Messages of invasive *Perccottus glenii* individuals eaten by an *Esox lucius* from the Danube Delta

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**Abstract**
In the stomach of a pike from the Danube Delta we have found seven *Perccottus glenii* individuals. Their message indicated that in the Danube Delta *P. glenii* has already large population. Also, it proves that in its habitats, the pike can consume numerous individuals of this invasive species. Their gut contents prove that *P. glenii* hunted near the shores, ingesting numerous terrestrial preys.

**Keywords:** Feeding habits; habitat; predator; invasive species; *Perccottus glenii*; *Esox lucius*

**INTRODUCTION**
The pike, *Esox lucius* is a predator with a pronounced opportunism and feeding plasticity (e.g. Pedreschi et al. 2015), whose trophic spectrum is well known (e.g. Lawler 1965; Diana 1979; Chapman et al. 1989; Kangur and Kangur 1998; Sandlund et al. 2016). It can reduce the populations of other fish species in the areas it was introduced in (Hesthagen et al. 2015). In the same time, the pike can affect negatively invasive species like *Pseudorasbora parva*, reducing their abundance and biomass, without affecting the native species (Lemmens et al. 2015). This fact is important because numerous invasive species are present and spreading in Europe (see: Copp et al. 2005). One of those invasive species, *Perccottus glenii*, invaded many European freshwaters in the last years (e.g. Reshetnikov 2013; Reshetnikov and Karyagina 2015). In Romania this species was recorded for the first time in the year 2001 in Suceava River (Nalbant et al. 2004). After that, the species was identified in other rivers from the county: Siret (Luca et al. 2014), Prut (Bulat et al. 2016), Danube (Popa et al. 2006) including the Danube Delta (Năstase 2007, 2012) and some smaller rivers from western Romania (Copilaș-Ciocianu and Părvulescu 2011; Covaci-Marcov et al. 2011). The present note aimed to add new information upon this species in Romania. It is the result of the incidental discovery of some *P. glenii* individuals in the stomach of a pike, confirming that in some cases the pike can also intervene in the control of this invasive species.

**METHODOLOGY**
A pike of approximately 40 cm length, fished from the Danube Delta (eastern Romania) was brought in September 2015 to a market from Oradea (western Romania) for commercial purposes. We did not know the exact origin of the pike, the fish being captured in different zones of the Delta and sent for commercialization from Sulina (the easternmost locality of the Danube Delta). We incidentally encountered in its stomach numerous fishes in different stages of digestion. The fishes found in the pike’s stomach (including some Amur sleepers) were conserved in alcohol and...
transported to the laboratory. The individuals were measured (total length and standard length), and their sex and age was established. We established the age of the fishes by analyzing the growth rings present on the scales. Because the majority of *P. glenii* individuals were generally in good condition, we also studied their gut contents. For this purpose we have dissected the individual and remove their gut. The prey eaten by the Amur sleepers were identified at a stereomicroscope. The same methods were recently used in the case of other invasive fish species in Romania (Sas-Kovács et al. 2015).

RESULTS AND DISCUSSION

In the stomach of the pike we have found seven *P. glenii* individuals beside of a *Rutilus rutilus*, a *Carassius* sp. and another strongly digested cyprinid fish. The Amur sleepers have been digested in different stages (Figure 1), they being ingested by different occasions. Their total length varied between 69 and 97 mm, five of them being females (Table 1). The seven *P. glenii* individuals consumed 18 preys (Table 1). The preys were generally aquatic, but six of them were terrestrial animals that prefer humid places (earthworms, terrestrial isopods, and a *Lissotriton vulgaris* newt). The newt was highly digested, only its posterior part being recognizable. Thus, we cannot tell if it was a juvenile or a big larva before metamorphosis. The two terrestrial isopods belong to *Trachelipus* genus, a well represented genus in Romania, with some common species (Tomescu et al. 2015).

Table 1: The total and standard length, age, sex and gut content of the *P. glenii* individuals from the pike’s stomach

<table>
<thead>
<tr>
<th>No.</th>
<th>Total length (mm)</th>
<th>Standard length (mm)</th>
<th>Age</th>
<th>Sex</th>
<th>Gut content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>97</td>
<td>81</td>
<td>4+</td>
<td>♀</td>
<td>Lumbricidae – 1 Planorbis sp. - 2 Lamellibranchiata - 1</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>76</td>
<td>3+</td>
<td>♀</td>
<td>Detritus with shell fragments</td>
</tr>
<tr>
<td>3</td>
<td>76</td>
<td>62</td>
<td>2+</td>
<td>?</td>
<td><em>Lissotriton vulgaris</em> – 1 Chironomida – 1 larva Lumbricidae - 1</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>63</td>
<td>2+</td>
<td>♀</td>
<td>Odonata – 2 larvae Planorbis sp. - 1</td>
</tr>
<tr>
<td>5</td>
<td>75</td>
<td>64</td>
<td>2+</td>
<td>♀</td>
<td>Isopoda, <em>Trachelipus</em> sp. - 2 Lumbricidae - 1</td>
</tr>
<tr>
<td>6</td>
<td>69</td>
<td>56</td>
<td>2+</td>
<td>♀</td>
<td>Odonata – 1 larva Trichoptera, <em>Polycentropus</em> sp. - 2 Chironomidae – 1 larvae</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
<td>57</td>
<td>2+</td>
<td>?</td>
<td>Detritus</td>
</tr>
</tbody>
</table>

Figure 1: *Percottus glenii* from the stomach of the *Esox lucius* individual from the Danube Delta.

The message brought by the Amur sleepers from the pike’s stomach seems alarming. On the one hand it shows that in the Delta *P. glenii* has large populations, but on the other hand indicates that pikes can eliminate many individuals of this invasive species. *P. glenii* was recently recorded in the Danube Delta (Năstase 2007; Kvach 2012). Nevertheless, in only few years its populations increased much (Năstase 2012), a fact confirmed also by the pike stomach content. The Danube Delta is the last station in the downstream distribution of *P. glenii* alongside the Danube, where it can reach from three directions (Reshetnikov 2013). However, despite the short time it seems that *P. glenii* has reached very high effectives in the Delta, being the most common prey of the pike that we have studied. Also, the individuals were bigger than those identified in a smaller habitat in western Romania (Covaci-Marcov et al. 2011).

The fact that *P. glenii* is consumed by numerous predators, including the pike, is well known (see: Litvinov
Bulat D, Bulat D, Davideanu A, Popescu IE and David eanu G

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CONTRIBUTION OF THE AUTHORS

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Species identification, gut content analysis, measurements and manuscript preparation

Alfred-Ștefan Cicort-Lucaciu
Supply of study materials and manuscript preparation