Investigation on Predator/Prey Body Weight and Length Proportions in Pike *Esox lucius* L.

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**Abstract**


The object of the present study was to investigate pike *Esox lucius* L. cannibalism and specially the ratio of body weight and length between predator and prey. The investigation was carried out with 81 pike fingerlings with an average body weight of 2.24±0.56 g and a total body length of 7.14±0.54 cm. The same prey body parameters were as follows: 0.56±0.13 g and 4.18±0.51 cm. The obtained results indicated that the prey took 13.64 to 43.64% from the predator’s body weight and 42.35 to 73.44% from its total body length. The minimal body weight and body length of pike, in which cannibalism was established were 1.46 g and 6.1 cm respectively. The co-storage of pikes with different body size creates conditions for cannibalistic behavior, which can cause considerable losses.

**Key words**: pike, cannibalism, predator, prey, body length, body weight

**Introduction**

Cannibalism is an usual phenomenon among predatory fish like pike (Craig and Kipling, 1983; Smith and Rea, 1991; Bry et al., 1992; Grimm and Klinge, 1996; Nilson and Bronmark, 1999). A number of authors point out that the pike does not show selectivity when choosing its preys (Raat, 1988; Adams, 1991; Hiskley et al., 1994; Lorenzoni et al., 2002), among which there are also individuals from the same species, especially when the populations are with higher density. Other authors (Wahl and Stain, 1988; Nilson et al., 1995; Nilson and Bronmark, 1999, 2000) point out that pike prefers eating species with smaller body height; moreover among the individuals of a certain species it prefers those with smaller dimensions. Pike demonstrates also affinity towards species with spindle-like body shape; it means a characteristic feature that is typical of the predator itself (Margenau et al., 1998).
It was established that cannibalism is one of the major limitation factors in pike’s rearing, especially during the first year (Bry, 1983). Some authors (Bry and Gillet, 1980; Bry and Gillet, 1980) indicate losses amounting to 80%, caused by the acts of cannibalism, while other (Wright and Giles, 1987) establish that about 30% of the preys of one-summer-old pike reared in small ponds are smaller individuals from the same species. In this respect the issue on the proportion between predator/prey body weight and body length is of great interest, it means the proportions at which pike is able to swallow individuals from the same species. The lack of investigations in this aspect provides additional grounds to carry out the current research.

The object of the present study was to investigate pike *Esox lucius* L. cannibalism and specially the ratio of body weight and length between predator and prey.

**Material and Methods**

The investigation was carried out with 60-day-old pike fingerlings caught from a spawning pond. 12 000 pike (6000 ind. m⁻³) were stored in a tank with a volume of 2 m³ in the course of 24 h at a constant water flow and aeration. During the period in which pike were stored in the tank the water temperature and the quantity of the oxygen dissolved in it were measured two times (at 8 a.m. and at 4 p.m.). 81 individuals from the storage tank were caught at random and a presence of swallowed fish was visually ascertained; after that the species were dissected. The body weight (BW, g) and total length (TL, cm) both for the predator and the prey were individually measured.

**Results**

The water temperature and the oxygen dissolved in it for the period of investigation were 16.2°C and 5.4 mg.l⁻¹ respectively.

The average body weight of the examined predators was 2.24±0.56 g, the former varying from 1.46 to 4.36 g (Cv, 24.84%). As far as the average body length is concerned, the registered value was 7.14±0.54 cm and the ranges of variation were from 6.1 to 9.1 cm (Cv, 7.5%) (Table 1).

Preys had considerably smaller average body weight compared to that of predators - 0.56±0.13 g, the variation being from 0.32 to 0.89 g (Cv, 22.77%). The average body length is also smaller - 4.18±0.51 cm and is within the limits from 3.4 to 5.2 cm (Cv, 12.17%) (Table 1).

In terms of percentage on the average preys account for 26% (13.64 – 43.64%) of the weight of predators and 58.7% (42.35 – 73.44) of their length, some of the preys reaching 43.64% of the body weight and 73.44% of the body length of the predator that has swallowed them (Table 2). These values outline the limits in which pike was able to consume smaller individuals and its great capabilities in this respect.

The ratio between the absolute average values of the body weight and the length of the predator and those of their preys were shown in Figure 1. The ratio between the body length of the predators and their preys was 1.7:1, and those between their body weights 4:1.

In the stomach of 80 predators, only one prey was found, while in one fish the preys were two. The weight and length of
Table 1

Body weight (g) and total length (cm) of predators and preys

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Predator, n=81</th>
<th>Prey, n=82</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body weight, g</td>
<td>Total length, cm</td>
</tr>
<tr>
<td>(\bar{x}) + SD</td>
<td>2.24 ± 0.56</td>
<td>7.14 ± 0.54</td>
</tr>
<tr>
<td>CV, %</td>
<td>24.84</td>
<td>7.51</td>
</tr>
<tr>
<td>lim</td>
<td>1.46 - 4.36</td>
<td>6.1 - 9.1</td>
</tr>
</tbody>
</table>

Table 2

Relative proportions (in %) between predator/prey body weight and total length in pike *Esox lucius* L.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Relative predator/prey proportions in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>by the body weight</td>
</tr>
<tr>
<td>(\bar{x}) + SD</td>
<td>26.07 ± 7.04</td>
</tr>
<tr>
<td>CV, %</td>
<td>27.02</td>
</tr>
<tr>
<td>lim</td>
<td>13.64 - 43.64</td>
</tr>
</tbody>
</table>

Fig. 1. Body weight (g) and length (cm) proportions between predator and prey

Those pike were respectively 3.1 g and 7.9 cm, while the swallowed preys were with body weight of 0.67 g and 0.36 g and length of 4.6 cm and 3.2 cm.

**Discussion**

There exist different data on the dimensions at which pike turns to a predatory way of feeding, incl. first acts of cannibalism. In the current investigation the minimal length and weight of the predator at which we establish cannibalism were respectively 6.1 cm and 1.46 g. This data is in keeping with the data reported by other authors (Mittelbach and Persson, 1998), who point out that pike turns to feeding with fish when its length is 4.5 - 10 cm, cannibalism extending with the decreasing of the alternative food (other fish species) (Grimm, 1981; Craig and Kipling, 1983).

The registered water temperature in the tank and the oxygen values were within
the limits of the optimal ones, creating conditions for the active feeding of pike and massive acts of cannibalism. On the other hand preys were easily accessible because of the lack of places they could swim away to and hide in. The large number of the preys and the great variety in terms of their dimensions provided also possibility for the larger pikes to have choice when hunting.

The current investigation supports the statement that the storage of pike at a great density is related to acts of cannibalism, as a result of which losses could be considerable.

Conclusions

In acts of cannibalism of 60-day-old pike fingerlings (Esox lucius L.) preys account for 13.64 to 43.64% of the body weight of the predator and from 42.35 to 73.44% of its total length.

The minimal pike’s body weight and total length at which cannibalism is established are respectively 1.46 g and 6.1 cm.

The storage of pike with different dimensions creates conditions for acts of cannibalism, which could bring about considerable losses.

References


