

**OCCURRENCE OF ANGUILLICOLA CRASSUS (NEMATODA:
DRACUNCULOIDEA) IN EELS OF LAKE OHRID, MACEDONIA**

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(Received 15. January 2002)

*The first record of the eel parasite *Anguillicola crassus* Kuwahara, (Niimi et Itagaki, 1974) from Lake Ohrid and the Republic of Macedonia is reported here. Parasitological examinations comprised 68 specimens of the eel *Anguilla anguilla* Linnaeus, 1758 of which 39.71% were infected with *Anguillicola crassus*. The prevalence varied depending on the season, with the highest value occurring during the autumn (47.06%). Average intensity of infection was 10.33. *Anguillicola crassus* was probably introduced into the lake by the artificial stocking with eel young, imported from abroad. It has found convenient conditions for development and multiplication in the lake due to the presence of transitional and paratenic hosts.*

*Key words: *Anguilla anguilla*, *Anguillicola crassus*, Lake Ohrid, Macedonia, prevalence, intensity of infection*

INTRODUCTION

In the last few years, in the world, great attention has been paid to "Anguillicolosis", a disease provoked by the nematode *Anguillicola crassus* Kuwahara, (Niimi and Itagaki, 1974). Its original host was the Japanese eel (*Anguilla japonica*), in which the infection does not cause major lesions (Egusa, 1979). In Japan, the parasite is widely distributed in open waters and eel farms, from where it spread to East Asia, New Zealand and Australia. *Anguillicola crassus* was introduced into Europe at the beginning of the 1980s, with the import of infected eels from East and Southeast Asia. It spread rapidly in many European countries from west to east, in open waters and farms for intensive eel breeding (Szekely, 1994).

Anguillicola crassus was detected for the first time in Europe 10-15 years ago, but today it is very widely distributed thanks to the easy survival of free living larvae, the wide specificity of its intermediate and paratenic hosts, high fecundity and use of the widespread and versatile eel as a definitive host (Kennedy, 1993). A positive correlation exists between the transfer of larvae to the eels and the temperature of the water (Höglund and Thomas, 1992). The density of the fish population is also a very important factor for the spread of infection with

Anguillicola crassus (Höglund, 1993). Survival of the adult parasites and their eggs is not disturbed during fish acclimatisation in salt waters (Petter, 1993). There is a possibility of transferring *Anguillicola crassus* from one region to another one by transporting the little eels in lorries (Boëtius, 1993).

The goal of our study was to seek for the first time the mentioned *Anguillicola crassus* in the ichthyoparasitofauna of Lake Ohrid, Republic of Macedonia, and to determine its prevalence and the intensity of infection between different seasons.

MATERIALS AND METHODS

Materials - The fish material was sampled at the exit of the river Crn Drim from Lake Ohrid. Fishing was performed in different seasons, in the period from April, 1995 to March, 1996. During that time, 68 specimens of eel were caught.

Characteristics of Lake Ohrid - Lake Ohrid is situated in the Ohrid valley and occupies the farthest south-west part of the Republic of Macedonia, while one smaller part belongs to the Republic of Albania. It is placed at 693 m above sea level and is one of the biggest European lakes with a surface area of 358.2 km² and maximum depth of 288.7 m. The lake has one outlet, the River Crn Drim (22.24 m³/sec) which flows into the Adriatic. This outlet is man controlled, and the lake water can be released to a maximum level of 54 cm.

