

MORPHOLOGY OF *LERNANTHROPINUS TRACHURI* (BRIAN, 1903)
(COPEPODA, SIPHONOSTOMATOIDA, LERNANTHROPIDAE)
FROM BANDIRMA BAY
(TURKEY)

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ABSTRACT

The parasitic copepod, *Lernanthropinus trachuri* (Brian, 1903) (Copepoda, Siphonostomatoidea, Lernanthropidae) was found on the Mediterranean horse mackerel, *Trachurus mediterraneus* in Bandırma Bay, Turkey. The aim of this study is to present female *Lernanthropinus trachuri* with morphological characters with photos from Turkey. The details unseen in photos were supported with drawings. All parasites were firmly attached to the gill filaments of the host. This parasite is also specific for the genus *Trachurus* (Costa et al 2017). Therefore, this parasite may use as biomonitor or tag species for fish stock studies in Turkey.

ZUSAMMENFASSUNG: Die Morphologie von *Lernanthropinus trachuri* (Brian, 1903) (Copepda, Siphonostomatoida, Lernanthropidae) aus der Bandırma Bucht (Türkei).

Der als Parasit lebende Ruderfußkrebs *Lernanthropinus trachuri* (Brian, 1903) (Copepoda, Siphonostomatoidea, Lernanthropidae) wurde an der mediterranen Pferdemackrele *Trachurus mediterraneus* in der Bandırma Bucht/Türkei gefunden. Daraus ergibt sich das Ziel vorliegender Arbeit für die Türkei das Weibchen von *Lernanthropinus trachuri* mit seinen morphologischen Kennzeichen anhand von Photos zu dokumentieren. Details, die in den Fotos nicht sichtbar waren, wurden mithilfe von Zeichnungen dargestellt. Sämtliche Parasiten hafteten fest an den Kiemenfäden der Wirtsart. Dieser Parasit ist auch kennzeichnend für die Gattung *Trachurus* (Costa et al. 2017). Daher kann er Zeigerart bei Biomonitoring eingesetzt oder als Leitart für die Untersuchungen an Fischbeständen in der Türkei verwendet werden.

REZUMAT: Morfologia speciei *Lernanthropinus trachuri* (Brian, 1903) (Copepda, Siphonostomatoida, Lernanthropidae) din golful Bandırma (Turcia).

Copepodul parazitar *Lernanthropinus trachuri* (Brian, 1903) (Copepoda, Siphonostomatoidea, Lernanthropidae) a fost identificat pe specia stavridul mediteranean *Trachurus mediterraneus* în Golful Bandırma din Turcia. Această descoperire a determinat obiectivul acestei lucrări de a studia în Turcia cu ajutorul unor fotografii, femela de *Lernanthropinus trachuri* cu toate caracterele ei morfologice. Detaliile care nu au fost vizibile în fotografii au fost documentate cu ajutorul unor desene: Toți paraziții au fost strâns alipiti de filamentele branchiale ale speciei gazdă. Parazitul de asemenea este caracteristic pentru genul *Trachurus* (Costa et al. 2017). Din acest considerent poate fi folosit ca indicător la monitorizări sau ca specie indicatoare pentru cercetarea stocurilor de pești din Turcia.

INTRODUCTION

Mediterranean horse mackerel, *Trachurus mediterraneus* (Steindachner, 1868), is a commercially-important marine fish species with a wide geographical distribution, they inhabit the pelagic-oceanic zone (Froese and Pauly, 2017).

Lernanthropidae is the most common family of parasitic copepods on fishes. The family *Lernanthropidae* Kabata, 1979, currently comprises about 150 species belonging to eight genera (Boxshall and Halsey, 2004). The genus *Lernanthropus* de Blainville, 1822, is the largest of the family, containing approximately 120 valid species, all of which parasitize marine fish hosts, belonging to least 31 different teleost families (Boxshall and Halsey, 2004).

