

EXTENDED ABSTRACT
VI IBERIAN CONGRESS OF ICHTHYOLOGY



SIBIC2016

VI CONGRESO IBÉRICO
DE ICTIOLOGÍA / MURCIA
21 - 24 JUNIO

The influence of parasites on the population status of the European eel, *Anguilla anguilla* L.

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Citation: Saraiva A, Pereira A (2016) The influence of parasites on the population status of the European eel, *Anguilla anguilla* L. FiSHMED Fishes in Mediterranean Environments 2016.003: 4p

There has been a significant decline in *Anguilla anguilla* throughout its distribution range in the last decades (Haenen et al., 2012). The causes of this decline are yet unclear but are thought to involve multiple environmental and anthropogenic factors. Eel parasites, mainly invasive ones, namely *Anguillicoloides crassus* and *Pseudodactylogyrus* spp., are suspected to play an important role in the eel decline (ICES, 2014).

In our Laboratory several surveys were conducted in eels collected in northern Portuguese rivers (Lima, Cávado, Ave, Douro and Vouga) since the 1980s. A total of 1097 eels were collected by electrofishing or acquired from fishermen and examined for the presence of parasites. A total of 28 parasite species were detected from which 15 are specific to eel host. The detected species are the following:

PROTISTA (Saraiva and Chubb, 1989; Saraiva and Eiras, 1996; Cruz and Eiras, 1997; Cruz and Davies, 1998)

Ichthyophthirius multifiliis Fouquet, 1876

Trichodina jadranica Raabe, 1958

Trypanosoma granulorum Laveran & Mesnil

Babesiosoma bettencourti (França, 1908);

MYXOZOA (Saraiva and Chubb, 1989; Saraiva and Molnár, 1990; Saraiva and Eiras, 1996; Hermida et al., 2008)

Myxidium giardi Cépède, 1906

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Myxobolus portucalensis Saraiva & Molnár, 1990

Hoferellus gilsoni (Debaisieux, 1925)

Zschokkella stettinensis Wierzbicka, 1987;

MONOGENEA (Saraiva and Chubb, 1989; Saraiva, 1995; Rodrigues and Saraiva, 1996; Saraiva and Eiras, 1996; Hermida et al., 2008)

Pseudodactylogyrus anguillae (Yin & Sproston, 1948)

Pseudodactylogyrus bini (Kikuchi, 1929)

DIGENEA (Hermida et al., 2008)

Lecithochirium rufoviride (Rudolphi, 1819)

Helicometra fasciata (Rudolphi, 1819)

Podocotyle Dujardin, 1845

Deropristis inflata (Molin, 1859)

CESTODA (Saraiva and Eiras, 1996; Saraiva et al., 2005; Hermida et al., 2008)

Bothriocephalus claviceps (Goeze, 1782)

Proteocephalus Weinland, 1858;

NEMATODA (Saraiva and Chubb, 1989; Saraiva and Eiras, 1996; Cardoso and Saraiva, 1998; Saraiva and Moravec, 1998; Saraiva et al., 2002; Saraiva et al., 2005; Hermida et al., 2008)

Anisakis simplex (Rudolphi, 1809)

Contracaecum Railliet & Henry, 1912

Cucullanus truttae Fabricius, 1794

Paraquimperia tenerrima (Linstow, 1878)

Pseudocapillaria tomentosa (Dujardin, 1843)

Rhabdochona anguillae Spaul, 1927

Spinitectus inermis (Zeder, 1800)

Anguillicoloides crassus (Kuwahara, Niimi & Itagaki, 1974);

ACANTHOCEPHALA (Saraiva and Eiras, 1996; Saraiva et al., 2005; Hermida et al., 2008)

Acanthocephalus clavula Dujardin, 1845

Pomphorhynchus laevis (Zoega in Müller, 1776);

CRUSTACEA (Saraiva and Chubb, 1989; Saraiva and Eiras, 1996; Hermida et al., 2008)

Ergasilus gibbus Nordmann, 1832

Gnathiidae Leach, 1814.

