PRELIMINARY STUDY ON ODONATA LARVAE (INSECTA: ODONATA) FROM “ELEȘTEIELE JIJIEI ȘI MILETINULUI” (ROSPA0042): POPULATION DYNAMICS AND CONSERVATION ISSUES

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Abstract. Recent studies on Odonata diversity from farm ponds revealed that species assemblages were not correlated with pond use or to landscape variables and farm ponds made a positive contribution to the maintenance of aquatic biodiversity. Our study was made in October 2010-October 2011 in the fish ponds and rivers from Eleșteiele Jijiei și Miletinului (ROSPA0042) on Odonata larvae. Population dynamics and diversity of Odonata species lead us to consider their importance in the assessment of biotic integrity and conservation of the wetlands and ponds.

Keywords: Odonata larvae, populations, fish ponds, conservation.

Introduction

Odonata requirements are not strictly restricted to aquatic habitats, but the surrounding landscape structure may affect dispersal, maturation, foraging, and nocturnal roosting (Taylor & Merriam, 1995; Bried & Ervin, 2006). Many Odonata species have relatively poor dispersal ability, especially damselflies, and generally move within a few hundred meters at most, with rare long-distance dispersal events (Corbet, 1962; Conrad et al., 1999; Angelibert & Giani, 2003). Increased distance to the nearest source habitat and reduced connectivity negatively affect species richness of odonates, both at the adult and larval stages, suggesting that isolation plays an important role in determining the structure of odonate assemblages (McCauley, 2006).

From the total of 5,680 species of Odonata known in the world (2,739 belonging in 19 families to the suborder Zygoptera and 2,941 in 12 families to the suborder Anisoptera) (Kalman et al., 2008), 69 species occur in Romania (Manci, 2011).

Odonates are used as bioindicators because they respond to local abiotic variables landscape structure and composition (Chovanek & Raab, 1997). A few methods included Odonata in ecological quality assessment of lakes, ponds, small waterbodies (Biggs et al., 2000; Boix et al., 2005; Chovanec et al., 2005; Oertli et al., 2005; Galbrand et al., 2007; Solimini et al., 2008; Menetrey Perrotet, 2009, etc).
Assessing the importance of 37 farm ponds for the biodiversity of Odonata in an agricultural landscape lacking natural wetlands in south-western France, farm ponds captured 40% of the regional species pool, including both common and rare species; the species assemblages were not correlated with pond use (e.g. cattle watering, duck farming, etc.) or to landscape variable. Species richness was correlated with pond area, suggesting that community diversity was primarily driven by autoecological processes. Farm ponds thus made a positive contribution to the maintenance of aquatic biodiversity (Rugierro et al., 2008).

Jijia and Miletin Ponds (ROSPA0042) have 1,730 ha aquatic surfaces and other 280 ha in canals and dams. Named also “The Vlădeni wetland”, they were the object of conservation and management studies (e.g. Nicoară et al., 2001) attending the present status of protected area. The wetland was created during the ’80 in order to decrease the flooding risks in the Jijia plain. This wetland territory, with large reed surfaces, is the most important breeding area in the whole Romanian Prut River basin, a ratio of this territory avifauna and that recorded for Romania emphasizes that the wetland Vlădeni shares 53.33% of the total amount of species present in the country. The image of a small delta is created due to the presence of spoonbills, cormorants, herons, egrets, ducks, geese, swans, gulls, warblers, nightingales, etc. (Gache, 2005).

Jijia River is the source for the ponds of Vlădeni and Larga Jijia, used for aquaculture of fish only. Miletin River forms at 35 km for its source the Halceni Dam Lake, used as water source for fish ponds and agriculture. There is no industrial source of pollution; diffuse pollution might occur by domestic waste water and agricultural landscape drainage water.

A previous hydrobiological study of the Larga Jijia-Vlădeni ponds assessed water quality by saprobity as β-meso to α-mesosaprobe based on algae and 35 invertebrate taxa, most at family level, but none from Odonata (Nicoară et al., 2001a).

