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Occurrence of the invasive crayfish *Procambarus clarkii* (Girard, 1852) in Belgium (Crustacea: Cambaridae)

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The red swamp crayfish or Louisiana crayfish *Procambarus clarkii* (Girard, 1852) originates from north-eastern Mexico and the southern part of the USA, from Texas to Alabama and northwards to Illinois (1). Mostly due to its commercial value, this species has been introduced into other parts of the USA. Its range now includes the east and west coasts and northward up to the states of Idaho and Ohio (2). Nowadays, *P. clarkii* has been introduced almost worldwide. In Europe, it was introduced for the first time into southern Spain in 1973 for aquaculture, as bait used by anglers and for aquarium purposes (3). It was subsequently introduced into Portugal, Cyprus, the United Kingdom, France, Germany, the Netherlands (3) and recently Switzerland (4). The species is now present in at least 13 European countries and also occurs on islands like the Azores and the Canaries (5). Since its introduction, this species has given rise to naturally-breeding populations and soon became established in the wild. Recently, *P. clarkii* has been reported in a number of ponds and streams in the Netherlands, especially in the west of the country, where it rapidly expanded towards the Belgian border, but with only a few records in the east (6).

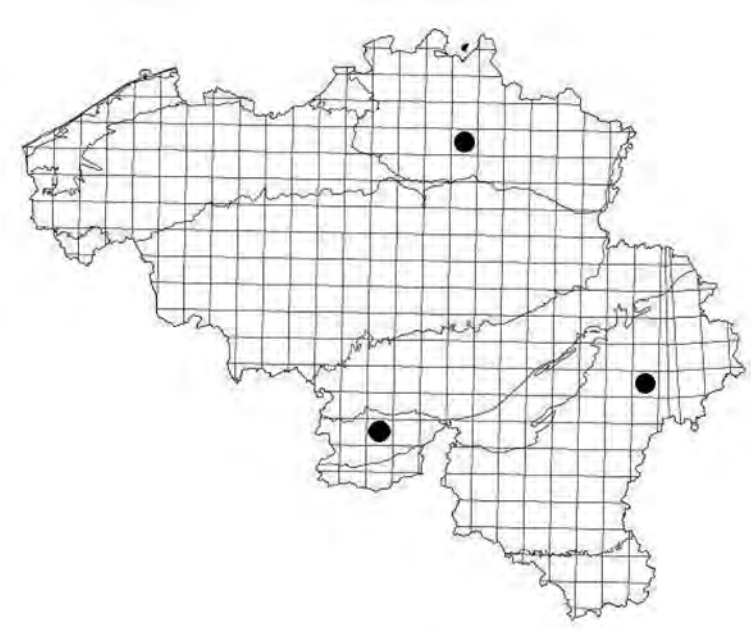

Fig. 1. – Distribution of *Procambarus clarkii* in Belgium, on a 10*10km UTM grid.

In Belgium, the first specimen of *P. clarkii* was found dead in the reservoir of Vielsalm (Ardennes, alt. 375m; Fig. 1) during the first Belgian crayfish distribution survey, made by the Station de Recherches Forestières et Hydrobiologiques of Groenendaal during the years 1983-1985. This specimen might have originated from a nearby restaurant. More interesting was the discovery of a living individual in a pond nearby Cerfontaine (Fagne-Famenne, alt. 245m; Fig. 1) on 3 September 1996 during a large scale distribution survey of crayfish in Wallonia, funded by a grant from the Ministry of the Walloon Region during the years 1994-1996. More recently, on 2 July 2008,

P. clarkii was found in the nature reserve Zammelsbroek in Zammel (Kempen, alt. 15m; Fig. 1). On 28 January 2009, populations of *P. clarkii* were found there in three ponds situated northeast of the nearby River Grote Nete although the ponds were not directly connected to this river. The ponds were sampled using a handnet with a mesh size of 0.5mm. Without much effort, several individuals including juveniles were caught, indicating that the species is well established and that it reproduces. The nature reserve Zammelsbroek has a varied landscape consisting of landdunes, meadows, shrubbery, ponds and brooks and is classified as biologically valuable (7). The presence of sensitive taxa such as caddisflies and mayflies indicates that the ponds at Zammelsbroek have a good biological water quality.