Some of these parasites can cause several problems on the European eel. From all detected parasites the nematode *A. crassus* (Fig.1A), parasite of the swimbladder, was presumably the most deleterious. It causes swimbladder wall thickening and strong histological changes (hemorrhage, inflammation, necrosis and exudates) causing functional impairment and probably influencing the ability of eels to migrate to their spawning grounds in the Sargasso Sea (Cardoso and Saraiva, 1998). Mass mortalities of eel in Lake Balaton, Hungary were attributed to this parasite (Molnár et al., 1991). Additionally, the monogeneans *Pseudodactylogyrus anguillae* (Fig.1B) and *P. bini* can cause respiratory impairment (hyperplasia, secondary lamella fusion and sometimes hyperaemia) especially when other gill parasites and/or polluted waters are present with potential to compromise eel health and fitness (Saraiva, 1995).

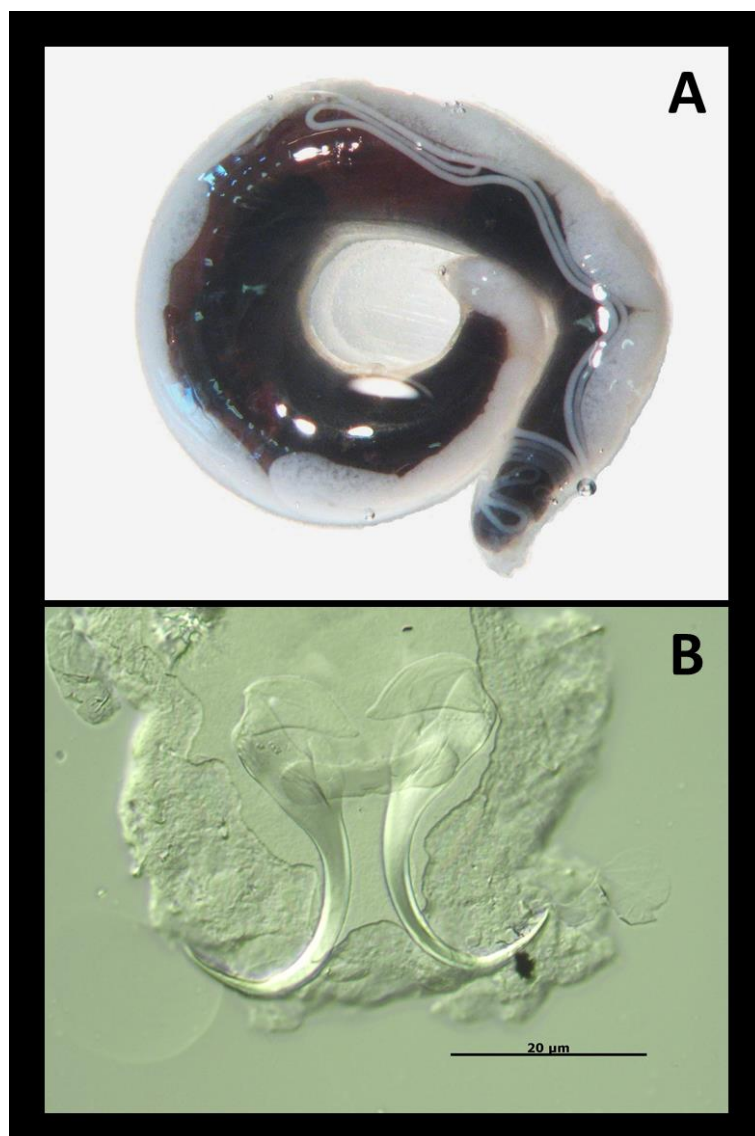


FIGURE 1. A: Female of *Anguillicolloides crassus* removed from an eel swimbladder. B: Attaching organ of *Pseudodactylogyrus anguillae*. Photographs by A. Saraiva.

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