Bahri et al. (2002) examined *Lernanthropus kroyeri* as a bio-indicator species of populations that belong to two fish species, *Dicentrarchus labrax* and *Dicentrarchus punctatus* in Tunisia. Their preliminary analysis seems to indicate that samples of *L. kroyeri* from the north differ from those in the south. Manera and Dezfuli (2003) examined *Lernanthropus kroyeri* infections and pathology in cultured sea bass in Greece. They determined that *Lernanthropus kroyeri* cause the erosion, desquamation and necrosis on the secondary lamellae and laceration on the tissue and vessels of infested gill.

The genus, *Lernanthropinus*, includes ten species (Walter, 2015). Venmathi Maran et al. (2014) referred that the diagnostic features of the genus *Lernanthropinus* are: the presence of posterolateral plate-like structures on the trunk; the absence of dorsal and ventral plates on the trunk; both leg four and the urosome are visible in dorsal and ventral views (Ho and Do, 1985 cited by Venmathi Maran et al., 2014).

Nine species of the family, *Lernanthropidae*, have previously been recorded as parasitizing fishes in Turkish marine habitats. They are: *Lernanthropus kroyeri* Van Beneden, 1851 (Tokşen, 1999; Özal et al., 2004; Öktener et al., 2010); *Lernanthropus brevis* Richiardi, 1879 (Akmirza, 2003); *Lernanthropus indefinitus* Koyuncu, Castro Romero and Karaytuğ, 2012 (Koyuncu et al., 2012); *Lernanthropus gisleri* Van Beneden, 1852 (Özak et al., 2016); *Lernanthropus callionymicola* El-Rashidy and Boxshall, 2012 (Özak et al., 2016); *Lernanthropsis mugilis* (Brian, 1898) (Altunel, 1983); *Lernanthropinus trachuri* (Brian, 1903) (Öktener and Trilles, 2004); *Mitrapus oblongus* (Pillai, 1964) (Romero and Öktener, 2010); *Sagum posteli* Delamare-Debouteville and Nunes-Ruivo, 1954 (Tokşen et al., 2012). This study aims to present the morphological characters of *Lernanthropinus trachuri* from Turkey and is given with drawings and photos.

MATERIAL AND METHODS

Three hundred twenty of Mediterranean horse mackerel were collected by local gears from the Bandırma Bay, Sea of Marmara in Turkey. Parasites recovered from the hosts were fixed in 70% ethanol. Some specimens were cleared in lactic acid and their appendages were dissected out by using Wild M5 stereo microscope. Dissected parts were mounted on slides in glycerin-gelatine mounting medium. The photos were taken with the aid of Canon camera (EOS 1100D) connected to a microscope. The appendages were drawn with the aid of a camera lucida (Olympus BH-DA). All measurements are in millimeters. Terminology of appendage structure follows Kabata (1979; 2003). The scientific names, synonyms of parasite and host were checked with Walter and Boxshall (2018a, b, c).

RESULTS AND DISCUSSION

Subclass Copepoda Milne Edwards, 1840; Order Siphonostomatoida Thorell, 1859; Family Lernanthropidae; *Lernanthropinus trachuri* (Brian, 1903) (Figs. 1-3); Syn. *Lernanthropus trachuri* Brian, 1903; *Lernanthropus lichiae* Goggio, 1906 (Walter and Boxshall 2018 a, b, c)

Host: *Trachurus mediterraneus* (Steindachner, 1868) (Pisces: Carangidae); Mediterranean horse mackerel.

Total number of parasites: 28 females. Dissected material: 10 females.

All parasites attached to the gill filaments. The prevalence of parasites was 8.75%.



Figure 1: *Lernanthropinus trachuri* female.