It has to be mentioned that the presence of *P. clarkii* has been suspected in the Belgian upper courses of the Rivers Leie, Scheldt and Sambre. These canalized rivers are connected by canals to the French River Somme. On 11 July 1997, many individuals of *P. clarkii*, including juveniles, were found together with *Orconectes limosus*, in the locality of Corbie-sur-Somme (France), in a pond closely connected to this river. Since then, some investigations have been done in order to check the presence of *P. clarkii* in the Rivers Leie, Scheldt and Sambre nearby the French border in the Province of Hainaut, but without positive results.

The scattered distribution of *P. clarkii* in Belgium (Fig. 1) suggests that the species probably escaped from nearby private ponds or was deliberately released by amateurs keeping crayfish as a hobby. It is also possible that the species has actually a much larger distribution but remained unnoticed, however, this seems unlikely as it is a large, conspicuous species. Regardless of its way of introduction, the expansion of the species in the neighbouring countries indicates that the species will become more common in Belgium as well and therefore, that more records are to be expected in the future.

Identification of *P. clarkii* is easy. Like other members of the family Cambaridae, it possesses a strong spur at the inner side of the carpopodite (Fig. 2). Moreover, the propodite is armed with strong spines on its inner side as well as conspicuous knots on its dorsal face (Fig. 2). The branchiocardiac grooves of the carapace converge dorsally. Lateral spines or tubercles in front of and behind the cervical groove are absent or reduced. The rostrum is devoid of a median keel and has an obvious triangular shape, the sides tapering anteriorly. The head itself is elongated and narrowing towards the front. Special attention is needed to identify juvenile crayfish, which are not coloured red and look very similar to other *Procambarus*-species (i.e. marbled crayfish) (6).