Downstream on the same river two dams for electricity power stations have been constructed. The dams impede the eels from leaving this lake for the sea, where they spawn naturally. Therefore, artificial stocking is performed with young of this species, imported from abroad (Stanković, 1959). This lake is probably a unique one in the world, because its water is mainly supplied from numerous surface and sublacustrine springs, mostly located on the east and the south part of the lake. It belongs to the category of oligotrophic lakes (Cvijić, 1911). The lake is more than 2 million years old, and it is the oldest lake in Europe. Geographic isolation of the West Balkan area, especially Lake Ohrid from other parts of the Balkan Peninsula and its great age, were the basic reasons that the greatest number of tertiary fauna of the Mediterranean area are maintained in this region. Undoubtedly, both the trout species *Salmo letnica* Karaman, 1924 and *Acantholingua ochridana* Hadjisce, 1961 as well as *Pachychilon pictus* Heckel et Kner, 1858 are relicts, which stand alone among the European freshwater fauna. The lake is inhabited with 17 autochthonous species, and one of them is the eel *Anguilla anguilla* Linnaeus, 1758 (Stanković, 1959).

Methods - The total length and weight of the eels were recorded prior to dissection in the laboratory. After opening the body cavity, fresh squash preparations were prepared from the swimbladder and surrounding mesenteric tissues in order to establish the presence of *Anguillicola crassus* (Blanc et al., 1990; Køie, 1988).

The eels were subjected on routine methods of section and observation and separated parasites were fixed in glycerine-alcohol. The parasites were then cleared in lactophenol and mounted in glycerol jelly.

Prevalence and mean intensity were calculated to provide an index of the degree of dispersion of *Anguillicola crassus* during different seasons.

RESULTS

We found *Anguillicola crassus* during the whole year in the swimbladder of *Anguilla anguilla* (Figure 1). We examined 68 specimens of eel among which 39.71% were infected with parasites.

Prevalence varied depending on the season with the highest value during the autumn and the lowest during winter (Figure 2).