Description – Female morphology (Fig. 1): Body length varies from 2.75 to 3.25 mm. Antennule (Figs. 2a and 3a) seven segments; first segment without segmentation, second segment two setae, third segment with three setae, fourth segment with one seta, fifth segment with two setae; sixth segment with one seta, seventh segment with nine setae. Antenna (Figs. 2b and 3b) two segmented; robust and bearing small papilliform process and small spine; subchela forming as strongly curved claw; claw two short spiniform processes, distal part with longitudinal ringes. Maxillule (Figs. 2c and 3c) bilobed; smaller outer lobe (exopod) with inflated base and tipped with a papilliform process; longer inner lobe (endopod) bearing three unequal terminal process. Maxilliped (Figs. 2d and 3d) two segments; corpus robust and myxal area with unarmed; subchela bears two small spines on medial surface of shaft; claw with fine longitudinal ridges. Mandible (Figs. 2e and 3e) two segmented, basal segment short, distal segment elongated, with seven teeth on terminal blade. Maxilla (Figs. 2f, 2g and 3f) two segmented, brachiform; proximal part robust with no arms and longer than brachium; distal part (brachium) distally long with a spine on inner margin and terminal claw with one spiniform process and two rows of sharp denticles on inner margin. First leg (Figs. 2i and 3h) protopod with an outer seta and an inner seta; exopod larger than endopod; exopod 1-segmented and tipped with five robust spines; endopod inflated lobe tipped with slender seta. Second leg (Figs. 2j and 3i) smaller than first leg; with inconspicuous protopod carrying a blunt inner process; exopod tipped with five spines and endopod with short apical seta; a lateral large outer protuberance on protopod. Leg three not fused, unarmed. Leg four and leg five represented by pair of bilobate process, long, fleshy, having identical blunt tips. Uropod (Figs. 2h and 3g) with two short setae distally; two long setae posteriorly.

Lernanthropinus trachuri has been found in the North Atlantic, Mediterranean, and Adriatic seas (Walter and Boxshall 2018 a, b, c). This lernanthropid is mainly a parasite of carangid fishes. It was reported from four fish families. *Lernanthropinus trachuri* (Brian, 1903) were mostly reported as *Lernanthropus trachuri* (Brian, 1903) on *Trachurus lathami* (Timi and Etchegoin, 1996; Braicovich et al., 2012; Luz et al., 2012), on *Trachurus trachurus* (Brian, 1903, 1906; Nunes-Ruivo, 1954; Papoutsoglou, 1976; Diebakate, 1994; Benmansour and Ben Hassine, 1998; MacKenzie et al., 2008), on *Trachurus capensis* (syn. *T. trachurus c.*) (Piasecki, 1982; Roux, 2013; Bowker et al., 2016), on *Trachurus picturatus* (Gaevskaya and Kovaleva, 1985), on *Trachurus murphyi* (syn. *Trachurus symmetricus murphyi*; *Trachurus picturatus murphyi*) (Romero and Kuroki, 1985; George-Nascimento and Arancibia, 1992; Oliva, 1994; Oliva, 1999; George-Nascimento, 2000; Quiroz Gil, 2014), on *Ariomma bondi* (syn. *Paracubiceps ledanoi*) (Delamare-Deboutteville and Nunes-Ruivo, 1954; Capart, 1959), on *Chloroscombrus chrysurus* (Diebakate, 1994), on *Erythrocles monodi* (Diebakate, 1994), on *Seriella violacea* (Romero and Kuroki, 1985; Jara and Díaz-Limay, 1995; Iannaccone, 2003), on *Trachurus mediterraneus* (Öktener and Trilles, 2004), on *Campogramma glaycos* (syn. *Lichia vadigo*) (Brian, 1903), *Caranx rhonchus* (syn. *Caranx ronchus*) (Delamare-Deboutteville and Nunes-Ruivo, 1954). *Lernanthropinus trachuri* (Brian, 1903) was also reported as *Lernanthropus lichiae* Goggio, 1906 on *Erythrocles monodi* (Capart, 1959) and *Campogramma glaycos* (syn. *Lichia vadigo*) (Goggio, 1906).

The hosts' parasitism with *Lernanthropinus trachuri* was examined according to family characteristics nine of 12 host species belongs to Carangidae, one species to Centrolophidae, one species to Emmelichthyidae; and one species to Ariomatidae. The hosts' parasitism with *Lernanthropinus trachuri* was examined according to habitat selections; four of 12 host fish species are pelagic-neritic; three species of benthopelagic; three species of pelagic-oceanic; one species of demersal; one species of reef-associated. The hosts parasitism with *Lernanthropinus trachuri* according to feeding habits; all hosts are carnivorous.

