Ann. Zool. Fennici 15:328—330. 1978

Oxygen consumption of Eurytemora hirundoides nauplii and adults as a function of salinity

GÖRAN GYLLENBERG & GUNNAR LUNDQVIST

GYLLENBERG, G. & LUNDQVIST, G. 1978: Oxygen consumption of Eurytemora hirundoides nauplii and adults as a function of salinity. — Ann. Zool. Fennici 15:328—330.

The O_2 consumption of adults and nauplii of *Eurytemora hirundoides* has been measured. Both showed an increase in O_2 consumption in hypo- and hyperosmotic media (sea-water). The O_2 consumption was minimal in 6 $^0/_{00}$ salinity for adults, and in 3 $^0/_{00}$ for nauplii. The osmotic concentration of the body fluids is isosmotic with 6 $^0/_{00}$ NaCl.

G. Gyllenberg, Department of Zoology, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki 10, Finland.

1. Introduction

Effects of salinity on oxygen consumption have been investigated extensively (for references to crustaceans, see e.g. DEHNEL 1960). Earlier research dealt with salinity effects alone, whereas later work has concentrated upon the combined effects of temperature and salinity (see e.g. DIMOCK JR. & GROVES 1975).

Only a few investigations have been made on naupliar stages of crustaceans (ELIASSEN 1952, ENGEL & ANGELOVIC 1968). This short report presents some observations on the effects of salinity on O_2 consumption of both nauplii and adults of *Eurytemora hirundoides*.

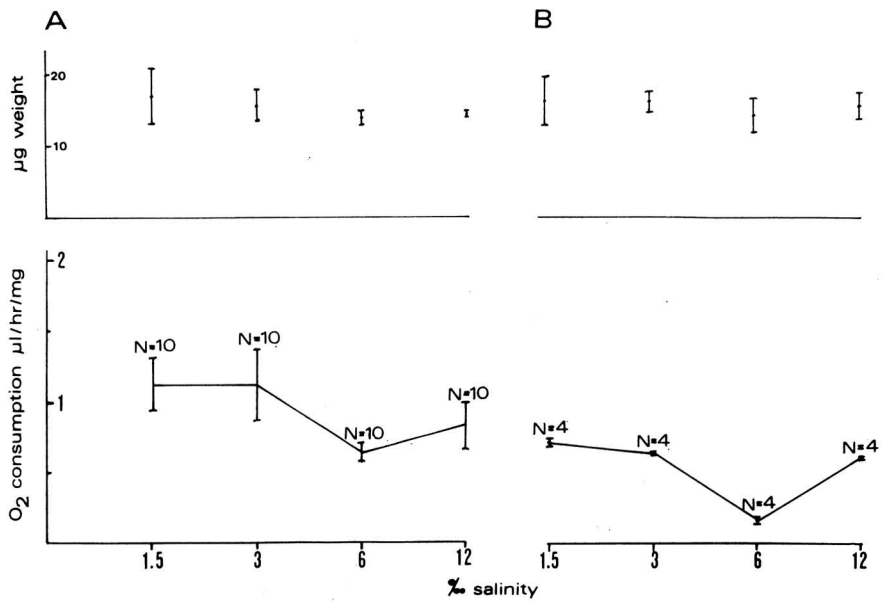

Fig. 1. O_2 consumption of adult *Eurytemora hirundoides* in different salinities, and corresponding weights of the animals. A. Respiration of normally active animals, B. Respiration of anaesthetized animals (see text). Mean values and standard errors are given.

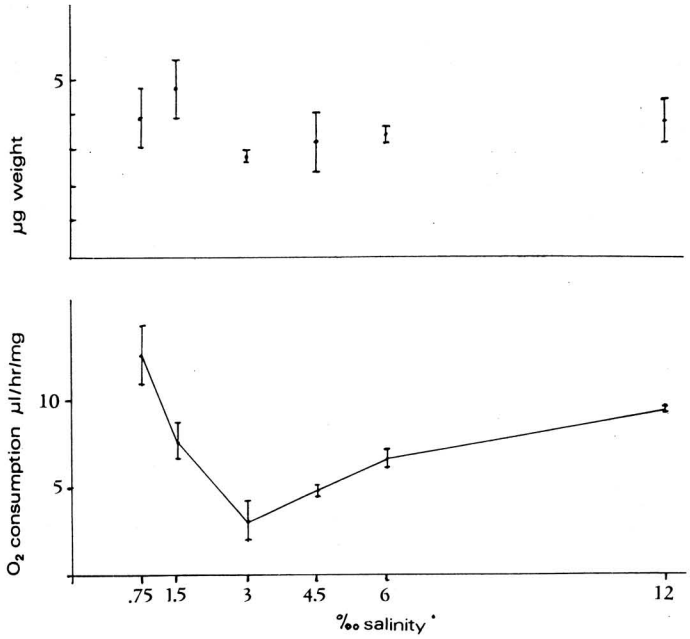

Fig. 2. O_2 consumption of *Eurytemora hirundoides* nauplii in different salinities, and corresponding weights of the animals (number of replicates = 10). Mean values and standard errors are given.