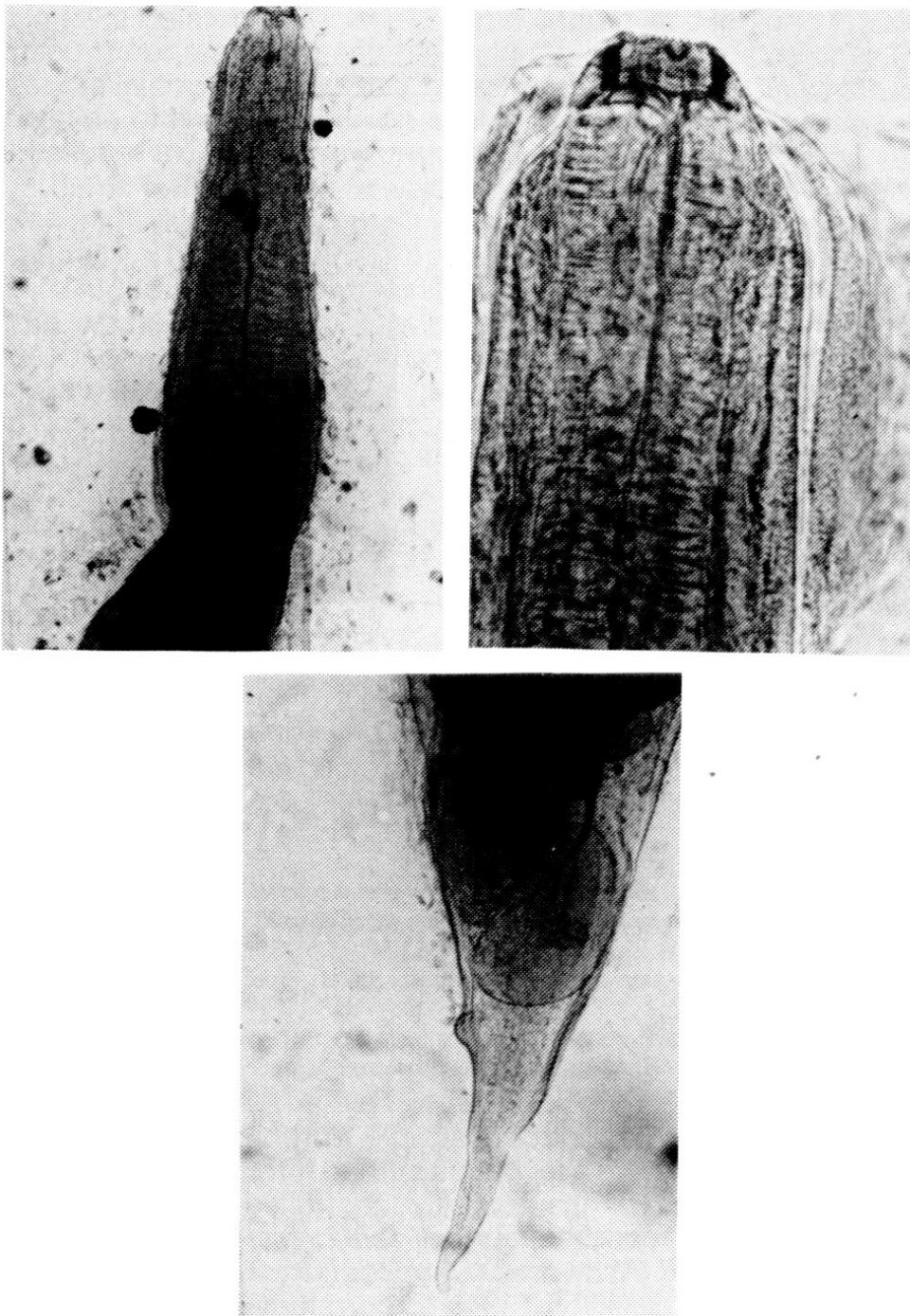


Figure 1. *Anguillicola crassus* Kuwahara, (Niimi et Itagaki, 1974) from the eel (*Anguilla anguilla*) swimbladder. A. Anterior end; B. Buccal capsule; C. Posterior part of the male.

The intensity of infection by *Anguillicola crassus* varied between 1-90. Predominantly eels carried 1-10 parasites (7.41% with one, 11.11% with two, 7.41% with three, 25.93% with five and 33.33% with ten). Only 3 fishes were infected by twenty parasites and one fish had 90 parasites.

Average intensity of infection was 10.33. It varied between the seasons with the highest value during the autumn, the lowest during the summer and similar during the spring and winter (Figure 2).

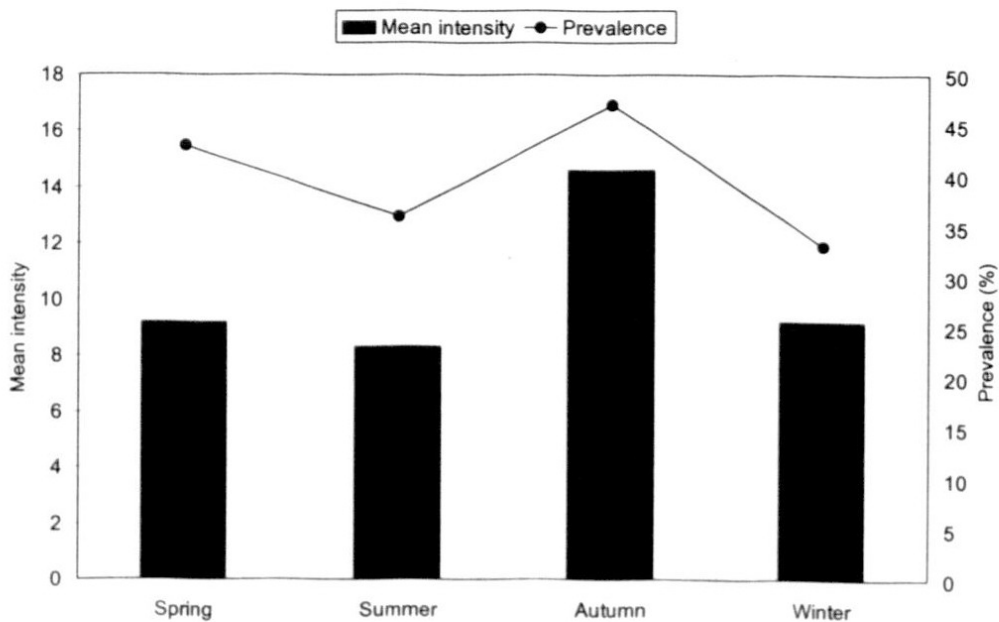


Figure 2. Seasonal variation in prevalence and mean intensity of *Anguillicola crassus* infection from the Lake Ohrid.

