Demon Shrimp eDNA

Technical White Paper

SureScreen Scientifics

Demon Shrimp

The demon shrimp (*Dikerogammarus haemobaphes*) is a small shrimp-like amphipod crustacean. As a close relative of another highly invasive species (the killer shrimp, *Dikerogammarus villosus*), demon shrimp are able to survive in a wide variety of salinities, from fresh water to brackish water. They are also found living within a wide range of temperature and substrate habitats, although they prefer to live in coarse grained gravel substrates or on top of muscle shells such as that of the zebra mussel (*Dreissena polymorpha*). With 2-3 generations per year, each consisting of 3-5 cohorts of between 20-50 eggs per brood, demon shrimp breed quickly in large numbers. Demon shrimp are omnivorous, feeding on detritus, algae and other small aquatic invertebrates.

Invasive Potential

Native to the Ponto-Caspian region, the demon shrimp has been spreading throughout Europe for over 20 years. With rapid growth rates, early maturation and high fecundity, in addition to their tolerance levels for a variety of different environments, demon shrimp are well suited to successfully invading new habitats. First found in Hungary, Austria, Belgium, Germany, Poland, Russia and Ukraine, it was first recorded in the River Severn in the UK in 2012 and has since spread widely across the UK.

At one site on the River Churnet, Staffordshire Wildlife Trust carried out three-minute kick samples regularly. After no demon shrimp were recorded in January 2014, 442 were recorded in October 2016 after a very rapid invasion occurred throughout 2015. The speed in which populations of demon shrimp can become established in new environments is one of the characteristics that allow them to be successful invaders. In addition to the demon shrimp, other invasive species from the Ponto-Caspian region have previously become established within the UK such as the tube building corophiid amphipod (*Chelicorophium curvispinum*) and the killer shrimp (*D. villosus*). Often interactions between species can facilitate each other, aiding with the establishment of an additional new species.

Invasive Impact

Through direct predation, increased competition for resources and the addition of new diseases and parasites into the ecosystem, demon shrimp can cause significant damage to native species. The increased presence of the demon shrimp in UK waters has coincided with the decline of the native freshwater shrimp (*Gammarus pulex*) and several mayfly and caddisfly species. In some ecosystems, such species are now locally extinct. Plants, insects, fish, mammals and birds all rely on the various fly species as a food source, causing severe knock on effects across the food chain and habitat when they are removed.

In addition, native freshwater amphipods, such as *Gammarus pulex*, are considered key to leaf litter processing within UK rivers. With a lower survival rate of *G. pulex* due to predation by the demon shrimp, leaf litter processing and recycling may be reduced, disrupting natural cycles in the rivers.

Native species such as Gammarus pulex have vital contributions in the recycling of detritus as part of natural river cycles. The introduction of demon shrimp threatens native populations, leading to a reduction in such natural processes.

Demon Shrimp Surveys

Due to the wide-ranging and highly damaging effect that the invasive demon shrimp can have on non-native ecosystems, early detection and monitoring systems are essential to develop conservation plans for important native species. Traditional survey methods used (i.e. kick sampling, capture-recapture) are labour-intensive, time consuming, expensive, ecologically invasive, require a high level of taxonomic expertise and are often ineffective, especially if the target organism occurs at low population densities.

Traditional survey methods for demon shrimp such as kick sampling (pictured here) are time consuming, require taxonomic expertise and can be dangerous in certain river conditions.

Demon Shrimp eDNA

All aquatic species leave traces of their DNA in the environment, in the form of gametes, mucus, faeces or shedding of cells. Known as environmental DNA, it is possible to extract this DNA from a water sample in order to determine species presence. eDNA is a non-invasive tool for quickly and easily assessing species distribution, demonstrated to be highly repeatable and cost effective due to the lower sampling effort required.

SureScreen Scientifics has a strong background in assay development, with new services being launched frequently. Developed in-house in partnership with researchers from the University of Derby, SureScreen now offers an eDNA identification service for demon shrimp, using only a small water sample.

Throughout the development process, the assay design was optimised using the Minimum Information for Publication of Quantitative Real-Time PCR Experiments (MIQE) guidelines, described in more detail in our Pearl Mussel White Paper. As with all of our services, these guidelines ensure that the demon shrimp identification service meets our high standards. Applying stringent testing processes, as we do for all of our assays, we can ensure that we provide a fast, accurate and reliable service. Throughout its development, this process was tested across 33 locations in the West Midlands, including canals, rivers and reservoirs. With confirmed presence in 21 of these locations, and confirmed presence in Hertfordshire and Kent, among others, the demon shrimp is now widely spread across the UK.

Our demon shrimp identification service is now available to ecologists, conservationists and environmental groups in an effort to help control the spread of this damaging, invasive species.

Technical Paper

Mauvisseau, Q., Troth, C., Young, E., Burian, A., Sweet, M. (2019) The development of an eDNA bsed detection method for the invasive shrimp Dikerogammarus haemobaphes. Management of Biological Invasions 10 (3), 449-460.

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