ACTA ICHTHYOLOGICA ET PISCATORIA
Vol. XXIII, Suppl. Szczecin 1993

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OBSERVATIONS ON THE DEVELOPMENT OF *SALMINCOLA EDWARDSII* (OLSSON, 1869) (*COPEPODA: LERNAEOPODIDAE)* PARASITIZING THE ARCTIC CHARR (*SALVELINUS ALPINUS* (L.)) IN THE HORNSUND REGION (VEST SPITSBERGEN)

OBSERWACJE NAD ROZWOJEM *SALMINCOLA EDWARDSII* (OLSSON, 1869) (*COPEPODA: LERNAEOPODIDAE)* PASOŻYTUJĄCEGO NA GOLCACH *SALVELINUS ALPINUS* (L.) Z REJONU HORNSUNDU – ZACHODNI SPITSBERGEN

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A successful *in vitro* incubation of eggs of *Salmincola edwardsii* (Olsson, 1869), a parasitic copepod living on gills of the Arctic charr [*Salvelinus alpinus* (L., 1758)] resulted in obtaining nauplii and copepodites of the parasite. The pre-molt nauplii were found to contain well-formed copepodites.

INTRODUCTION

Salmincola edwardsii (Olsson, 1869), of the family *Lernaeopodidae,* is a typical gill parasite of the genus *Salvelinus.* In his comprehensive revision of the genus *Salmincola* (Wilson, 1925), Kabata (1969) states that the parasite's range is identical with that of the host, that is the range is circumpolar in the Arctic.

Preliminary observations made by the present authors on the Arctic charr individuals caught in 1985–1987 in the Hornsund region (Spitsbergen) and parasitologic studies carried out by Sobecka and Piasecki (this volume) showed the charr gills to house a single parasitic copepod species, *S. edwardsii* (Olsson, 1869).

In the present work, observations were made on early developmental (post-embryonic) stages of *S. edwardsii* with an idea to contribute to the elucidation of the so far contentious question of whether the species' development involves a nauplius.

MATERIALS AND METHODS

The gills of an Arctic charr female (55.5 cm total length) caught in the summer 1986 in Lake Revvatnet (1° C water temperature) were found to house three female *S. edwardsii* with well-developed egg sacs. Fragments of gill lamellae with parasites attached to them (Fig. 1) were dissected out of the gills of the fish and placed in water.

In the laboratory of the Polish Polar Station in Hornsund, the gill fragments with live parasites were re-examined and a female with eggs at the most advanced developmental stage was selected for subsequent observations. The egg sacs themselves as well as the egg cases were translucent, which made pigmentation of the embryos well visible (Fig. 2).

The selected female was transferred to a fresh water-filled container and observed continuously under a stereomicroscope. The spontaneous break-down of the egg sac, followed by the release of the eggs to the water, hatching of the nauplii, and their molt could be seen.