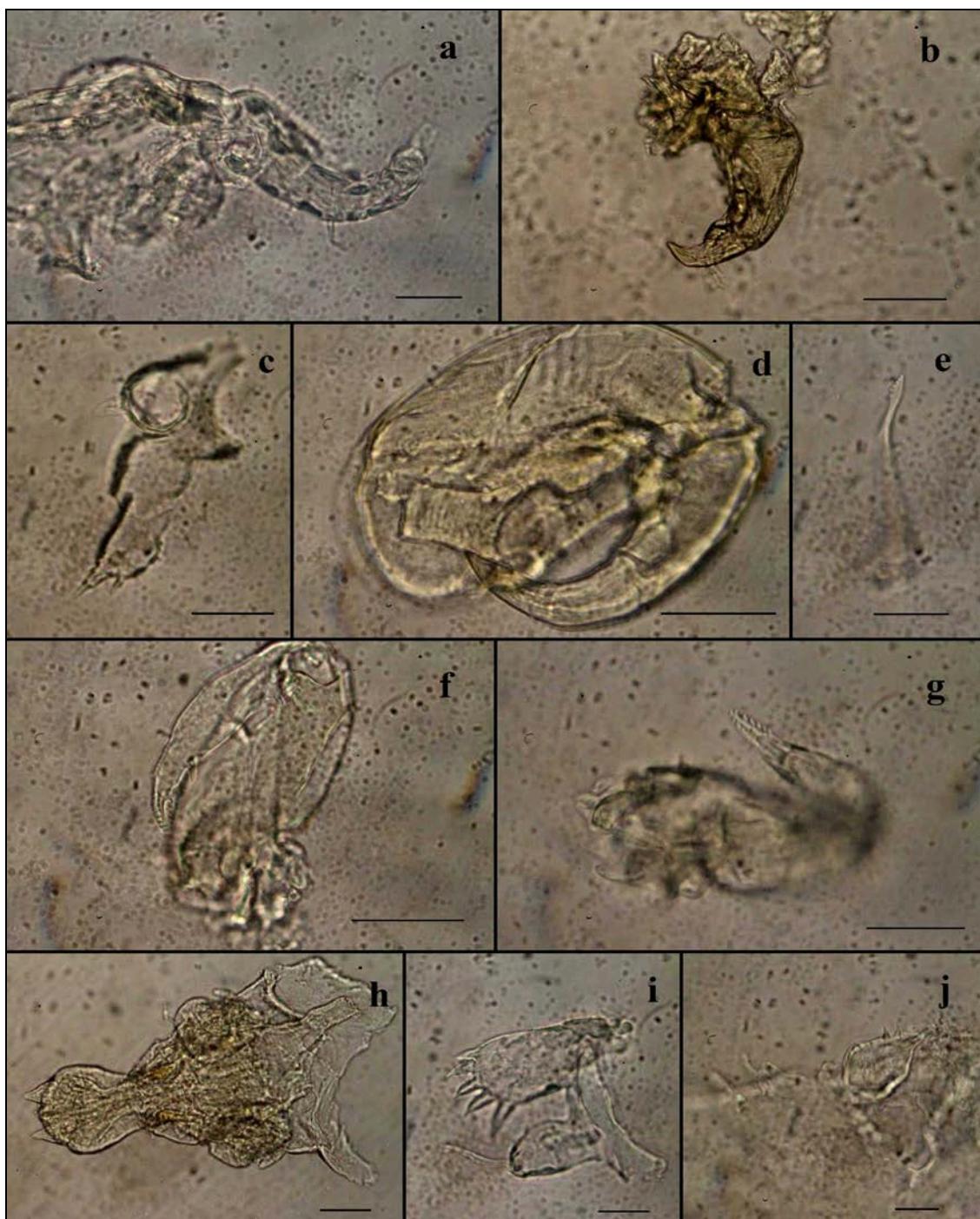


Figure 2: *Lernanthropinus trachuri*; (a) Antennule (0.02 mm), (b) Antenna (0.13 mm),
(c) Maxillule (0.03 mm), (d) Maxilliped (0.05 mm), (e) Mandible (0.03 mm),
(f) Maxilla (0.045 mm), (g) Caudal ramus (0.07 mm),
(i) First leg (0.015 mm), (j) Second leg (0.04 mm).

