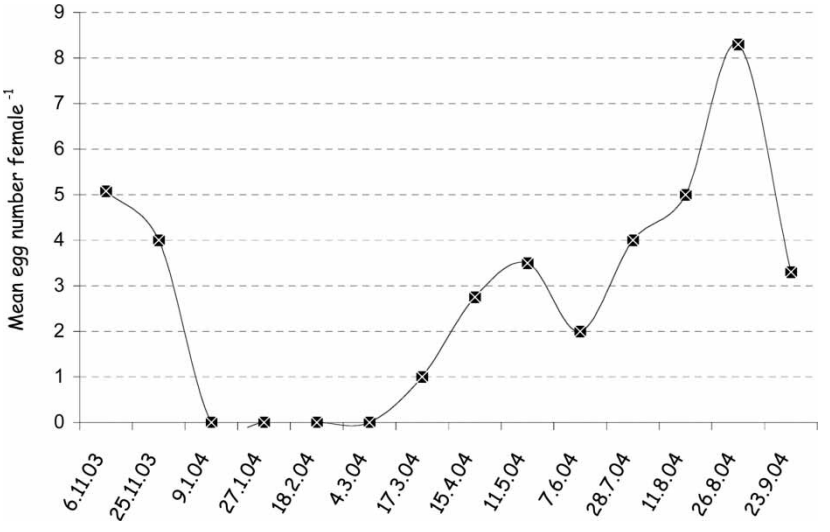

Figure 1. Daily mean egg production of *P. xiphophorus* in situ.

4. Discussion

The present paper represents a first contribution to knowledge of egg production rates and some 'biological attributes' of *P. xiphophorus*, reared in the laboratory and observed in situ.

These studies demonstrate that at higher temperatures, although the average number of eggs produced per female per day is higher, the period of egg laying is reduced as shown by [5] for *A. omorii*. Consequently, the overall mean egg production rate is lower. The average number of eggs produced is higher because of an accelaration in the metabolic activity and the rate of accumulation of material in the developing oocytes so that the production is higher, and spawning intervals are shortened.

Field studies showed a lower limit of temperature, at which *P. xiphophorus* was unable to produce eggs, and an optimal temperature range, at which *P. xiphophorus* exhibited maximal daily egg production. This optimum temperature range seems to be higher than that reported for

