## Short communication

# First record of eyeless specimens of *Gammarus roeselii* Gervais 1835 (Amphioda, Gammaridae) in a small stream of the sub-lacustrine Ticino River basin (Lombardy, Northern Italy)

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**Abstract -** In this short communication, we report the unusual presence of blind specimens of the non-native *Gammarus roeselii* Gervais 1835 (Amphioda, Gammaridae) in the sub-lacustrine Ticino River basin (Po River floodplain, Northern Italy). Considering that *G. roeselii* is present in almost all small semi-natural tributaries of the Ticino River, it is important to carry out further research on this well-established exotic species to verify its genetic variability.

**Key words:** non-native species, blind specimens, stygoxenes, gammarids.

**Riassunto -** Primo record di esemplari ciechi di *Gammarus roeselii* Gervais 1835 (Amphioda, Gammaridae) in un piccolo corso d'acqua del bacino sub-lacustre del fiume Ticino (Lombardia, Italia settentrionale).

In questa breve nota, segnaliamo la presenza inusuale di campioni ciechi di *Gammarus roeselii* Gervais 1835 (Amphioda, Gammaridae), specie non-nativa del bacino sub-lacustre del fiume Ticino (Pianura padana, Nord Italia). Considerando che *G. roeselii* è presente in quasi tutti i piccoli affluenti semi-naturali del Ticino, diventa importante effettuare ulteriori ricerche riguardo a questa specie esotica già consolidata, al fine di verificarne la variabilità genetica.

**Parole chiave:** specie non-nativa, campioni ciechi, stigosseni, gammaridi.

One of the most successful invaders in superficial and subterranean freshwater ecosystems are Gammarids (Hesselschwerdt *et al*., 2008).

All freshwater species within the genus *Gammarus* share many morphological characteristics such as small reniform eyes and mouthparts. However, according to Karaman and Pinkster (1977), it is possible to distinguish three artificial groups based on the morphological features of specimens: the *Gammarus roeselii*-group, the *Gammarus balcanicus*-group and the *Gammarus pulex*-group.

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In both the *pulex*- and the *balcanicus*-groups, dorsal carinae are completely absent, but on the contrary, the members of the *Gammarus roeselii*-group can be distinguished from those of the other two groups by the presence of dorsoposterior process (spines) on a number of metasome segments. Most populations in western Europe have four dorsal processes, while in south-eastern Europe, most of them only have three (Fig. 1).

These spines can be considered as a morphological antipredatory adaptation, like in many other organisms, such as fish (Hoogland *et al*., 1956), gastropods (West & Cohen, 1996) and other crustaceans (Tollrian, 1995).

The present communication is about the amphipod *Gammarus roeselii* Gervais 1835, which has a long invasion history in Eastern and Central Europe, where it is now considered as a well-established exotic species.


Fig. 1 - The non-native amphipod *Gammarus roeselii* Gervais 1835 (from Paganelli *et al*., 2015).

*G. roeselii* reaches a higher density in small streams with moderate water currents and abundance of plants by using such biotopes as refuge (Mayer *et al.,* 2012). Moreover, it is more eurybiont and it can survive in lower oxygen concentrations and higher temperatures than the native species *Echinogammarus stammeri* (Karaman, 1931), which prefers fresh running water (Karaman, 1993; Kley *et al*., 2009).

Up to 2005, in Italy its presence had only been reported for the Sile River basin (North-Eastern Italy); subsequently, it was discovered in the sub-lacustrine Ticino River basin (Po River floodplain, Northern Italy), despite the lack of a direct connection between these two basins. In this area, it lives in sympatry with dense populations and shares the same habitat and food resources, i.e. aquatic plants and leaf debris, with *E. stammeri* (Paganelli *et al*., 2016).

In an area characterized by high anthropogenic pressures, such as the low basin of the Ticino River Valley, the numerous small semi-natural streams of the intricate irrigation system represent a suitable refuge for native and non-native animals and plants.

Thus, in order to monitor the distribution of *G. roeselii* in these habitats, we selected 13 semi-natural main tributaries of the Ticino River (11 on the right bank and 2 on the left bank) covering an area of 150 $km^2$ and, from June to September 2015, we collected three random sub-samples in each stream, using a modified net (950 μm mesh) with a square frame (22×23 cm, which corresponds to an area of 0.0506 $m^2$). Then we identified and counted all the amphipod specimens in the laboratory.

