Study of the water-beetles communities of the Po plain

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The situation of the water-beetles communities of the Po plain was investigated and compared with the situation in the past. The results show a marked fall in biodiversity, due in some cases to the arrival of the introduced species *Procambarus clarkii* (Girard, 1852) but in other cases to other factors, which are probably global warming and water pollution.

1 Introduction

The original objective of this research was to study the water beetles communities in order to identify the characters of their composition relative to ecological variables, in view of a possible use of these communities as indicators of the conditions of lentic habitats: that is I hoped to develop a method for the assessment of the quality of marshy areas comparable to the methods existing for lotic habitats, such as for instance the EBI (Extended Biotic Index). To that end I had identified a number of lentic habitats of the Po plain, some of which I had already sampled in the 1980’s and were chosen because they were characterized by very rich water beetles communities, and some not yet sampled. Unluckily, the research could not be carried out according to this plan, because the first samplings revealed a disastrous situation of the water beetles communities, even in the biotopes which had been chosen for their supposed richness of water beetle fauna: in fact, many of the communities which I planned to study had practically disappeared. Therefore, I was forced to modify my original project and as a consequence the present work is composed of two parts: in the first part, I have tried to achieve my original objective, that is to identify the characteristics of a water beetle community in an environment still in good ecological conditions, using only the data found in the literature or the results of samplings carried out in the past, before the present collapse of the communities. The result, I fear, will only have an historical value, since in the present condition of the lentic habitats of the Po plain it is very difficult to imagine that the knowledge so acquired will ever be used to evaluate the conditions of environments which by now are profoundly and probably irreversibly altered relative to their original condition. In the second part of the work I have tried instead to describe the process by which this collapse took place and to identify the possible causes. For this purpose I considered mainly the environments of the Po plain (and some not strictly in the plain, but very close to it and with similar ecological conditions) in which samplings had been carried out in the past, before the collapse of the communities, and whose data were available in the literature or known to me although not yet published, so that I could compare those data with the results of the samplings which I carried out during this research (which spans the years 2006-2008).

2 Materials and methods

As already mentioned in the introduction, the paper is based on the study of a number of biotopes of the Po plain, which had already been studied in the past. I chose all the biotopes which I could find, that is: Torbiere di Iseo-Provaglio (Ravizza 1972), Torbiera di Marcaria and Lanca di Le Bine (Mazzoldi 1987), Garzaia di Valenza Po (Della Beffa et al., 1982), Lago di Sartirana Briantea (Brivio 1970). Some of these (Torbiere di Iseo-Provaglio and Lago di Sartirana Briantea) are not strictly in the Po plain because they are really situated in the morainic belt south of the North-italian lakes, but they are very close to the plain, at
the same altitude and enjoy similar climatic and ecological conditions, so their faunas are comparable to those of the plain.

I also sampled personally a number of the above mentioned biotopes and some others, not yet sampled or sampled but not yet published (Lanca di Abbadia Lariana, Pian di Spagna). The sampling was carried out with a standard net for water beetles, sampling along 2 m of shore for about 1 hour.

It was originally planned to consider all the water beetles, but in consideration of the fact that I have to base most of the study on past data, I have decided to limit the study to the group Hydradephaga (comprising, in the study area, the three families Haliplidae, Gyrinidae & Dytiscidae) because only for this group there are enough data for comparisons in the literature.

3 The original water beetle faunas of the Po plain

The first step in the study has been an evaluation and comparison of the original water beetles communities based on the data found in the literature of the years 1970’s and 1980’s. For this purpose I have used the data of the above mentioned biotopes and the data derived from the sampling of the marshy area of Pian di Spagna (Sondrio, Lombardy); this environment is not in the Po plain, since it is at the northern tip of lake Como, but is placed at about the same altitude than the plain and it had been sampled by me in 1991, so a comparison with the present situation was possible.

It was of course necessary to choose the parameters to be evaluated, and it seemed logical to choose a measure of biodiversity, since it is intuitive that environments in good ecological conditions should have richer and more complex communities than degraded environments. To evaluate biodiversity many methods and indexes are available, but, since I had to evaluate environments which I could not sample myself on the basis of samples collected by different authors with different methods, it was necessary to choose indexes and methods which were sensible as little as possible to the disparity of sampling methods.

A first very simple index is the number of species of a community. The problem with this index is that one should reach a reasonable degree of certainty that all the species of the community have been included in the sample, which is not easy to achieve, especially with certain taxa. A number of methods have been therefore devised in order to estimate if this result has been achieved (Magurran, 2004). Luckily, as far as water beetles are concerned, this problem is less serious than in other groups, for the following reasons: a) water beetles are generally confined to a limited space, not only because they are obviously restricted to aquatic environments, but also because within such environments water beetles are generally only found in a very narrow (often not wider than 1 m) belt of low water with aquatic vegetation along the shore. Therefore sampling inside this limited space it is not too difficult to collect all the species, although the very rare ones may escape (but usually replication of sampling solves the problem); b) the adult stage of water beetles is pretty long compared to other groups of insects, and usually 2-3 samples adequately spaced in the period spring-summer are enough to catch all or almost all the species.