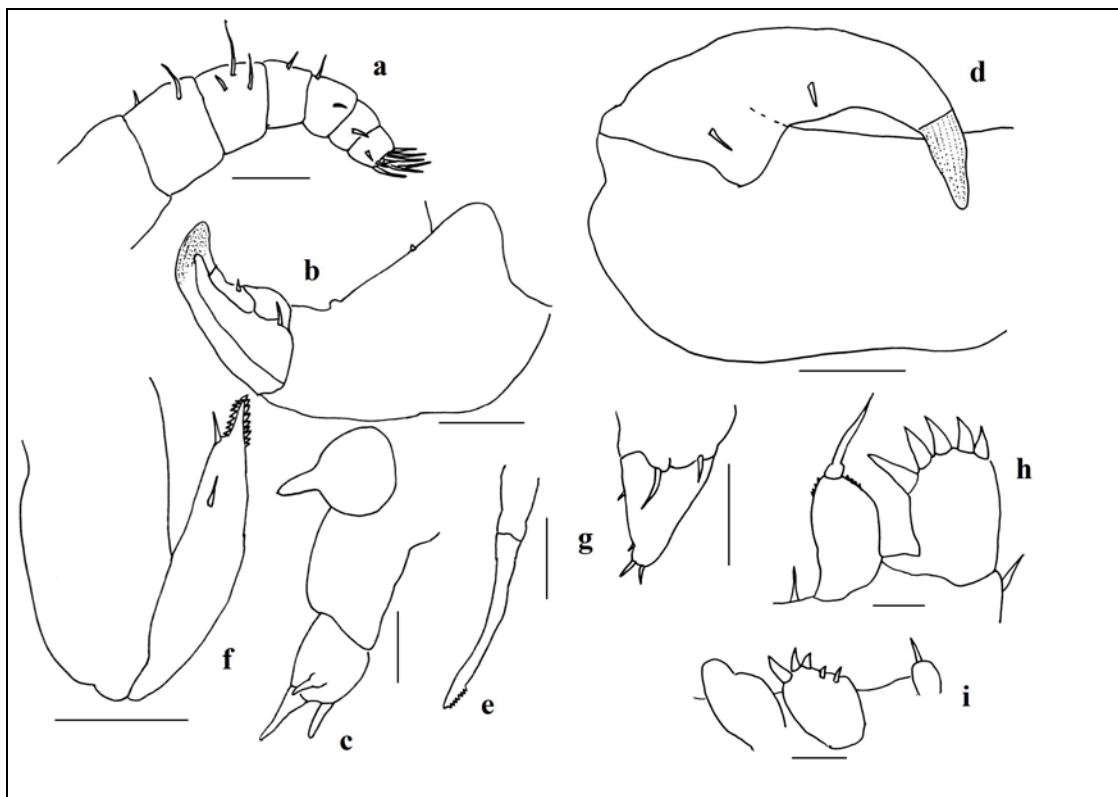


Figure 3: *Lernanthropinus trachuri*, (a) Antennule (0.03 mm), (b) Antenna (0.065 mm), (c) Maxillule (0.03 mm), (d) Maxilliped (0.05 mm), (e) Mandible (0.05 mm), (f) Maxilla (0.05 mm), (g) Uropod (0.05 mm), (h) First leg (0.015 mm), (i) Second leg (0.04 mm).

General body status, first and second legs, mouth parts such as antennules, antenna, maxilliped, maxillule, maxilla of *Lernanthropinus trachuri* described from specimens collected in this study were in agreement with previous descriptions of this species by (Brian 1906; Goggio, 1906; Nunes-Ruivo, 1954; Piasecki, 1982; Romero and Kuroki, 1985; Diebakate, 1994), except of seta number on segments of antennules.

CONCLUSIONS

Lernanthropinus trachuri (Brian, 1903) (Copepoda, Siphonostomatoida, Lernanthropidae) was reported from the Bosphorus, Sea of Marmara by Öktener and Trilles (2004). But the morphological characters of it could not be presented by the first author's limited laboratory possibilities and literature. Now, the same author found this parasite from the same host species. This study aims to present the morphological characters from Turkey and to compare other morphological characters from various countries in the future.