Our field investigations confirm that the non-native amphipod is well-established in this area, where we found it in ten out of the thirteen streams that were examined.

During the identification process of specimens collected in the Venara Stream, a right bank tributary of the Ticino River, a few non-native gammarids (mean body size: 9.5±1.91 mm) caught our attention: four out of thirty-eight specimens collected in this stream were eyeless (Fig. 2).

Although few in number, these findings should not be undervalued or regarded as occasional, since they represent about 10% of the total amphipods found in the Venara Stream. No other eyeless specimens were found in the other nine streams where we collected a total of 459 specimens of the non-native species.

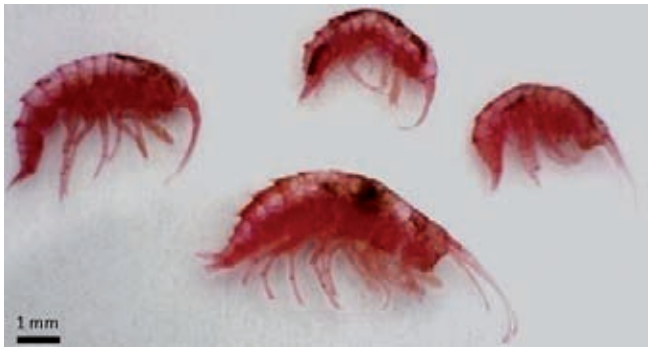


Fig. 2 - Eyeless specimens collected in the Venara Stream, one of the small right bank tributaries of the Ticino River.

Usually, the gammaridean eyes are typically positioned on the lateral surface of the head and they are sessile, compound, pigmented and multifaceted. The eyes are moderately large with a reniform shape and sexual dimorphism is quite common, with the male having larger eyes than the female.

However, the absence of eyes has little taxonomic value because there are numerous cases of blind forms in the same genus, often reflecting the different habitats they occupy (Lincoln, 1979).

Effectively, according to their affinity to subterranean environments, organisms can be classified as one of three types: i) stygoxenes, defined as accidental or occasional presence in subterranean waters (*e.g*. the amphipod *Gammarus fossarum* Koch, 1836), ii) stygophiles which inhabit both surface and subterranean aquatic environments, but are not necessarily restricted to either, and iii) stygobites, which are obligate or strictly subterranean animals where they complete their entire life (*e.g*. amphipods belonging to the genus *Niphargus*).

The first two types of organisms may live in caves for part of their lives, but do not complete their life cycle in these environments, while the third type usually appears to be highly modified for subterranean life with lack of eyes and pigment, and generally has a gracile appearance, largely due to long appendages and antennae.

In particular, the reduction or the absence of eyes is very common in organisms which inhabit subterranean or aphotic habitats (Karaman & Pinkster, 1977) but, in superficial waters, records of eyeless amphipods are very rare: according to Özbek & Belgin (2010), eyeless *Gammarus* species distributed in European freshwaters belong to the *Gammarus pulex*- and *Gammarus balcanicus*-groups, but no blind species have been reported in the *roeselii*-group.

Overall, the four eyeless specimens collected in the Venara Stream did not show any other specific morphological adaptations to a subterranean life and this suggests that the absence of eyes should only be considered as a genetic mutation, without an evolutionary significance. Moreover, the Venara Stream does not show any particular environmental features which may suggest a genetic adaptation to survive here; this stream has all the typical ecological characteristics of a small stream of the Po River Plain such as a moderately water current, sandy-gravelly bottom and presence of aquatic plants.

However, Gammarids usually live near the bottom of the stream, hidden under stones or aquatic plants, eating leaf debris. Considering their habit and the fact that the blind specimens collected had quite a large body, the lack of eyes does not seem to represent a handicap for their survival in the wild.

Finally, our discovery also suggests that *Gammarus roeselii* could be classified as stigoxene organisms.

Taking into account the fact that the non-native species *Gammarus roeselii* is present in almost all semi-natural streams of the intricate irrigation system of the lower course of the Ticino River, it is important to carry out further research on this well-established exotic species to verify its genetic variability as reported by Grabowski *et al.* (2017) in other countries.

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