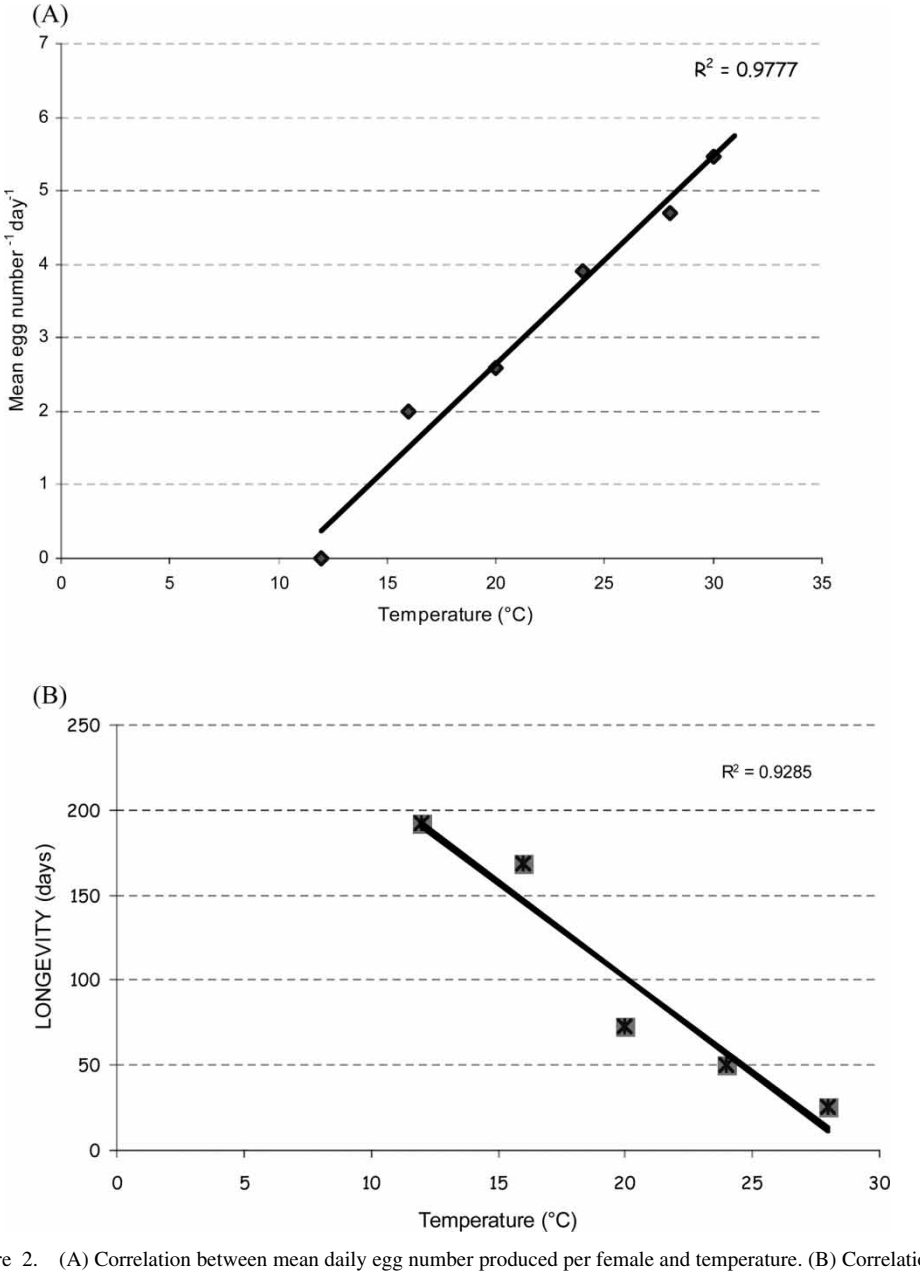

Figure 2. (A) Correlation between mean daily egg number produced per female and temperature. (B) Correlation between longevity and temperature.

most common subtemperate copepod species, ranging from ca. 15 °C for *Centropages typicus*, *Temora stylifera*, and *Temora longicornis* [6, 7] to 20 °C for *Acartia tonsa* and *Sinocalanus tenellus* [8].

P. xiphophorus has lower egg production rates than most planktonic calanoid copepods of subtemperate regions [1], but they are very similar to those of another bentho-pelagic congeneric species described for this region *P. umbraticus* [2].

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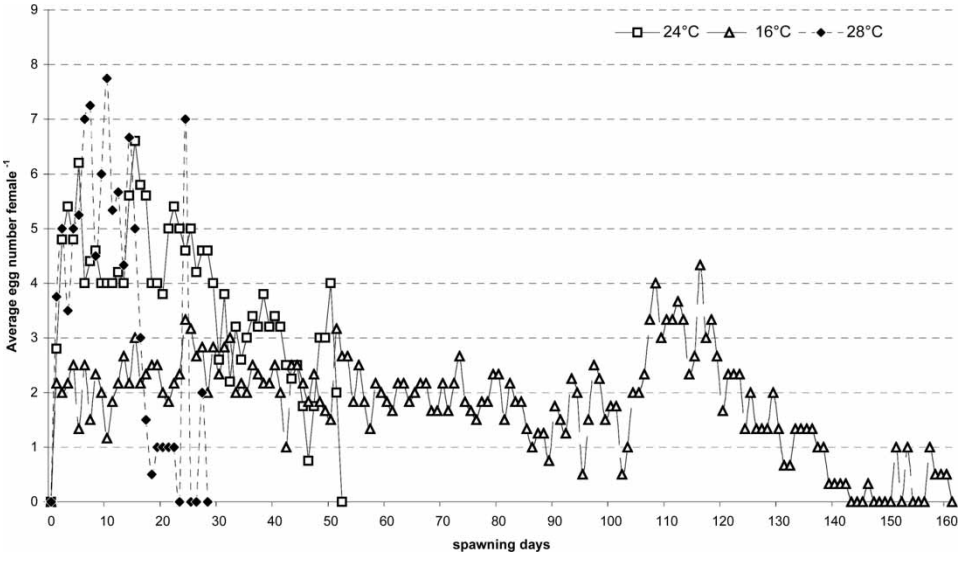

Figure 3. Overall mean egg production of *P. xiphophorus*, reared in laboratory at different temperatures.

Although these bentho-planktonic calanoid species have very low egg production rates, they are able to survive in restricted habitats, where interspecific competition is high, mainly with harpacticoid copepods.

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