The following table gives the number of species of Hydradephaga in the biotopes considered (the years refer to the date of sampling):

<table>
<thead>
<tr>
<th>Biotope</th>
<th>Number of Species</th>
<th>Year/s of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Bine</td>
<td>31</td>
<td>1984-1985</td>
</tr>
<tr>
<td>Marcaria</td>
<td>31</td>
<td>1985-1986</td>
</tr>
<tr>
<td>Valenza Po</td>
<td>33</td>
<td>before 1982 (not indicated)</td>
</tr>
<tr>
<td>Sartirana</td>
<td>26</td>
<td>1953-1960</td>
</tr>
<tr>
<td>Iseo</td>
<td>26</td>
<td>1971-1972</td>
</tr>
<tr>
<td>Pian di Spagna</td>
<td>27</td>
<td>1991</td>
</tr>
</tbody>
</table>

The table immediately shows two facts: a) all the biotopes were very rich in species (values between 26 and 33 place them amid the richest Italian biotopes); b) the three biotopes situated in the middle of
Afterwards, a comparison between the composition of the 6 environments was carried out using cluster analysis. A matrix of presence/absence data for all the species and biotopes was compiled, and from it a dissimilarity matrix was computed using the Euclidean distance between the biotopes; this was used for the analysis. Fig. 1 shows the resulting dendrogram.

It is interesting to note that the dendrogram puts the three environments of the plain (Valenza Po, Marcaria, Le Bine) into one group and the three ones of the morainic and mountain belt (Iseo, Sartirana, Pian di Spagna) into another.

4 The collapse of the populations of water beetles

What is written above describes the situation as it used to be, but as I already mentioned, the present situation is very different. The situation in Marcaria clearly exemplifies this. The diagram in Fig.2 shows the fall in number of species and number of specimens from 1985 to 2008.

Since the first thing that I noticed when I began sampling at Marcaria in 2006 was the presence (in great quantity, 30-40 specimens per sampling) of the introduced crayfish *Procambarus clarkii*, and the disastrous effects that this species exercises on the indigenous communities are well known (Pederzani & Fabbri 2006, Geiger et al. 2005, Rodríguez et al. 2005), it was natural to attribute the collapse of the communities to its action. But a more careful consideration of all the data available showed that *Procambarus*, while surely important, is not the only factor involved.

First of all, the data available indicate that at Marcaria the population of water beetles were declining before the arrival of the crayfish: at the turn of the century (when the crayfish had not yet arrived) the species were almost all still present, but the numbers of specimens had already strongly fallen (M. Toledo,
personal communication). Second, comparison of the old data relative to Torbiere di Iseo and Pian di Spagna and the data collected during the present study, shows that in those two biotopes (which are still free from \textit{Procambarus}), the populations of water beetles are also declining. Fig. 2 shows the trend of specimens and species collected in 1972 and 2007-2008 for Iseo and the analogous trend for the years 1991 and 2007-2008 for Pian di Spagna. The decline in both number of specimens and species is evident, especially for Iseo. Pian di Spagna appears to be still in relatively good condition, but it seems that the number of species present is being gradually eroded.

It is difficult to identify the cause of this decline, which is probably due to various factors acting simultaneously. Global warming might be involved in the disappearance of some species, for instance the disappearance of the two Gyrinid species (\textit{Gyrinus suffrianii} Scriba, 1855 and \textit{Gyrinus paykulli} Ochs, 1927) from Torbiere di Iseo. In fact, they seem to have disappeared between 1980 and 2000, just when the warming was accelerating; since these two species, and in particular \textit{Gyrinus paykulli} Ochs, 1927, in Italy were clearly a glacial relict (in central Europe they are still widespread) it is not impossible to imagine that even a small increase in temperature might have wiped them out. On the other hand, \textit{Gyrinus substriatus} Stephens, 1828 seems to have disappeared from Pian di Spagna, and this is a species common (or at least, which used to be common) all over Italy. And there remains the mystery of \textit{Porhydrus lineatus} (Fabricius, 1775), which seems to have disappeared from the whole Po plain in the last ten years of the past century. This is a species which used to be very abundant in the biotopes of the Po plain, sometimes collected in hundreds of specimens. Possibly polluting substances are also involved, although chemical analysis relative to the most common parameters did not show any particular abnormality for the environments investigated.

5 Conclusion

The water beetle faunas of the lentic environments of the Po plain were investigated. These environments used to have a rich water beetle fauna, richer than that of the biotopes situated in the morainic belt or more to the north amid the mountains. Today, unluckily, these faunas are declining, in some cases dramatically, as in the case of the biotopes in the central area of the plain where the arrival of the introduced crayfish \textit{Procambarus clarkii} has dealt the water beetle communities a final blow, but also in places where the crayfish has not yet arrived. It is difficult to identify the causes because various factors are probably at work simultaneously, but the main suspects are water pollution and global warming.

References