

**LIGHT AND SCANNING ELECTRON MICROSCOPIC STUDIES OF
ECHINORHYNCHUS GADI INFECTING THE EUROPEAN EEL
ANGUILLA ANGUILLA IN EGYPT**

By

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Abstract

Fish are important to man as a good source of protein in man's diet and as source of some zoonotic pathogens. This study investigated the helminthes infecting the European eel *Anguilla anguilla* that collected from Red Sea, Egypt. Only acanthocephala parasite was recovered from the intestine of infected fish with prevalence of 12.5%. The infection was analyzed according to the seasonal prevalence and showed the highest rate during winter rather than the lowest one during summer. Morphological and morphometric analyses for the parasite species revealed that it possess all the characteristic features of the genus *Echinorhynchus*, but closely related to *Echinorhynchus gadi* described by Müller (1776). Future molecular studies are recommended for this parasite in order to clarify the actual systematic position.

Keywords: Echinorhynchidae; *Echinorhynchus* sp.; Morphology

Introduction

Acanthocephala are a small group of permanent parasites of most vertebrates, including man; with over 1,150 species, belonging to 125 genera and 19 known families (Kennedy, 2006). The relationship between acanthocephala and their hosts were studied previously. Many authors mentioned that the thorn bearing proboscis get much deeper into the intestinal epithelium of fish causing laceration and complete obstruction leading to large mortalities in young fish. This made them easily exposed to secondary damage by other parasites degrading intestinal tissues (Grassi and Calandruccio, 1888; Crompton, 1975; Anderson and May, 1978; Boxrucker, 1979; Uznanski and Nickol, 1982; May, 1985; Glovan and Buron, 1988; Taraschewski, 1989; Moore and Gotelli, 1990; Helluy and Holmes, 1990; Maynard *et al.*, 1996; Dezfuli and Giari, 1999; Dezfuli, 2000; Eissa, 2002; Sparks *et al.*, 2004; Tain *et al.*, 2007).

Echinorhynchus gadi Müller (1776) is an acanthocephalan parasite infecting a wide range of teleost fish hosts in the North Atlantic

and North Pacific. It was reported from marine gadid fish, particularly Atlantic cod *Gadus morhua* L. It infects brackish and fresh water fish (Bauer, 1987). It is the commonest parasite of cod in the southern Baltic Sea (Moller, 1975; Pilecka-Rapacz and Sobocka, 2004). Bykhovskaya-Pavlovskaya *et al.* (1962) found that species of genus *Echinorhynchus* caused lesions, ulcerations, inflammation, tumors and connective tissue hypertrophy as the proboscis penetrates intestinal mucosa heavy infection caused high mortality rates.

The present study aimed to provide a full morphological description of the recovered *Echinorhynchus* parasite infecting the European eel *Anguilla Anguilla* using light and scanning electron microscopic techniques.

Materials and Methods

Eighteen specimens of the European eel *Anguilla Anguilla* (F: Anguillidae) were collected from coasts at the Gulf of Suez of the Red Sea. Fishes were immediately transported to the Parasitology Lab., Department of Zoology Cairo Faculty of Science. Macro- and microscopic examinations of fish were done to detect helminthic infection. Acanthocephalan pa-

parasites were isolated and relaxed by chilling overnight until particular or complete eversion of the proboscis. Hot formalin acid alcohol was used as fixative. Specimens were washed for several times in distilled water, ethanol dehydrated, stained with Gower's carmine stain, cleared with clove oil and mounted in Canada balsam.

For scanning electron microscopy, specimens were fixed in 3% buffered glutaraldehyde, post-fixed in osmium tetroxide (OsO₄) for 2h, dehydrated in ascending ethanol series, infiltrated with amylacetate, mounted on stubs, coated with gold, examined and photographed by high-resolution Etec Autoscan Jeol 6100 SEM at an accelerating voltage of 20 KV.

Normal shaped whole mount parasites were measured by using ocular micrometer calibrated against a stage micrometer slide. Measurements were in millimeter (mm) after Bush *et al.* (1997), minimum and maximum values were given as mean (\pm SD).

Results

Ten (12.5%) out of 18 specimens of the European eel *Anguilla anguilla* were found to be naturally infected with *Echinorhynchus gadi* Müller, 1776. Infection was in intestine. Infection rate increased during winter reached 40% (8/20) and fall to 10% (2/20) in summer.

Morphological description (Figs. 1-7, Tab. 1): Worms, milk-white color, trunk elongated, sub-cylindrical, somewhat swollen anteriorly, a spinose, and covered with transverse striated cuticle. Proboscis was cylindrical, stout, claviform, densely armed with rows of strongly re-curved hooks of various sizes; bigger on proboscis top but progressively smaller backwards. Worms have 18-20 longitudinal rows, with 6-10 hooks per row.