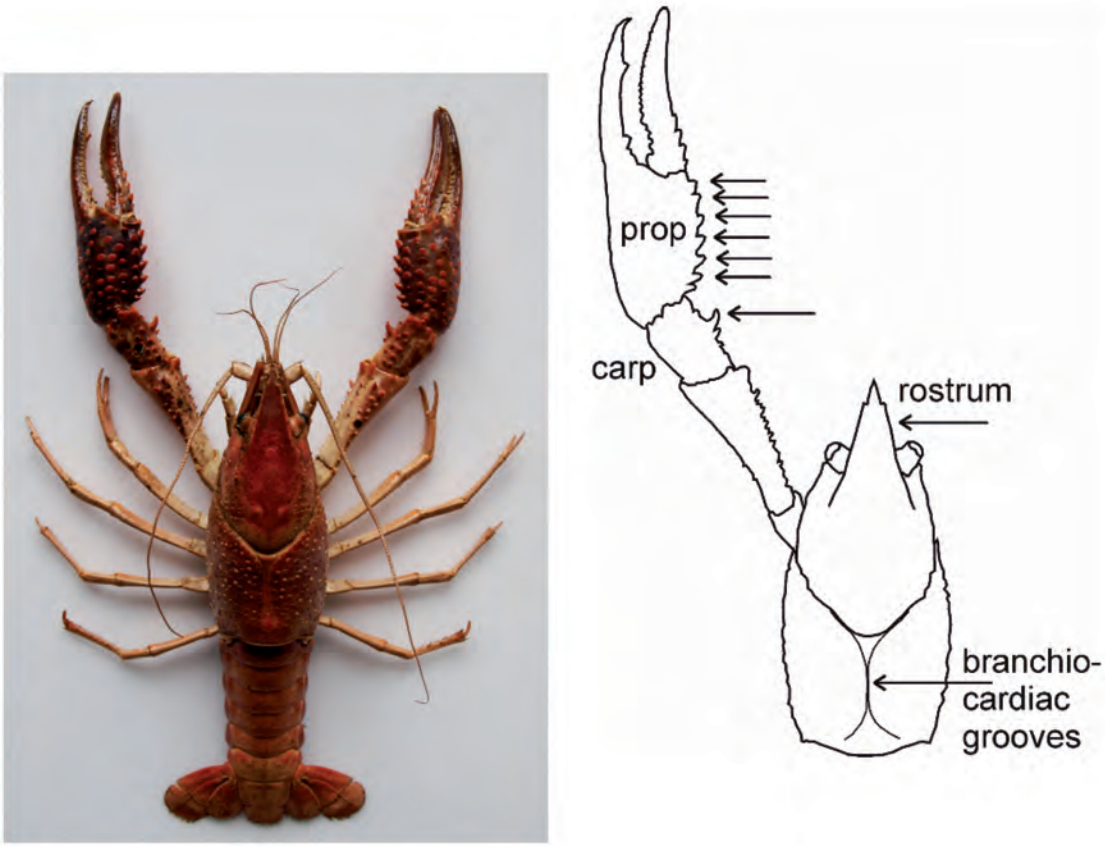

Fig. 2. – Photograph of a naturalized *Procambarus clarkii* specimen (left) and drawing of typical (arrowed) morphological features (right). (prop: propodite; carp: carpopodite).

Besides the red swamp crayfish, the family Cambaridae is also represented in Belgium by the spiny-cheek crayfish *Orconectes limosus* (Rafinesque, 1817), an invasive species that was reported for the first time in 1962 from the River Meuse (8). Five other Cambarid species that have been introduced in Europe, have not yet been reported from Belgium: *O. immunis* (Hagen, 1870), *O. juvenilis* (Hagen, 1870), *O. virilis* (Hagen, 1870), *P. acutus* (Girard, 1852) / *zonangulus* (Hobbs & Hobbs, 1990) and an unidentified species of *Procambarus*, which is known as the marbled crayfish (9; 10). All these Cambaridae were imported from North America and are liable to appear one day in our country. Crayfish belonging to the family Astacidae are also represented by three species in Belgium: *Astacus astacus*, *A. leptodactylus* and *Pacifastacus leniusculus*. *A. astacus* is the only indigenous species in Belgium, however, its distribution area has dramatically collapsed since the introduction of exotic crayfish carrying the crayfish plague (8). *A. astacus* is now restricted to a few places in the south and the east of Belgium (11). *A. leptodactylus* was probably introduced in the 1950's and *P. leniusculus* in the 1970's, both for alimentary purposes (8).

P. clarkii is considered as an important polytrophic consumer that may act as a keystone species (12). The species is omnivorous and consumes mainly microbial-enriched detritus, benthic and planktonic invertebrates and plant material (13). Research about the feeding habits indicated that there was a seasonal difference in food choice: plants were mostly consumed during summer, while animal preys were especially consumed during winter (12). Besides this seasonal pattern, the species also showed a difference in food selection depending on age and maturity. *P. clarkii* is a large, aggressive species that is well adapted to areas with drastic seasonal fluctuations in water level, where it survives by digging deep burrows (14). Individuals are able to spread over land and are in this way not restricted to the aquatic environment to colonize new areas. The species tolerates low oxygen concentrations and strong fluctuations in salinity and acidity (13). In addition, it is highly resistant to the crayfish plague, has an early maturity, a rapid growth rate and a high fecundity. The red swamp crayfish is known to contribute to biodiversity losses and habitat degradation recorded in several freshwater systems of south-central Europe (15). The burrowing activity of this species may result in the destabilization of banks of rivers and lakes. An indirect effect of the crayfish activity may be the increase in turbidity, leading to a decrease in light penetration and thus a decrease in plant growth. As *P. clarkii* feeds especially on molluscs, fish, amphibians, macroinvertebrates and macrophytes, it may cause changes in food webs and even disappearance of some species (14). Consequently, it can be expected that this opportunistic species will have a strong impact on the local community.

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