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REFERENCES

1. Akmirza A., 2003 – Arthropod parasite (*Lernanthropus brevis* Richiardi, 1879) found on the seabass (*Dicentrarchus labrax*), *The Turkish Journal of Parasitology*, 27, 3, 214-216.
2. Altunel F. N., 1983 – Parasitism on the mullets, I, Ulusal Deniz ve Tatlısu Araştırmaları Kongresi, *Ege University, Journal of Science Faculty*, B 1, 364-378. (in Turkish)
3. Bahri L., Hamida J. and Ben Hassine O. K., 2002 – Use of the parasitic copepod, *Lernanthropus kroyeri* (Van Beneden, 1851) (*Lernanthropidae*) as a bio-indicator of two fish populations, *Dicentrarchus labrax* (Linnaeus, 1758) and *Dicentrarchus punctatus* (Bloch, 1792) (Moronidae) in Tunisian inshore areas, *Crustaceana*, 75, 3-4, 253-267.
4. Benmansour B. and Kalthoum Ben Hassine O. K., 1998 – Preliminary analysis of parasitic copepod species richness among coastal fishes of Tunisia, *Italian Journal of Zoology*, 65, 341-344.
5. Bowker J., Roux J., Reed C., Lingen C., Hemmingsen W. and MacKenzie K., 2016 – Parasites of Cape (*Trachurus capensis*) and Cunene (*T. trecae*) horse mackerel in the Benguela ecosystem, 45TH Parasitological Society of Southern Africa (PARSA) Conference, 28th-30th August 2016, Cape Town, South Africa, 10.
6. Boxshall G. A. and Halsey S. H., 2004 – An introduction to copepod diversity, London, The Ray Society, 966.
7. Braicovich P. E., Luque J. L. and Timi J. T., 2012 – Geographical patterns of parasite infracommunities in the rough scad, *Trachurus lathami* Nichols, in the southwestern Atlantic Ocean, *Journal of Parasitology*, 98, 768-777.
8. Brian A., 1903 – Sui copepodi parassiti di pesci marini dell' Isola D'Elba, 4 nota, *Atti della Società Ligustica di Scienze Naturali e Geografiche*, 14, 77-84. (in Italian)
9. Brian A., 1906 – Copepodi parassiti dei Pesci d'Italia, Stab. Tipo-Litografico R. Istituto Sordomuti, Genova, 187. (in Italian)
10. Capart A., 1959 – Copépodes parasites, *Résult scient. Expedition Oceanographique Belge dans les Eaux Cotieres Africaines de l'Atlantique Stud* (1948-1949), 3, 55-126. (in French)
11. Costa G., MacKenzie K. and Oliva M.E. 2017 – A Review of the Parasites Infecting Fishes of the Genus *Trachurus* (Pisces: Carangidae), *Reviews in Fisheries Science and Aquaculture*, 25, 4, 297-315.
12. Delamare-Deboutteville C. and Nunes-Ruivo L., 1954 – Parasites de poissons de mer ouest africains récoltés par Cadenat M. J., II, Copépode (1er. note), Genres *Lemanthropus*, *Sagum*, *Paeon*, *Pennella*, *Bulletin Institute français d' Afrique noire*, XVI, 1, série A, 139-166. (in French)
13. Diebakate C., 1994 – Recherches sur la morphologie, la taxonomie et la bio-écologie des Hatschekiidae et des Lernanthropidae, copépodesparasites des poissons des côtes sénégalaises, PhD Thesis, Université Cheikh Anta Diop de Dakar, Senegal, 90. (in French)
14. Froese R. and Pauly D., 2017 – FishBase, World Wide Web electronic publication version (Cited 2017-07-30), available from: <http://www.fishbase.org>.
15. Gaevskaya A. V. and Kovaleva A. A. 1985 – Parazitofauna okeanicheskoy stavridy *Trachurus picturatus* i ekologo-geograficheskie osobennosti ee formirovaniya, *Ekologiya Morya*, 20, 80-84. (in Russian)
16. George-Nascimento M. and Arancibia H., 1992 – Stocks ecologicos del jurel (*Trachurus symmetricus murphyi* Nichols) en tres zonas de pesca frente a Chile, detectados mediante comparacion de su fauna parasitaria y morfometria, *Revista Chilena de Historia Natural*, 65, 453-470. (in Spanish)
17. George-Nascimento M. 2000 – Geographical variations in the jack mackerel *Trachurus symmetricus murphyi* populations in the southeastern Pacific Ocean as evidenced from the associated parasite communities, *Journal of Parasitology*, 86, 5, 929-932.
18. Goggio E., 1906 – Intorno al genere *Lernanthropus*, De Blainv. (Epaelithes, v. Nordm.) con descrizione di tre specie non descritte, *Atti Della Societa Toscana Di Scienze Naturali Residente in Pisa (Memorie)*, 22, 134-150.