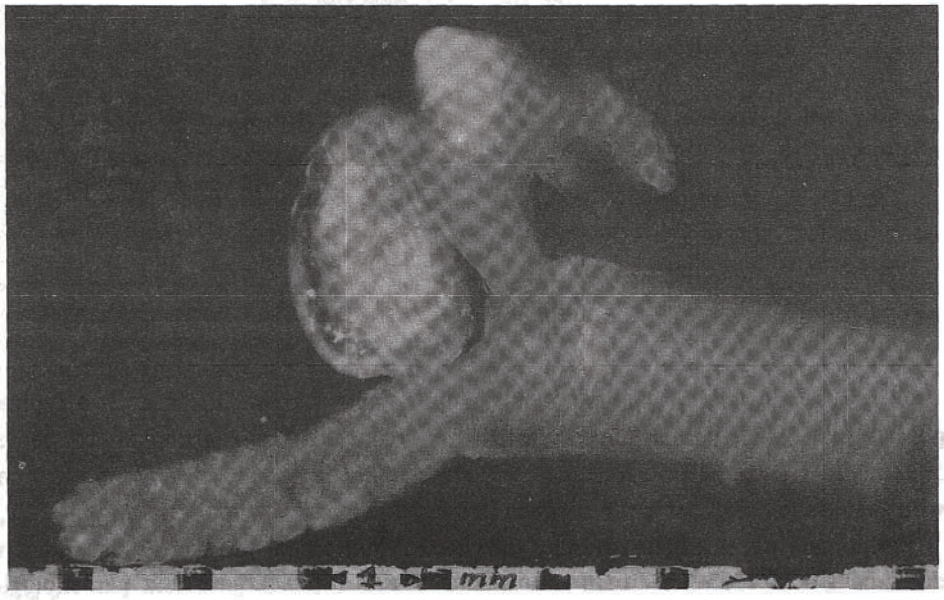

Fig. 1. A female *Salmincola edwardsii* anchored in the gill lamella

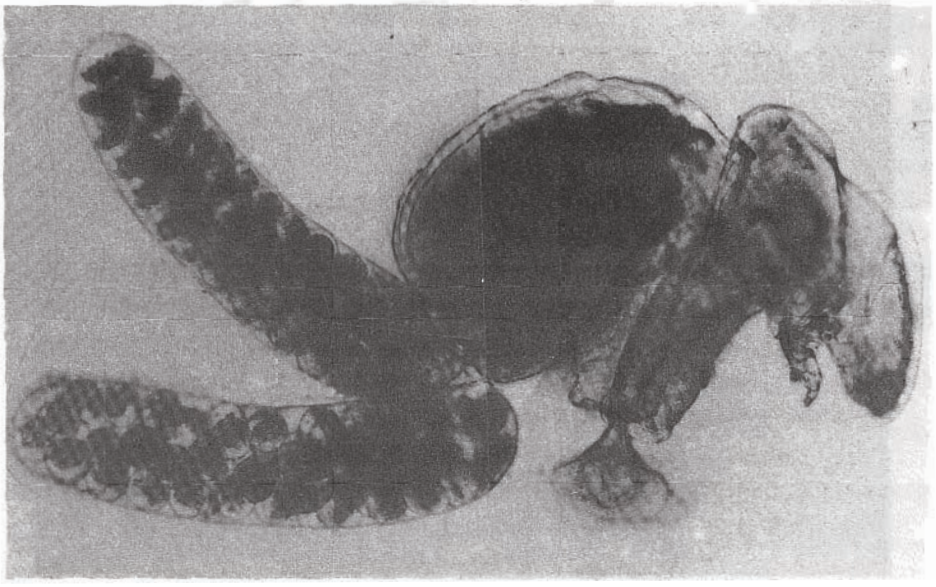

Fig. 2. A female *S. edwardsii* with well-formed egg sacs and eggs visible in them

The developmental stages obtained were preserved in 4% buffered glutaraldehyde and stored until further morphological observations could be made and the specimens photographed at the home laboratory in Poland.

RESULTS

The eggs of *S. edwardsii*, released from the egg sac, are oval in shape and surrounded by a transparent case through which the embryos are well visible (Fig. 3). The released eggs' incubation outside the egg sac in water (10°C) took a few seconds only and terminated with the hatching of the nauplii (Fig. 4).

The nauplius body is oval in shape and somewhat flattened dorsoventrally. The cephalic region is provided with swimming appendages in the form of non-differentiated antennae and antennulae, each terminating with a hook. A curled-up copepodite is clearly visible, through the naupliar cuticle, inside the nauplius (Fig. 5); the copepodite's frontal filament is conspicuous as well.

The nauplius described is a pre-molt form; further observations showed that molting occurred almost immediately after hatching and produced a copepodite.