Material and Methods

We had five sampling stations: Miletin River (N 47º25.379’ E 027º15.387’, elevation 61.6 m) before the entrance in Halceni Dam Lake, Jijia River (N 47º23.064’ E 027º20.962’, elevation 48.7 m) before the entrance in Larga Jijia Fish Farm, Larga Jijia Pond (N 47º22.070’ E 027º20.132’, elevation 41.7), Vlădeni Pond (N 47º24.429’ E 027º18.735’, elevation 27.3 m), Halceni Dam Lake (N 47º25.611’ E 027º17.497’, elevation 59.8 m). Sampling sessions were carried out monthly for Miletin River, Halceni Dam Lake, Larga Jijia Pond, Vlădeni Pond, from October 2010 to October 2011 with one exception: in February 2011 the thick ice formed did not allowed the sampling in the Miletin River. Jijia River was sampled in October-November 2010 and April-October 2011.

A hand net (with 500 µm mesh, net-opening: 30 X30 cm) and a Van Veen grab were used to collect the macroinvertebrates from immersed roots of marginal vegetation and the shoreline. Collected specimens were preserved in formaldehyde 5%, the Odonata larvae being identified in the laboratory using keys and descriptions of Askew (1988).

The species were ranked on the basis on density (individuals m⁻²), relative abundance and frequency for the study area.

Diversity of the sampled stations was assessed by Simpson's Index and Shannon's Index (Log base 2).
By their relative abundance – calculated by the formula $A = \frac{n}{N} \times 100$ where $n =$ number of individuals of the species, $N =$ total number of individuals in the sample – there were found the five groups of dominance: subrecedent species (under 1%); recedent or sporadic species (1.1-2%); subdominant species (2.1-5%); dominant species (5.1-10%); eudominante species (over 10.1%).

According to the frequency – $F\% = \frac{p}{P} \times 100$ where $p$ is the number of the samples with the species and $P$ is the total number of the samples, we assessed the continuity in the biotope: accidental species ($F$ between 1-25%), accessory species ($F$ between 25.1–50%), constant species ($F$ between 50.1-75%), euconstant species ($F$ of 75.1-100%).

Results and Discussion

During our study we sampled 462 odonata larvae (Table 1) from eight species of six families: Calopterygidae – *Calopteryx splendens* (Harris, 1782), Platycnemididae – *Platycnemis pennipes* (Pallas, 1771), Coenagrionidae – *Enallagma cyathigerum* (Charpentier, 1840) and *Ischnura elegans* (Vander Linden, 1820), Libellulidae – *Orthetrum albistylum* (Selys, 1848) and *Orthetrum cancellatum* (Linnaeus, 1758), Gomphidae – *Onychogomphus forcipatus* (Linnaeus, 1758), Aeshnidae – *Anax imperator* (Leach, 1815).

All these species are previously registered in Romania (Bulimar, 1995; Cîrdei & Bulimar, 1965; Patriche & Manci, 2008; Manci, 2011).

Concerning the conservation status, in the 'IUCN Red List of Threatened Species’ the Odonata we identified in our study are listed as ‘Least concerned’ except *Onychogomphus forcipatus* (Linnaeus, 1758) (that is not yet assessed); major threats that might affect Odonata populations include habitat destruction and the associated water pollution, so the conservation measures must prevent habitat loss (IUCN v.2011.2; Dow, 2010; Kalkman et al., 2010).

As a general observation for our study no larvae were found in December (Figs. 1-4) and also no larvae were found in the Hălceni Dam Lake (where the absence of larvae may be related with the lack of the marginal vegetation).

The relative density of larvae per square meter was calculated for each species collected in the entire study area, the results being represented for each month, in the graphs below.

*Calopteryx splendens* (Harris, 1782), the banded demoiselle, has the flight period from April to the beginning of September, but in northern latitudes mainly from June to early August (Askew, 1988). Maximum density of *Calopteryx splendens* larvae was observed in April, in our study, the species being collected in Jijia River and Miletin River (Figs. 1, 2).

*Platycnemis pennipes* (Pallas, 1771), the white-legged damselfly, mentioned as the only European species of the genus founded in the completely standing water, has the flight period is mostly in June and July, declining in numbers through August (Askew, 1988). *P. pennipes* was collected during our time study in January to October, maximum density being registered in January (four larvae), and the species being present in both fish ponds and investigated rivers (Figs. 1-4).

Considering the relative abundance (Table 1), there were found groups of: subrecedent species (*Orthetrum cancellatum*, *Anax imperator* and *Onychogomphus forcipatus*); recedent or sporadic species (*Platycnemis pennipes* and *Calopteryx splendens*);
dominant species (*Orthetrum albistylum*); eudominant species (*Ischnura elegans* and *Enallagma cyathigerum*).