19. Iannacone J., 2003 – Tres metazoos parásitos de la cojinoba *Seriola violacea* Guichenot (Pisces, Centrolophidae), Callao, Perú, *Revista Brasileira de Zoología*, 20, 257-260. (in Portuguese)
20. Jara C. A. and Díaz-Limay E. 1995 – Frecuencia e intensidad de infestación por copépodos en peces de la zona norte del mar peruano, *Revista Peruana de Parasitología*, 11, 1, 68-71. (in Spanish)
21. Kabata Z., 1979 – Parasitic Copepoda of the British Fishes, The Ray Society Publications, The Bristish Museum, London, 468.
22. Kabata Z., 2003 – Copepods parasitic on fishes, in Crothers J. H. and Hayward P. J. (eds), *Synopses of the British Fauna*, 47, 2nd revised edition, London, 261.
23. Koyuncu C. E., Romero R. C. and Karaytuğ S., 2012 – Lernanthropus indefinitus sp. (Copepoda, Siphonostomatoida, Lernanthropidae) parasitic on Argyrosomus regius (Asso, 1801), (Pisces, Sciaenidae), *Crustaceana*, 85, 12-13, 1409-1420.
24. Luz V. C. F. G. A., Cezar A. D. and Oliveira J. M., 2012 – Copepodes Parásitos de Trachurus lathami (Nichols, 1920) (Osteichthyes, Carangidae) Do Litoral Do Estado Do Rio De Janeiro, Brasil, *Revista Eletrônica Novo Enfoque*, 15, 51-53. (in Portuguese)
25. MacKenzie K., Campbell N., Mattucci S., Ramos P., Pinto A. L. and Abaunza P., 2008 – Parasites as biological tags for stock identification of Atlantic horse mackerel Trachurus trachurus L., *Fisheries Research*, 89, 136-145.
26. Manera M. and Dezfuli B. S., 2003 – Lernanthropus kroyeri infections in farmed sea bass *Dicentrarchus labrax*: pathological features, *Diseases of Aquatic Organisms*, 57, 177-180.
27. Nunes-Ruivo L. P. 1954 – Copépodes parasites de poissons. Résultats des Campagnes du Pr. Lacaze-Duthiers I, Algérie 1952 (Parasitic copepods from fishes. Results of the campaigns by the Pr. Lacaze-Duthiers. I. Algeria 1952), *Vie et Milieu*, 3, 115-138. (in French)
28. Oliva M. E., 1994 – Parasites of the Chilean jack mackerel *Trachurus symmetricus murphyi* (Pisces: Carangidae), *Memorias Instituto Oswaldo Cruz*, 89, 363-36.
29. Oliva M. E., 1999 – Metazoan parasites of the jack mackerel *Trachurus murphyi* (Teleostei, Carangidae) in a latitudinal gradient from South America (Chile and Peru), *Parasite*, 6, 223-230.
30. Öktener A. and Trilles J. P., 2004 – New Parasitic Copepod Species for the Parasite Fauna of Marine Fishes of Turkey, *Journal of the Black Sea/Mediterranean Environment*, 10, 71-80.
31. Öktener A., Koç H. T. and Erdogan Z., 2010 – Lernanthropus kroyeri on the cultured sea bass from the Black Sea of Turkey, *E-Journal of New World Sciences Academy, Ecological Life Sciences*, 5, 4, 332-333.
32. Özak A. A., Demirkale İ. and Yanar A., 2016 – Lernanthropid copepods parasitic on marine fishes in Turkish waters including two new records, *Zootaxa*, 4174, 1, 161-175.
33. Özel İ., Öktener A. and Aker V., 2004 – SEM Study of morphology of Lernanthropus kroyeri van Beneden, 1851 (Copepoda, Lernanthropidae) obtained from a Sea Bass farm in Bodrum, *Ege University, Journal of Fisheries and Aquatic Sciences*, 21, 3-4, 335-337.
34. Papoutsoglou S. E., 1976 – Metazoan parasites of fishes from Saronicos Gulf Athens – Greece, *Thalassographica*, 1, 69-102.
35. Piasecki W., 1982 – Parasitofauna of Cape horse mackerel, *Trachurus trachurus capensis* Castelnau, 1861, *Acta Ichthyologica Piscatoria*, 12, 1, 43-56.
36. Quiroz Gil L. K., 2014 – Estudio de la parasitofauna en el jurel (*Trachurus picturatus murphyi* Chirichigno y Vélez 1998), con énfasis en Zoonosis parasitaria, Universidad Nacional Agraria La Molina, Facultad De Pesquería, Msc Thesis, 81. (in Spanish)
37. Romero R. C. and Kuroki H. B. 1985 – Lernanthropus antofagastensis sp. nov. (copepoda: lernanthropidae) parasitic on *Anisotremus scapularis* in Chilean waters, and new records of *Lernanthropus trachuri* (Brian, 1903), *Journal of Natural History*, 19, 407-414.