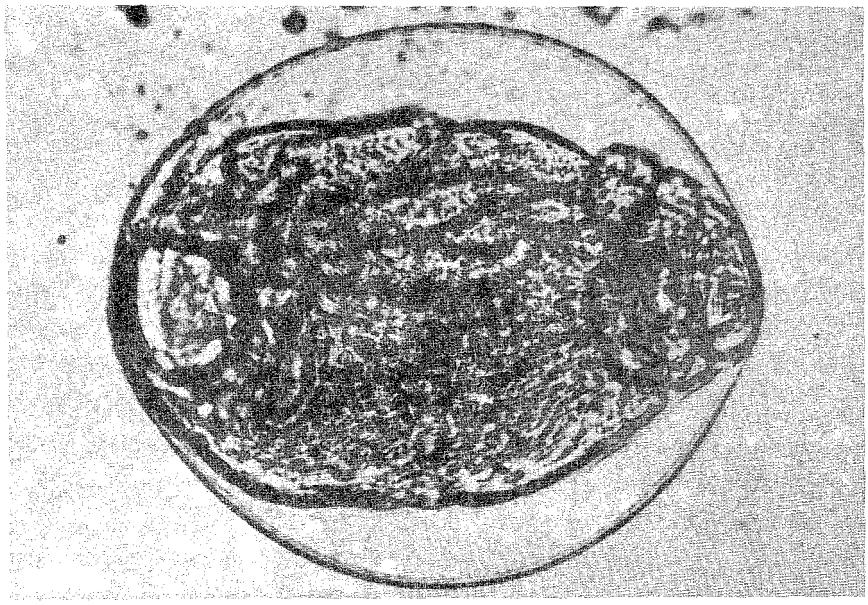

Fig. 3. *S. edwardsii* egg just after release from the egg sac

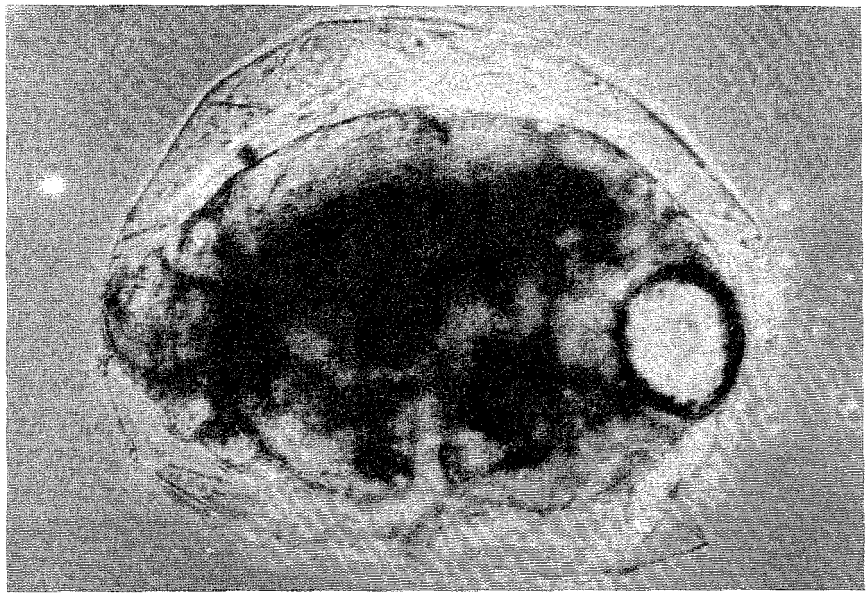

Fig. 4. A nauplius hatching from the egg

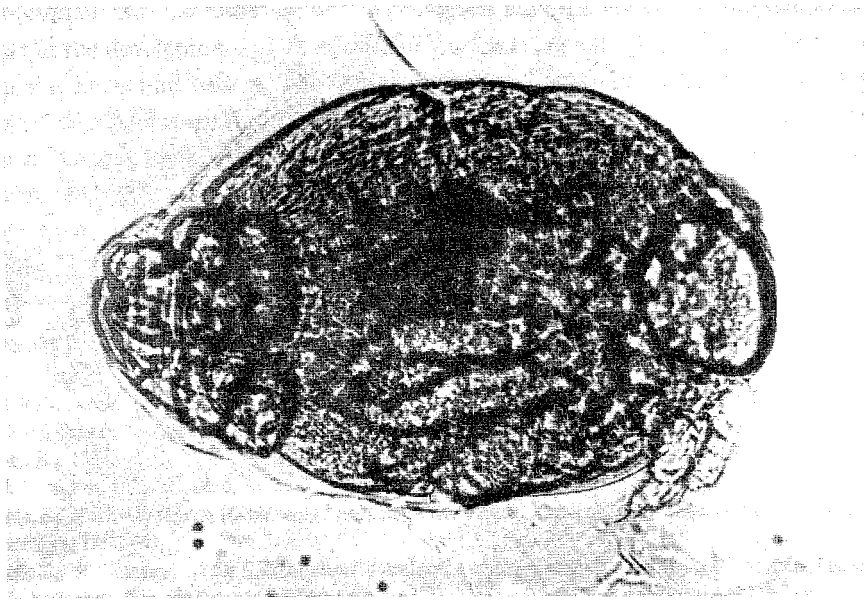

Fig. 5. A *S. edwardsii* nauplius immediately after hatching; a copepodite visible curled-up inside the cuticle

Initially, the copepodite's body shape is similar to the previously occurring one; subsequently, however, the copepodite stretches out. The frontal filament, i.e. the copepodite's attachment organ present in the invasive forms of lernaeopodids looks like a flattened sphere giving rise to a filament penetrating into the body and forming a characteristic coil there (Figs 6 and 7).

The copepodite's body is oval and slightly narrowed in mid-length. When examined from the lateral side (Fig. 7), the cuticle shows a fold separating the cephalosome and the metasome. The cephalic part shows antennae and antennulae as well as the second maxillae and maxillipeds, both terminating with hooks. The swimming legs are biramous and provided with setae. The urosome terminates with uropods, each having 3 setae. The distal setae are much shorter than the proximal ones.

CONCLUSIONS

Observations reported by different authors (Kabata and Cousens, 1973; Kabata, 1976; Piasecki, 1987; Kabata, 1987; Zandt, 1935) who studied developmental cycles of various lernaeopodids contradict one another with respect to the number of stages the development involves, most notably to the presence of a naupliar stage.