DISCUSSION

Anguillicola crassus was introduced into Europe at the end of the 1980s (Molnar et al., 1994) and during a few years spread through most of Europe (Køie, 1988) probably as result of insufficiently controlled live fish transportation (Szekely, 1994). The first records of *Anguillicola crassus* in the United Kingdom and Denmark were in 1987 (Ashworth, 1993; Boëtius, 1993) and in Hungary three years later (Pazooki and Szekely, 1994). In our study *Anguillicola crassus* was detected for the first time in the ichthyological parasitofauna of Lake Ohrid, Republic of Macedonia.

The biggest gaps in our ecological knowledge relate to the impact of *Anguillicola crassus* on natural eel populations (Kennedy, 1993). Lake Balaton appears exceptional with an extremely high rate of infection among the overpopulated eel stock which resulted in massive mortality (Molnar and Baska, 1993). In our study 39.71% of the eels from Lake Ohrid were infected but mortality due to infection with *Anguillicola crassus* was not recorded.

The highest prevalence in our study was during the autumn (47.06%) which is in accordance with the finding of Molnar and Szekely (1993) that the highest infection in Lake Balaton was in the autumn. Moreover, Höglund (1993) reported an increased proportion of infected eels in the late autumn catches in Sweden. The lowest prevalence in Lake Ohrid was in the winter (33.3%) which is similar to the observation of a relatively low prevalence of *Anguillicola crassus* in *Anguilla japonica* cultured in Japan and Korea in the winter (Egusa, 1979).

Two dams for electricity power stations are constructed on the River Crn Drim, which impeded the eels in their journey from this lake to the sea, where they spawn naturally. Therefore, artificial stocking is performed using young of this species, imported from abroad since the middle of the 1960s. In this way, *Anguillicola crassus* was probably introduced into the lake. Finding suitable conditions for development and reproduction in the lake such as the presence of transitional hosts (Copepod from genera *Cyclops*, *Eucyclops*, *Macrocyclops*, *Megacyclops*, *Asselus* etc., and Ostracoda), as well as paratenic hosts (insects of the families *Chironomidae* or fishes: *Alburnus alburnus*, *Carassius auratus gibelio*, *Cyprinus carpio*, *Gobio gobio*, *Pseudorasbora parva*, *Rhodeus sericeus*, *Rutilus rutilus*, *Scardinius erythrophthalmus* etc), this parasite species is widely distributed among the eels in the Lake Ohrid.

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POJAVA ANGUILLICOLA CRASSUS (NEMATODA: DRACUNCULOIDEA) KOD JEGULJE IZ OHRIDSKOG JEZERA, MAKEDONIJA

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SADRŽAJ

U periodu od aprila 1995. do marta 1996. godine, na makedonskom delu Ohridskog jezera, parazitološkom pretragom obuhvaćeno je 68 primeraka jegulja (*Anguilla anguilla* Linnaeus, 1758), od kojih je 27 bilo inficirano nematodom *Anguillicola crassus* (ekstenzitet infekcije je iznosio 39,71%). Ekstenzitet infekcije je varirao u zavisnosti od sezone. Najveći je bio u toku jeseni. Intenzitet infekcije je iznosio između 1-90, a prosečan intenzitet infekcije je iznosio 10,33.

Anguillicola crassus je najverovatnije uneta u jezero veštačkim poribljavanjem podmlatkom jegulja, uvezenim iz inostranstva. U jezeru je ovaj parazit našao povoljne uslove za razvoj i razmnožavanje – prisustvo prelaznih i parateničnih domaćina.

Anguillicola crassus je po prvi put spomenuta u ihtioparazitofauni Ohridskog jezera i Makedonije.