38. Romero R. C. and Öktener A., 2010 – *Mitrapus oblongus* (Pillai, 1964) (Copepoda: Siphonostomatoida: Lernanthropidae) redescription from specimens collected on *Sardinella aurita* from Turkey, *Bulletin of the European Association Fish Pathologists*, 30, 4, 120-127.
39. Roux J. L., 2013 – Parasite assemblages of Cape horse mackerel (*Trachurus capensis* Castelnau, 1861) from the northern and southern Benguela, Msc Thesis, *University of Cape Town*, 78.
40. Timi J. T. and Etchegoin J. A., 1996 – A new species of *Lernanthropus* (Copepoda: Lernanthropidae) parasite of *Cynoscion striatus* (Pisces: Scianidae) from Argentinean waters, and new records of *Lernanthropus trachuri*, *Folia Parasitologica*, 43, 71-74.
41. Tokşen E., 1999 – Metazoan Gill Parasites of Culture Gilthead Sea Bream (*Sparus aurata* L.) and Sea Bass (*Dicentrarchus labrax* L.) in Aegean Sea Coast and Their Treatment, Ege University, Institute of Science, PhD Thesis, 153. (in Turkish)
42. Tokşen E., Boxshall G. A. and Altinozek S., 2012 – *Sagum posteli* Delamare-Deboutteville and Nunes-Ruivo, 1954 (Copepoda: Siphonostomatoida: Lernanthropidae) parasitic on *Epinephelus aeneus* (Geoffroy Saint-Hilaire) in Turkish waters, with a key to the species of *Sagum* Wilson, 1913, *Systematic parasitology*, 82, 71-80.
43. Venmathi Maran B. A., Moon S. Y., Adday T. K., Khamees N. R. and Myoung J., 2014 – Three new records of copepods (Siphonostomatoida) parasitic on marine fishes of Iraq, including the relegation of two species of *Lernanthropinus* to *Lernanthropinus temminckii* (von Nordmann, 1864), *Acta Parasitologica*, 59, 1, 139-152.
44. Walter T. C. and Boxshall G., 2018a – World of Copepods database, *Lernanthropus trachuri* Brian, 1903, accessed through World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=135891> on 2018-02-20.
45. Walter T. C. and Boxshall G., 2018b – World of Copepods database, *Lernanthropinus trachuri* (Brian, 1903) accessed through World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=359158> on 2018-02-20.
46. Walter T. C. and Boxshall G., 2018c – World of Copepods database, *Lernanthropus lichiae* Goggio, 1906, accessed through World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=353011> on 2018-02-20.