Based on frequency (Table 1) in the samples, we assessed the constancy, which is the expression of the continuity in the biotope. Accidental species were *Anax imperator* and *Onychogomphus forcipatus*, accessory species were *Calopteryx splendens*, *Platycnemis pennipes* and *Orthetrum cancellatum*, constant species was *Orthetrum albistylum*, and euconstant species were *Ischnura elegans* and *Enallagma cyathigerum*.

**Table 1.** Odonata larvae sampled, the relative abundance (A) and frequency (F) for the entire study area.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Total</th>
<th>A</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Calopteryx splendens</em></td>
<td>8</td>
<td>1.73</td>
<td>38.46</td>
</tr>
<tr>
<td><em>Ischnura elegans</em></td>
<td>238</td>
<td>51.52</td>
<td>92.31</td>
</tr>
<tr>
<td><em>Enallagma cyathigerum</em></td>
<td>174</td>
<td>37.66</td>
<td>92.31</td>
</tr>
<tr>
<td><em>Platycnemis pennipes</em></td>
<td>9</td>
<td>1.95</td>
<td>38.46</td>
</tr>
<tr>
<td><em>Orthetrum albistylum</em></td>
<td>26</td>
<td>5.63</td>
<td>53.85</td>
</tr>
<tr>
<td><em>Orthetrum cancellatum</em></td>
<td>4</td>
<td>0.87</td>
<td>30.77</td>
</tr>
<tr>
<td><em>Anax imperator</em></td>
<td>1</td>
<td>0.22</td>
<td>7.69</td>
</tr>
<tr>
<td><em>Onychogomphus forcipatus</em></td>
<td>2</td>
<td>0.43</td>
<td>15.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>462</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The diversity of Odonata species (Table 2) calculated by the Simpson’s Index and Shannon’s Index (Log base 2) is slightly higher in Miletin River (6 species) compared with the fish ponds (5 species) while only three species (*Onychogomphus forcipatus*, *Platycnemis pennipes* and *Calopteryx splendens*) were found in Jijia River.

**Table 2.** Diversity of Odonata in the study area.

<table>
<thead>
<tr>
<th>Sample Station</th>
<th>Species richness</th>
<th>Shannon’s Index (Log base 2)</th>
<th>Simpson’s Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jijia River</td>
<td>3</td>
<td>1.500</td>
<td>0.625</td>
</tr>
<tr>
<td>Miletin River</td>
<td>6</td>
<td>1.385</td>
<td>0.559</td>
</tr>
<tr>
<td>Vlădeni Pond</td>
<td>5</td>
<td>1.679</td>
<td>0.643</td>
</tr>
<tr>
<td>Larga Jijia Pond</td>
<td>5</td>
<td>1.442</td>
<td>0.536</td>
</tr>
<tr>
<td>Halceni Dam Lake</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The density of larvae per square meter (for the Miletin River, Vlădeni Pond and Larga Jijia Pond) is represented for each month, in the graphs below.

The monthly occurrence of Odonata larvae (Fig. 1) reveals that the future sampling sessions in the study area must be done at least in spring (April) and autumn (October) when the maximum of Odonata species number may be sampled, or monthly in between.

*Enallagma cyathigerum* (Charpentier, 1840) with maximum density in September (44) and *Ischnura elegans* (Vander Linden, 1820) with maximum density of larvae in June (43) were collected in all our sampling sites each month except December (Fig. 1).

*Enallagma cyathigerum*, the common blue damselfly, has a broad tolerance of the water in which it breeds, occurring in both running and stagnant water – streams, small ponds; the flight period is from May to early September, earlier in lowland localities (Askew, 1988). The larvae density increased from May to September (Fig. 1).
Figure 1. Odonata larvae dynamics represented for each month for the entire study area.

<table>
<thead>
<tr>
<th>Species</th>
<th>X 010</th>
<th>XI 010</th>
<th>XII 010</th>
<th>I 011</th>
<th>II 011</th>
<th>III 011</th>
<th>IV 011</th>
<th>V 011</th>
<th>VI 011</th>
<th>VII 011</th>
<th>VIII 011</th>
<th>IX 011</th>
<th>X 011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calopteryx splendens</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ischnura elegans</td>
<td>3</td>
<td>11</td>
<td>0</td>
<td>6</td>
<td>28</td>
<td>8</td>
<td>6</td>
<td>14</td>
<td>39</td>
<td>19</td>
<td>30</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Enallagma cyathigerum</td>
<td>16</td>
<td>4</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>13</td>
<td>44</td>
<td>4</td>
<td>32</td>
<td>34</td>
<td>8</td>
</tr>
<tr>
<td>Platycnemis pennipes</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Oxychogomphus forcipatus</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Anax imperator</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Orthetrum cancellatum</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Orthetrum albistylum</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>12</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 2. Odonata larvae dynamics in the Miletin River.
Figure 3. Odonata larvae dynamics in Vlădeni Pond.