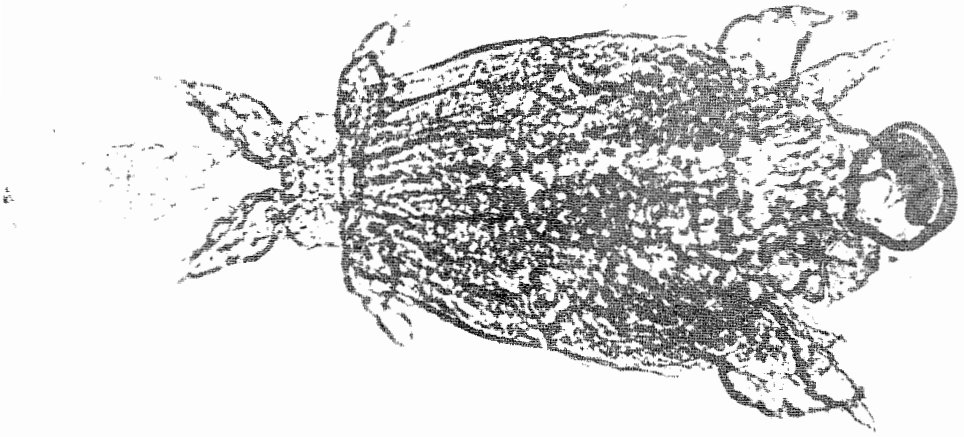

Fig. 6. A *S. edwardsii* copepodite in the dorsal view

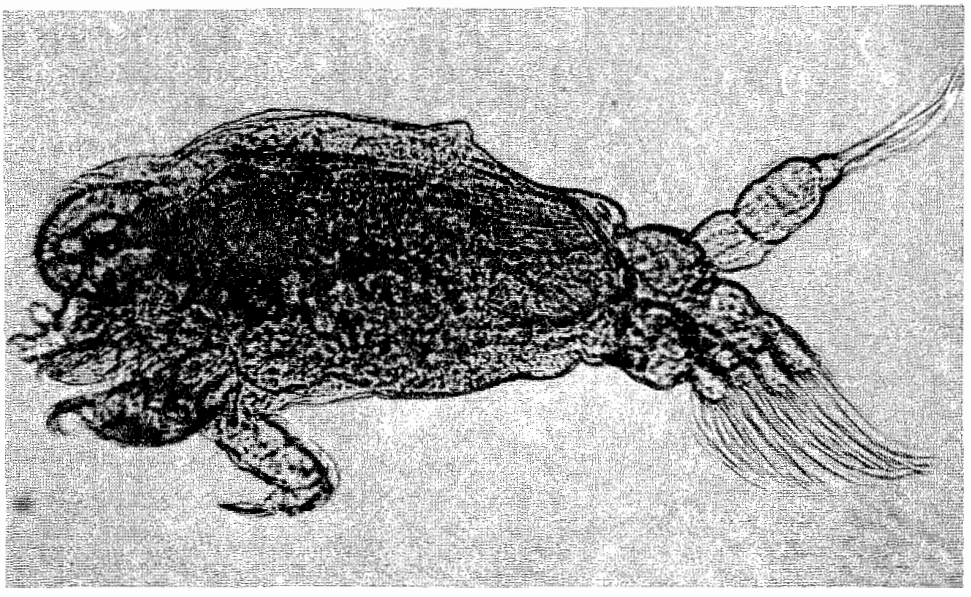

Fig. 7. A *S. edwardsii* copepodite in the lateral view

The *in vitro* observations reported in this paper, carried out while in Spitsbergen and coupled with examination of the preserved material show that the nauplius does occur in the development of *S. edwardsii* parasitizing on gills of the Arctic charr from the Hornsund region. The nauplius observed was a pre-molt form, as a well-developed copepodite resided inside the naupliar cuticle. Since the nauplius underwent molting almost immediately after hatching, this very brief phase might have been overlooked by some workers.

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Translated by: Dr T. Radziejewska

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STRESZCZENIE

Przeprowadzono latem 1985 roku na Spitsbergenie w laboratorium Polskiej Bazy Polarnej PAN doświadczenie polegające na inkubacji jaj *Salmincola edwardsii* (Copepoda: *Lernaeopodidae*) pasożytującego na skrzelach golca arktycznego *Salvelinus alpinus* (L.).

Pozwoliło to na prześledzenie początkowego cyklu rozwojowego tego pasożyta. Stwierdzono, że po wysypaniu się jaj z worków jajowych do wody następuje natychmiastowy wylęg formy nauplii.

Nauplii znajdują się w postaci przedlinkowej na co wskazuje dobrze widoczny poprzez kutikulę naupliusa kopepodit. W kilka minut po wylęgu nauplii z jaj, następuje następna faza – linienie naupliusa, czego wynikiem jest kopepodit. Na tym etapie doświadczenie zostało zakończone.

Z przeprowadzonych obserwacji wynika, że u *Salmincola edwardsii* pierwszą formą rozwojową jest nauplii, a następną kopepodit.

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Received: 1991.05.24