



# Marbled Crayfish

Technical White Paper

## Marbled crayfish

The marbled crayfish (*Procambarus virginalis*), also known as Marmorkrebs, is an invasive freshwater crayfish species which was first recorded in Germany in the 1990s. It is thought that marbled crayfish originated entirely from the pet trade, with no known native populations in existence. Since its first discovery, the species has rapidly spread into the wild and is now found abundantly across Europe in Germany, Italy, Ukraine and Sweden and also further afield in Madagascar and Japan.

## Parthenogenic Reproduction

What is interesting about the marbled crayfish is that it has a unique ability to reproduce fully through parthenogenesis, which is a form of asexual reproduction. Being a parthenogenic species means that the marbled crayfish can develop embryos without the need of fertilization. Embryo development without fertilization occurs naturally and is more common in lower classes of animals. However, no other crayfish or decapod crustacean species are known to be able to reproduce without mating in this manner. Due to this unique ability, all marbled crayfish are: female, clones of their single parent, and almost 100% completely genetically identical to each other.

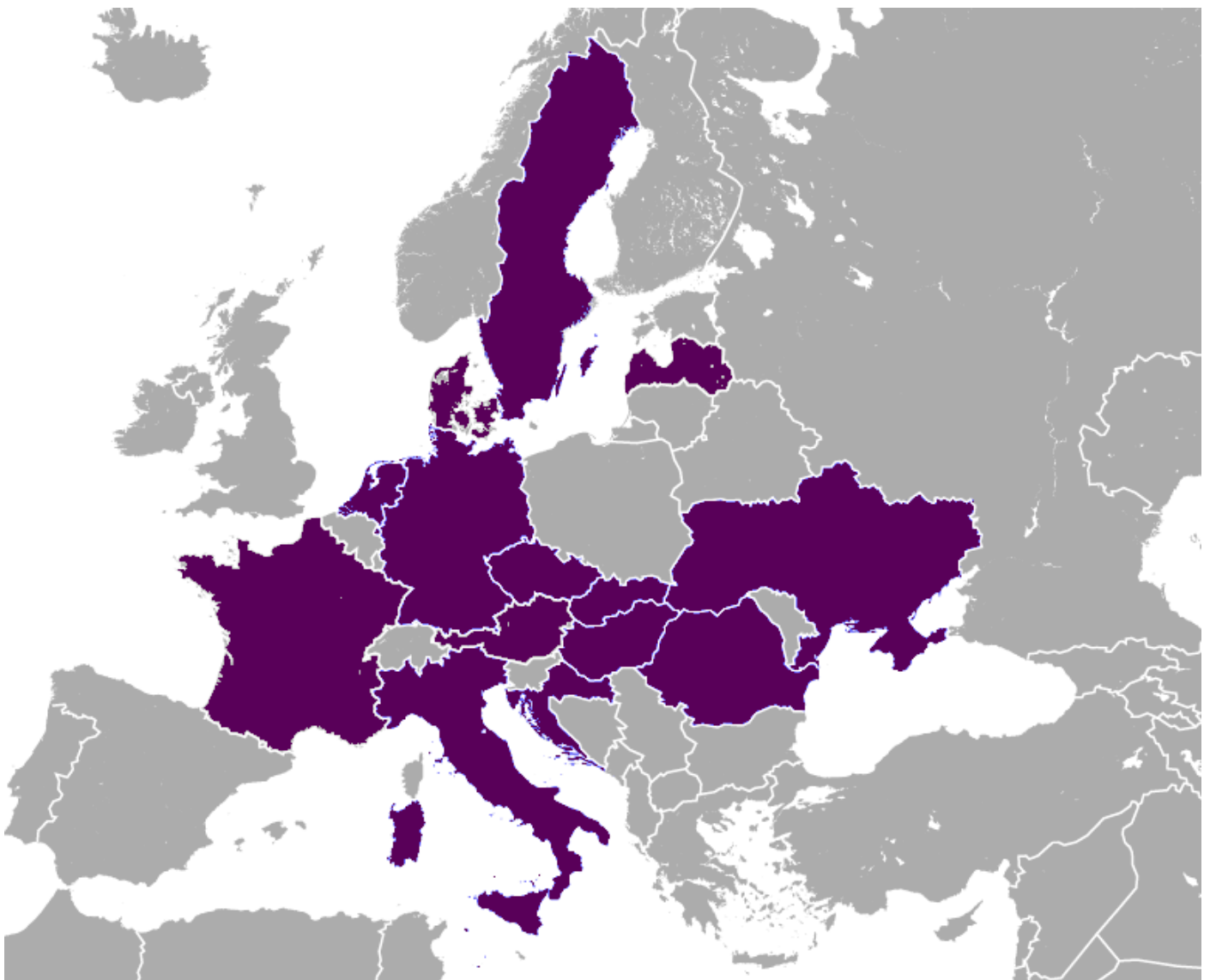
Molecular scientists from the German Cancer Research Center in Heidelberg have tracked the evolution of this unique species through DNA sequencing and genome analysis, determining that the species is closely related to the slough crayfish (*Promabarus fallax*). What is more, scientists suggest that most likely the marbled crayfish was created as a result of a genetic reproductive accident when two distantly related slough crayfish individuals mated in an aquarium in Germany, leading to the birth of a single parthenogenic crayfish from which all marbled crayfish descend from.