Figure 4. Odonata larvae dynamics in Larga Jijia Pond.

*Ischnura elegans*, the blue-tailed damselfly, is an ubiquitous species in ditches, canals, pools, ponds, lakes and slow flowing streams. The species is tolerant of brackish conditions and moderate pollution. The flight period is long and without clearly defined peak of abundance. In Mediterranean it appears in March and it has two, three generation of
adults per year, the last persisting at the end of October. In northern Britain, the adults do not emerge until May and the larvae require two years to complete their development. In southern England *I. elegans* is univoltine (Askew, 1988). In our study larvae density had a peak in February (Figs. 1-4), being high from May to December.

*Orthetrum albistylum* (Selys, 1848), the white-legged damselfly, is described as a chiefly a lowland species, in ponds, lakes, sometimes in brackish water; the flight period is from the end of April to the end of August, the average adult life span being twenty-five days (Askew, 1988). Maximum number of larvae of *Orthetrum albistylum* was found in August (12) (Fig. 1), being present from April to October, four larvae being collected in January.

*Orthetrum cancellatum* (Linnaeus, 1758), the black-lined Orthetrum, inhabits ponds and lakes, less commonly associated with streams and rivers. The flight period is from June to late August (Askew, 1988). *Orthetrum cancellatum*, was collected from April-May and October-November, occurring in the Miletin River and the Larga Jijia Pond, missing from our samples of Vlădeni Pond (Figs. 1-4).

Two larvae of *Onychogomphus forcipatus* (Linnaeus, 1758) were collected only in October from the Jijia River. Frequents rivers, sometimes lakes with clean water. Emmerges from the beginning of June and the adult may be found to September (Askew, 1988).

*Anax imperator* (Leach, 1815), the emperor dragonfly, has the flight period from June to August; in England some examples are given of some larvae developed rapidly after egg deposition and some attain their penultimate larval instar in the second year and spend their second winter in diapause to produce adults two years after egg-laying; the adult flies over open water or around reed beds in ponds, lakes, both natural and artificial (Askew, 1988). Only one larva of *Anax imperator* was collected in August from the Vlădeni Pond (Figs. 1; 3).

While in Miletin River (Fig. 2) most of the species larvae were found in spring (April-March), in the fish ponds of Larga Jijia that happened in January and October (4), while in Vlădeni Pond the Autumn (August-October) (Fig. 3).

The cluster analysis (Fig. 5) based on the presence in the sampling sites grouped *Ischnura elegans* and *Enallagma cyathigerum*, mentioned before as tolerant species, eudominant and euconstant species for the study area, were present in both running and standing waters, in all our sampling sites.
The dominant and constant species, *Orthetrum albistylum*, was captured from the Miletin River and the fish ponds, missing from the Jijia River fauna from our samples. From the group of accessory species *Orthetrum cancellatum* and *Platycnemis pennipes* were found in both, standing and running water, *Oncychogomphus forcipatus* being found only in Jijia River and *Calopteryx splendens*, being found in both investigated rivers.

Conclusions
In our preliminary study on Odonata larvae we were able to identify eight species for the study area, that, by their monthly occurrence reveal the necessity of sampling sessions at least in spring (April) and autumn (October) when the maximum of odonata species number may be sampled, or monthly in between.

Even most of them are considered by UICN ‘least concerned’, the fragmentation and loss of the habitats, agricultural practices and the associated water pollution must be considered in conservation status assessment for these species.

The diversity of Odonata species is slightly higher in Miletin River compared with the fish ponds, with six species each, while only three species were found in Jijia River. Accidental and subrecedent species were *Anax imperator* and *Onychogomphus forcipatus*, subrecedent and accessory *Orthetrum cancellatum*, recedent or sporadic - *Platycnemis pennipes* and *Calopteryx splendens*; dominant and constant *Orthetrum albistylum*; *Ischnura elegans* and *Enallagma cyathigerum*.

The absence of the larvae in the Hâlcan Dam Lake may be related to the lack of the marginal vegetation until further studies on water chemical parameters and benthic community structure.

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References


