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EFFECT OF DECREASED OXYGEN CONTENT ON EELS *(Anguilla anguilla)* INFECTED BY *Anguillicola crassus* (NEMATODA: DRACUNCULOIDEA)

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The survival chances of eels with *Anguillicola crassus* infection of varying intensity and with varying pathological changes were studied in an experimental system devoid of fresh oxygen supply. Eels most severely affected by anguillicolosis died first, while those with less expressed pathological lesions tolerated sublethal oxygen levels for a longer time. Findings were similar at 20–21 °C and at 27–28 °C; at 27–28 °C, however, the fish required a higher oxygen content to survive. The experiments demonstrate that *Anguillicola* infections substantially impair the eels' natural resistance and, under unfavourable environmental conditions, may lead to their death.

Key words: Eel, *Anguillicola crassus*, oxygen deprivation, pathogenicity

Since in the late 1980's the nematode *Anguillicola crassus* Kuwahara, Niemi et Itagaki, 1974 was introduced to Europe, dozens of papers have discussed its rapid spread, development and prevalence. However, relatively few researchers have dealt with the parasite's effect on the fish organism and with its pathogenicity. Of the latter, Boon et al. (1989, 1990*a*, 1990*b*) and Höglund et al. (1992) studied the effect exerted by the parasite on the eel's blood composition, while Sprengel and Lüchtenberg (1991) reported that parasite-infected eels were characterized by a reduced swimming speed. The observation of Thomas and Ollevier (1992), i.e. that more severely infected eel specimens are more easily sucked in by the water-pipes of power stations than those with a less intensive infection, also belongs to this category. Only a single work (Molnár et al., 1993) furnishes detailed information about the histopathology of *Anguillicola* infection, but data on the helminths' pathogenic effect exerted on the swimbladder and on occasional mortalities can be found also in the works of Egusa (1979), Hartmann (1987), Liewes and Schaminee-Main (1987), Mellergaard (1988), Boon et al. (1989), van Willigen and Decker (1989),

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Haenen et al. (1989), Banning and Haenen (1990) and Kamstra (1990). Similar data concern infections of eels with *A. globiceps* (Yamaguti, 1935) and with *A. novaezelandiae* (Sarti et al., 1985). To date, only one paper (Molnár et al., 1991) has been published on mass mortality caused by *A. crassus*.

In the summer of 1991, a mass and selective mortality occurred among eels of Lake Balaton in Hungary. This mortality recurred, though in a less severe form, in 1992. About 200 tons of eel died in 1991 and 40 tons in 1992. Our research team attributed this mortality to the extremely severe *Anguillicola* infection and the resulting swimbladder damage. As this opinion was received sceptically by Hungarian specialists unfamiliar with fish pathology, we conducted experiments to determine the influence exerted by adverse environmental conditions on the survival rate of eels whose physiological capacity and natural resistance had been impaired by *Anguillicola* infection. As a first step, the survival chances of eels affected with *Anguillicola* infection of varying intensity were studied in an environment of low oxygen content.

Materials and methods

Eels (*Anguilla anguilla* L.) derived from Lake Balaton and naturally infected by *A. crassus* were used in the experiments. The eels were 17–72 cm long and had been kept in the laboratory for a few days before the experiment. Each treatment group comprised 10 fish. The fish used in the individual experiments had always been derived from the same place and, as far as possible, they were of nearly the same size. The experimental fish specimens were placed in 10-litre aquaria filled with water to repletion and covered with a glass plate to prevent fresh oxygen supply. During the experiments, water temperature and oxygen content were recorded quarter-hourly. Water temperature was measured with a common internal water thermometer. Oxygen content of the water was measured with "Aquacheck", an instrument developed by the Radelkis Co-operative (Budapest) and routinely used in the Hungarian farm-pond practice for measuring water pH and oxygen level. The instrument measures the percentage of oxygen dissolved in water. From that value, the concentration of dissolved oxygen (in mg/litre) can be calculated with the help of a table if water temperature is known. Two temperature ranges were used. In ex-