Male body measured 6-10(8 \pm 0.1) mm x 0.3-0.6(0.4 \pm 0.1) mm. Proboscis measured 0.23-0.28(0.25 \pm 0.1) mm x 0.16-0.20(0.18 \pm 0.1) mm. Proboscis followed by a short neck. Trunk measured 4.5-5.2(4.8 \pm 0.2) mm x 0.36-0.44(0.40 \pm 0.2) mm width. In middle of trunk, two elliptical testes arranged linearly, posterior to testes, cement glands and lemnisci present. Female body larger than male, measured 7-10(8 \pm 0.1) mm x 0.34-0.54(0.42 \pm 0.1) mm. Proboscis measured 0.25-0.29(0.27 \pm 0.1) mm x 0.17-0.23(0.20 \pm 0.1) mm. Proboscis' hooks similar to those of males. Trunk measured 4.9-6.2(5.4 \pm 0.1) mm x 0.39-0.49(0.43 \pm 0.1) mm. Proboscis receptacle double walled, twice as long as proboscis. Hooks, very sharp terminal with simple and round roots, each worm with a uterine bell. Uterine bell and uterus present in bulbous swelling at body posterior portion.

Table 1: Comparative measurements (in millimeters) of present *Echinorhynchus gadi* and previous ones.

Species	<i>Echinorhynchus salmonis</i> Baylis (1928)		<i>E. lageniformis</i> Ward (1951)		<i>E. gadi</i> Müller (1776)		<i>Echinorhynchus gadi</i> (Present study)	
	Male	Female	Male	Female	Male	Female	Male	Female
Host	<i>Anguilla anguilla</i>		<i>Anguilla anguilla</i>		<i>Mullus surmuletus</i>		<i>Anguilla anguilla</i>	
Body (L)	2.8-4.5 (3.6 \pm 0.52)	2.8-4.5 (3.6 \pm 0.52)	1.5-5.0	2.5-6.5	7-9	8-11	6-10 (8 \pm 0.1)	7-10 (8 \pm 0.1)
Body (W)	0.54-0.65 (0.58 \pm 0.04)	0.54-0.65 (0.58 \pm 0.04)	0.5-0.8	--	0.3-0.5	0.4-0.6	0.3-0.6 (0.4 \pm 0.1)	0.34-0.54 (0.42 \pm 0.1)
No. of rows	18		18		18-19	14-18	18-20	
No. of hooks	13-14	13-15	8-10		4	6-10	6-10	
Proboscis (L)	0.82		0.34-0.44		0.8	1.1	0.23-0.28 (0.25 \pm 0.1)	0.25-0.29 (0.27 \pm 0.1)
Proboscis (W)	--	--	0.22-0.46	0.18-0.24	0.2	0.4	0.16-0.20 (0.18 \pm 0.1)	0.17-0.23 (0.20 \pm 0.1)
Trunk (L)	--	--	--	--	3.4-3.9 (3.5 \pm 0.2)	--	4.5-5.2 (4.8 \pm 0.2)	4.9-6.2 (5.4 \pm 0.1)
Trunk (W)	--	--	--	--	0.38-0.41 (0.39 \pm 0.2)	--	0.36-0.44 (0.40 \pm 0.2)	0.39-0.49 (0.43 \pm 0.1)

Discussion

Echinorhynchus gadi Müller (1776) is the commonest acanthocephalan parasite infecting marine fish worldwide, and found in more

than 60 species (Arai, 1989 and Omar, 1987). In the present study, *Echinorhynchus gadi* was recorded in the intestine of the European eel *Anguilla anguilla*, similar records given

by Ekbaum (1938) who described that *Echinorhynchus lageniformis* infecting the starry flounders *Platichthys stellatus* and occasionally it was found along the intestine.

Chubb (1964) studied the ecology of *Echinorhynchus clavula* in four fish (the grayling *Thymallus thymallus*, pike *Esox Lucius*, roach *Rutilus rutilus*, and eel *Anguilla anguilla*) and found that the total infection rate was 46.0%, 11.5%, 16.1%, & 27.7%, respectively. These agreed with the present study, which recorded *Echinorhynchus gadi* infecting European eel with a percentage of 12.5%, and the infection increased during winter season to 40%. Also, these results agreed with Barnes (2019) who found that *E. lageniformis* infection rate rise in late winter and early spring in *Platichthys stellatus*.

In the present study, morphological features corresponded to genus *Echinorhynchus*. Characters of body, eggs, and hooks coincided with other authors (Müller, 1776; Yamaguti, 1963; David, 1986; Arai, 1989). Also, the neck showed two small pits, openings of solitary gland cell ducts and two sensory papillae, helping proboscis in the attachment and nourishment as well as a defensive role

Conclusion

This parasite must be considered as *Echinorhynchus gadi* a new Egyptian host record.

Acknowledgments

The authors would like to thank Faculty of Science, Cairo University, Cairo, for allowing all facilities to complete this work.

Conflict of interest: Authors neither have conflict of interest nor received fund

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Explanation of figures

Figs. 1-4: *Echinorhynchus gadi* infecting *Anguilla anguilla*. 1: Female with an anterior retractable proboscis (Pr) followed by neck region (N), trunk (T), and terminated at a uterine ball (U). High magnifications 2: Proboscis (Pr) provided with spines (SP) and followed by neck (N). 3: Spines (SP) of proboscis (Pr). 4: Female Posterior end showed uterine ball (U).

Figs. 5-7: SEM of *E. gadi* showed high magnifications 5: Anterior end with a retractable proboscis (Pr) with spines (SP) followed by neck region (N). 6: Spines (SP) of proboscis (Pr). 7: A uterine ball (UB).



