



## NOTES

UDC 595.34:597.2/.5:574.582(262.5)

### IDENTIFYING NAUPLIAL STAGES OF THE BLACK SEA COPEPODS OF CALANIDAE FAMILY IN FISH LARVAE GUTS

© 2019 Yu. A. Zagorodnyaya and I. V. Vdodovich

A. O. Kovalevsky Institute of Biology of the Southern Seas of RAS, Sevastopol, Russian Federation  
E-mail: [artam-ant@yandex.ru](mailto:artam-ant@yandex.ru)

Received by the Editor 18.01.2019; after revision 30.07.2019;  
accepted for publication 25.09.2019; published online 30.09.2019.

Naupliar stages of copepods are known to be the main food items for fish larvae. Their identification in fish larvae guts is usually a difficult task and a time-consuming procedure. Original approach to identification of larvae and juvenile fish common food items – naupliar stages of the Black Sea copepods of family Calanidae – is proposed. This work is a continuation of the initiated studies on the developing a method for determining the juvenile copepod stages from fish larvae guts. On the example of naupliar stage III of *Calanus euxinus* Hulsemann, 1991, specific features that can be used in identifying naupliar stages of three species of the Black Sea copepods from fish larvae guts are shown.

**Keywords:** food items, fish larvae, copepods, Calanidae, Black Sea

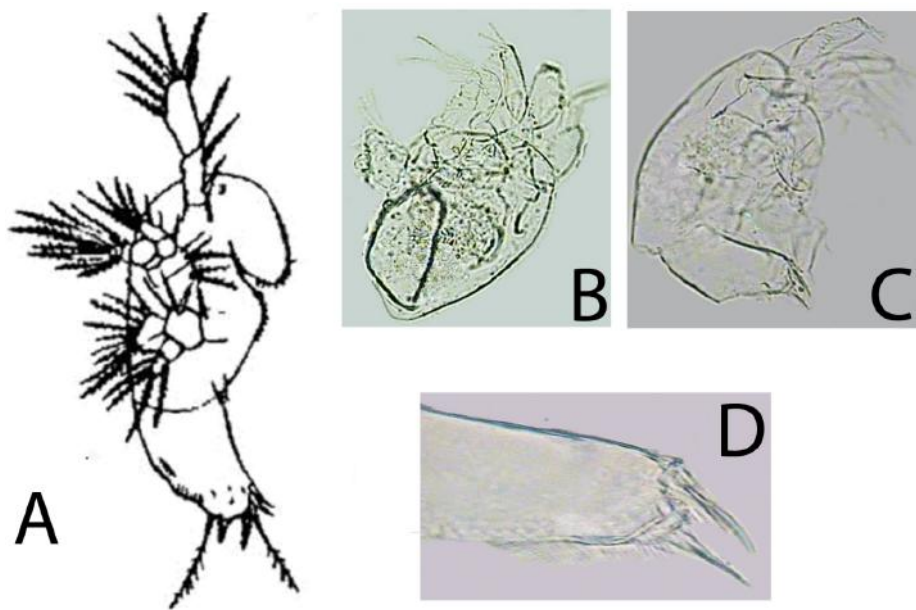
Naupliar stages of copepods are known to be the main food items for fish larvae [7, 8]. Their identification in fish larvae guts is usually a hard and time-consuming procedure. It was shown [2] that “feeding of fish is characterized by high species specificity...”, so identifying species composition of food items consumed is an important task. At present, there are neither illustrations, nor generally accepted method for the determination of marine crustaceans in fish larvae guts, when analyzing the remains of food items. This work is a continuation of the initiated studies [9] on the developing a method for determining the juvenile copepod stages by fragments in the intestines of fish larvae.

Larvae of *Trisopterus luscus* (Linnaeus, 1758) were collected in the Black Sea in October 2016 (the 89<sup>th</sup> cruise of RV “Professor Vodyanitsky”). Samples with larvae were fixed in 4% formaldehyde solution. Species identification of fish larvae was made by [5]. In the laboratory, after species identification and morphological analysis of fish larvae, they were dissected under a binocular microscope, and their guts were removed as described in [1]. Food items found in guts were investigated under light microscope Nikon Eclipse 100 (4×10); all food items found in guts were counted and measured, and then identified to the proper taxon. Identification of food items in fish larvae guts was carried out by [3, 6]. Photomicrography of food items found in fish larvae guts was made with camcorder Ikegami ICD-848P, connected to the Nikon Eclipse 100 (light mode 10×10).

To identify naupliar stages of copepods (Fig. 1A), the following specific features were taken into account: the number of body segments and limb pairs, the number of branches on antennae, antennae and mouth part, as well as the location and length of setae, presence of spines, shape and downiness of labrum,

appearance of rudimentary swimming legs, caudal arms, and a number of others [3, 6]. Most of these features cannot be used for identifying nauplii from fish larvae guts, because as a result of digestion they are not distinguishable or are destroyed.

In the Black Sea, the family of Calanidae (Copepoda) is represented by one species – *Calanus euxinus* Hulsemann, 1991, and its naupliar stages are characterized by comma-like body shape [3, 6]. This shape of the body remains the same in fish larvae guts, but it is often not noticeable (Fig. 1B), as the abdominal segment can be pressed to cephalothorax, and it complicates the identification, while in the lateral projection the abdominal segment is well distinguishable (Fig. 1C). When identifying, one should also focus on the shape, length and the number of paired caudal setae and spines, which are usually well maintained in the nauplii of this family (Fig. 1D). Such a defining attribute as “thin hairs on the inferior border of labrum” [6] is not suitable for identifying semi-digested nauplius remains, but the shape of labrum is clearly distinguishable in the lateral projection.