## Invasive Potential

As female individuals of marbled crayfish are able to lay eggs and produce offspring without the need of egg fertilization from a male individual, it makes the species potentially invasive. This invasive characteristic of the species poses a threat to freshwater ecosystems; therefore, it has already been banned in the pet trade in the European Union and in parts of the United States of America. Despite there being no natural populations of marbled crayfish in existence, individuals of this species have been found spreading across many European countries, and even as far as Madagascar.

There is a high risk of marbled crayfish entering UK waters through the illegal aquarium trade or through accidental routes such as through the transportation of fish stocks. Once established within an ecosystem, marbled crayfish can quickly reproduce and have the potential to negatively impact native wildlife diversity and ecosystem function.



*Extent of the current spread of marbled crayfish in Europe (2019).*

## Marbled Crayfish eDNA

Monitoring the spread of marbled crayfish is an important step in the control of the species' distribution. The employment of a fast and effective screening methodology such as eDNA detection to detect marbled crayfish is important due to their rapid spread since they were first recorded in 1995.

In 2018, SureScreen Scientifics teamed up with researchers from the University of Derby and the German Cancer Research Center in order to develop the first eDNA methodology for the detection of marbled crayfish.

The assay was developed through rigorous testing and validation following the MIQE guidelines (Minimum Information for the publication of Quantitative PCR Experiments) for the development of qPCR (quantitative polymerase chain reaction), i.e. the analytical method used for the detection and amplification of DNA. The assay was tested using computer based modelling and on control DNA samples against various native and non-native crayfish species known to occur throughout Europe. Further, the reliability of the developed assay was assessed by determining its sensitivity and limits of detection. Once laboratory-based assessments of assay suitability were complete, field trials began in lakes and rivers in Germany which were known to contain populations of marbled crayfish.

For further reading see our technical scientific publication "Early detection of an emerging invasive species: eDNA monitoring of a parthenogenetic crayfish in freshwater systems" – Mauvisseu et al. (2019), outlining the full development and validation of the methods used, including some important considerations for sampling and approaches to address methodological constraints and limitations.



## Technical Paper

Mauvisseu, Q., Tönges, S., Andriantsoa, R., Lyko, F., Sweet, M. (2019) Early detection of an emerging invasive species: eDNA monitoring of a parthenogenetic crayfish in freshwater systems. *Management of Biological Invasions* 10 (3), 461-472.





## Marbled Crayfish eDNA at SureScreen

Since the publication of this technical paper, we are now able to offer an eDNA detection service for the marbled crayfish. This service can be combined with our white-clawed, signal or crayfish plague eDNA analysis and uses the same sample collection process. Our single species qPCR approach means that we can analyse a single sample from each site for any combination of target species listed below.

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Marbled crayfish                      (*Procambarus virginalis*)

*Commonly occurring species in the UK:*

White-clawed crayfish              (*Austropotamobius pallipes*)

Signal crayfish                      (*Pacifastacus leniusculus*)

Crayfish plague                      (*Aphanomyces astaci*)

**Other UK occurring crayfish species (available on request):**

Red swamp crayfish                (*Procambarus clarkii*)

Narrow-clawed crayfish            (*Astacus leptodactylus*)

Noble crayfish                      (*Astacus astacus*)

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