2. Methods

The polarographic equipment developed by GYLLENBERG (1973) and modified by GYLLENBERG & LUNDQVIST (1976) was used. Animals were caught in the surroundings of Helsinki and brought to the laboratory. Here they were acclimated for 1—3 days to the test salinities (dilutions of sea-water) at 4°C. A parallel set of experiments in different salinities was made with adults anaesthetized in 5×10^{-5} g/ml physostigmum salicylinum. For each experiment, we used 10—15 animals in the respiration chamber. The animals were acclimated for 1—2 h in the chamber.

3. Results

Fig. 1 shows the O_2 consumption at different salinities for adults of *Eurytemora hirundoides* when respiring normally (Fig. 1 A) and when anaesthetized (Fig. 1 B). The anaesthetized animals had a minimal respiration in 6 $^0/_{00}$ salinity, which was significantly different from the respiration in other salinities ($P < 0.01$). Non-anaesthetized animals also showed a minimum in 6 $^0/_{00}$, but this was less pronounced and not significantly different from the other O_2 consumption values ($P > 0.05$). The higher O_2 consumption and larger variation in the non-anaesthetized animals were apparently due to the different levels of kinetic activity reached in different experiments. The figures for O_2 consumption suggest that the differences observed are related, at least in part, to osmoregulatory work (cf. also RAO 1958, DEHNEL 1960, BULNHEIM 1974), since the osmotic concentration of the body fluids is isosmotic with 6 $^0/_{00}$ NaCl (unpublished measurements by one of us, G.L.), Lately, however, another explanation has been proposed for the increased consumption of O_2 in non-isosmotic concentrations. GILLES (1973) has demonstrated an increase in the oxidative metabolism of amino acids in isolated axons of the blue crab, *Callinectes sapidus*, after acclimation to reduced salinity.

Our results differ from those of most other authors in showing increased O_2 consumption in both hypo- and hypersaline solutions (see also FLEMISTER & FLEMISTER 1951). Normally in marine organisms respiration increases only in hyposaline media (cf. SCHLIEPER 1929, ELIASSEN 1952, ENGEL & ANGELOVIC 1968, BULNHEIM 1974).

The results for nauplii agreed with those for adult *Eurytemora* in having O_2 consumption peaks in both hypo- and hyperosmotic media. However, the minimum value (statistically different from all other salinities except 4.5 $^0/_{00}$ at the level $P < 0.05$) was at 3 $^0/_{00}$ and not at 6 $^0/_{00}$ as in the adults (Fig. 2). Both nauplii and

adults were caught at a salinity of 3 ‰, whereas the isosmotic medium is 6 ‰. The reason for the lower O_2 consumption minimum for nauplii is not fully understood.

In all the figures there is a significant correlation between O_2 consumption rate and weight of the animals. It is thought that exposure of the animals to non-isosmotic media resulted in volume changes. Plotting divergence from isosmotic value against weight gave a significant regression ($P \approx 0.05$) for both adults and nauplii.

Acknowledgement. We wish to thank Mrs JEAN MARGARET PERTTUNEN, B.Sc., who revised the manuscript.

This study was aided by grants from the Foundation for Research on Natural Resources in Finland.

References

BULNHEIM, H.-P. 1974: Respiratory metabolism of Idotea balthica (Crustacea, Isopoda) in relation to environmental variables, acclimation processes and moulting. — Helgoländer Wiss. Meeresunters. 26: 464—480.

DEHNEL, P. A. 1960: Effect of temperature and salinity on the oxygen consumption of two intertidal crabs. — Biol. Bull. Mar. Biol. Lab., Woods Hole 118: 215—249.

DIMOCK, R. V., JR. & GROVES, K. H. 1975: Interaction of temperature and salinity on oxygen consumption of the estuarine crab Panopeus herbstii. — Marine Biology 33:301—308.

ELIASSEN, E. 1952: The energy-metabolism of Artemia salina in relation to body size, seasonal rhythms, and different salinities. — Univ. Bergen, Arb. Naturv. R. 11:1—17.

ENGEL, D. W. & ANGELOVIC, J. W. 1968: The influence of salinity and temperature upon the respiration of brine shrimp nauplii. — Comp. Biochem. Physiol. 26: 749—752.

FLEMISTER, L. J. & FLEMISTER, S. C. 1951: Chloride ion regulation and oxygen consumption in the crab Ocypode albicans (Bosq). — Biol. Bull. Mar. Biol. Lab., Woods Hole 101:259—273.

GILLES, R. 1973: Oxygen consumption as related to the amino-acid metabolism during osmoregulation in the blue crab Callinectes sapidus. — Neth. J. Sea Res. 7: 280—289.

GYLLENBERG, G. 1973: Comparison of the Cartesian diver technique and the polarographic method, an open system, for measuring the respiratory rates in three marine copepods. — Commentat. Biol. 60:1—13.

GYLLENBERG, G. & LUNDQVIST, G. 1976: Some effects of emulsifiers and oil on two copepod species. — Acta Zool. Fennica 148:1—24.

RAO, K. P. 1958: Oxygen consumption as a function of size and salinity in Metapenaeus monoceros Fab. from marine and brackish-water environments. — J. Exp. Biol. 35: 307—313.

SCHLIEPER, C. 1929: Ueber die Einwirkung nieder Salzkonzentrationen auf marine Organismen. — Zeitschr. Vergl. Physiol. 9:478—514.

Received 29. V. 1978
Printed 30. XII. 1978