**Fig. 1.** The nauplii of *Calanus euxinus*, stage III. A – figure from [6]. B–D – original photos of nauplii from guts of *Trisopterus luscus* larvae: B – abdomen tucked under thoracic segment; C – abdomen and labrum; D – remains of caudal setae (with increasing)

**Рис. 1.** Науплиусы *Calanus euxinus*, III стадия. А — рисунок из [6]. В–D — оригинальные фотографии науплиусов из кишечника личинки тресочки *Trisopterus luscus*: В — abdomen подогнут под торакальный отдел; С — боковая проекция, на которой хорошо видны abdomen и верхняя губа; D — различные остатки каудального вооружения (увеличено)

Length of III naupliar stages of *Calanus euxinus* is 0.28–0.33 mm [3, 6], while the digested nauplii of this stage from fish larvae guts were smaller due to deformation of their body, usually to 0.28 mm. Naupliar stages of two other species of the Black Sea copepods – *Pseudocalanus elongatus* (Boeck, 1865) (Clausocalanidae) and *Paracalanus parvus* (Claus, 1863) (Paracalanidae) [4] – have a similar form, while they are well distinguishable by size, as a rule [3, 6]. Thus, using the example of stage III of *Calanus euxinus* nauplius, the following specific features are illustrated: characteristic body shape in the form of a comma, especially the caudal spines and setae, size of nauplius that can be used to identify the naupliar stages of three species of the Black Sea copepods from fish larvae guts.

*This scientific note was prepared within the framework of research issue of IBSS “Regularities of formation and anthropogenic transformation of biodiversity and bioresources of the Sea of Azov – the Black Sea basin and other regions of the World Ocean” (no. AAAA-A18-118020890074-2).*

## REFERENCES / СПИСОК ЛИТЕРАТУРЫ

1. Duka L. A., Sinyukova V. I. *Rukovodstvo po izucheniyu pitaniya lichinok i mal'kov morskikh ryb v estestvennykh i eksperimental'nykh usloviyakh*. Kiev: Naukova dumka, 1976, 110 p. (in Russ.)
2. Kasumyan A. O. Otsenka rybami ob"ektov pitaniya s pomoshch'yu vnutrirotovoi retseptsii: povedencheskie i fiziologicheskie aspekty. In: *Sovremennye problemy fiziologii i biokhimii vodnykh organizmov*. Vol. 1: *Ekologicheskaya fiziologiya i biokhimiya vodnykh organizmov* : sb. nauch. st. Petrozavodsk: KarNTs RAS, 2010, pp. 74–79. (in Russ.)
3. *Opredelitel' fauny Chernogo i Azovskogo morei*. Vol. 2. *Svobodnozhivushchie bespozvonochnye. Rakoobraznye*. Kiev: Naukova dumka, 1969, 536 p. (in Russ.)
4. Razouls C., de Bovée F., Kouwenberg J., Desreumaux N. *Diversity and Geographic Distribution of Marine Planktonic Copepods*. Sorbonne University, CNRS, 2005–2019. URL: <http://copepodes.obs-banyuls.fr> [accessed 2019.01.15].
5. Russell F. S. *The eggs and planktonic stages of British marine fishes*. London ; New York ; San Francisco: Academic Press, 1976, 522 p.
6. Sazhina L. I. *Naupliusy massovykh vidov pelagicheskikh kopepod Mirovogo okeana*. Kiev: Naukova dumka, 1985, 238 p. (in Russ.)
7. Turner J. T. *The feeding ecology of some zooplankters that are important prey items of larval fish*. Washington, DC : U. S. Dept. of Commerce, National Oceanic ; NOAA / National Marine Fisheries Service, 1984, pp. 1–28. (NOAA Tech. Rep. NMFS ; 7).
8. Turner J. T. The importance of small planktonic copepods and their roles in pelagic marine food webs. *Zoological Studies*, 2004, vol. 43, no. 2, pp. 255–266.
9. Vdodovich I. V., Khanaychenko A. N., Gubanova A. D., Kolesnikova E. A., Aganesova L. O. Identification of some common food items in the guts of fish larvae and juveniles in the Black Sea. *Morskoj biologicheskij zhurnal*, 2017, vol. 2, no. 1, pp. 3–10. <https://doi.org/10.21072/mbj.2017.02.1.01>

**ОПРЕДЕЛЕНИЕ НАУПЛИАЛЬНЫХ СТАДИЙ  
ЧЕРНОМОРСКИХ КОПЕПОД СЕМЕЙСТВА CALANIDAE  
В КИШЕЧНИКАХ ЛИЧИНОК РЫБ**

**Ю. А. Загородняя, И. В. Вдодович**

Федеральный исследовательский центр «Институт биологии южных морей имени А. О. Ковалевского РАН»,  
Севастополь, Россия  
E-mail: [artam-ant@yandex.ru](mailto:artam-ant@yandex.ru)

Известно, что науплиальные стадии копепод являются наилучшим кормом для личинок рыб. Их идентификация в кишечниках рыб ранних стадий онтогенеза — сложная и трудоёмкая задача. Предложен собственный подход к идентификации массово встречающихся объектов питания личинок и мальков рыб — науплиальных стадий черноморских копепод семейства Calanidae. Данная работа является продолжением исследований по созданию методики определения ювенильных стадий копепод из кишечников личинок. На примере III стадии науплиусов *Calanus euxinus* Hulsemann, 1991 проиллюстрированы характерные признаки, которые можно использовать при идентификации науплиальных стадий трёх видов черноморских копепод в кишечниках личинок рыб.

**Ключевые слова:** пищевые объекты, личинки рыб, копеподы, Calanidae, Чёрное море