NOTA DE PRENSA

Genetics also support the Italian origin of crayfish in Spain

- **Extensive evidence indicates that crayfish were introduced to Spain from Italy in the 16th century, although some authors argue that genetic findings contradict this origin story.**

- **A research team from the Doñana Biological Station – CSIC now shows that genetic patterns actually reinforce conclusions drawn from other types of evidence, ruling out the idea that the crayfish is native to Spain.**

Italian crayfish (Austropotamobius fulcisianus) photographed in the northern Apennines, within its native range. Photo: Miguel Clavero

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Sevilla, 23 de junio de 2025. A research team from the Doñana Biological Station – CSIC has reviewed all available genetic data on crayfish of the *Austropotamobius* genus to investigate the origin of the Italian crayfish (*Austropotamobius fulcisianus*) populations found in Spain. This species has been referred to at various times as the Spanish, native, or more recently, Iberian crayfish. However, its genetic patterns contradicts its classification as native and, together with a wide range of other evidence, clearly points to an Italian origin. The study has just been published in *Ecosistemas*, the scientific journal of the Spanish Association of Terrestrial Ecology.

Genetic analyses conducted so far show that the crayfish found in Spain are not only of the Italian species (*Austropotamobius fulcisianus*), but specifically of the subspecies native to Tuscany (*Austropotamobius fulcisianus subsp. fulcisianus*). “This is hard to explain without assuming a human-mediated introduction, given that the Iberian and Italian Peninsulas have been geographically isolated by mountain ranges for tens of millions of years and share very little freshwater fauna,” explains Miguel Clavero, researcher at the Doñana Biological Station and lead author of the study. “In fact, north of the Pyrenees there’s another crayfish species (*Austropotamobius pallipes*), which has never been detected in Spain.”

The hypothesis of an Italian origin for crayfish in Spain has been proposed by various authors since the 1980s. However, it was a research led by the Doñana Biological Station that uncovered the historical events behind their introduction. Spanish King Philip II, eager to stock the royal ponds with exclusive species, encouraged the arrival of crayfish. Historical records show that the royal court attempted to acquire crayfish from regions like Flanders and France for at least 25 years. The introduction was ultimately carried out with specimens sent from Tuscany in February 1588.

Despite this historical context, several studies published since 2008 have used genetic data to argue that *Austropotamobius fulcisianus* is a native species in the Iberian Peninsula. “It seemed clear to us that something had gone wrong in the interpretation of that data,” says Clavero. “Iit’s hard to believe they could contradict well-established historical events that already provide a solid explanation for current biogeographical patterns.”

A pesar de este contexto, diferentes trabajos publicados desde 2008 han utilizado datos genéticos para defender que *Austropotamobius fulcisianus* es una especie nativa en la península ibérica. “Nos parecía que algo tenía que haber fallado en la interpretación de los resultados genéticos, porque es difícil asumir que contradijesen sucesos históricos bien conocidos, que explican adecuadamente los patrones biogeográficos actuales”, apunta Clavero.

Those studies based their arguments on the richness of haplotypes (the different genetic variants detected in a DNA sequence) and the presence of exclusive haplotypes (not found in other regions). “But neither of these factors is a reliable indicator of whether a species is native or not,” the researcher asserts.

As a result, the team at the Doñana Biological Station decided to review known genetic patterns in introduced species, then apply that framework to the case of crayfish in the Iberian Peninsula.

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Introduction does not mean low genetic diversity

It is often assumed that when a species is introduced from its native range to a new region, it suffers a loss of genetic diversity—because the subset of individuals transported likely doesn't capture all the genetic variants found in the native populations. While this is true in many cases, there are several scenarios where introduced populations can maintain high, or even greater, genetic diversity than in their native range. This can occur when many individuals are introduced, repeatedly, from multiple sources, or when the introduced individuals come from genetically diverse populations—such as those formed by mixing individuals from different origins.

This latter case likely applies to the crayfish introduced to Spain from Tuscany in 1588, as they came from artificial populations maintained in the gardens of the Grand Duchy of Tuscany.

Furthermore, the presence of exclusive haplotypes in a region—as seen in the Spanish populations of *Austropotamobius*—does not necessarily mean the species is native. The idea of haplotype exclusivity heavily depends on how thoroughly the species' genetic diversity has been studied across its entire distribution. In the case of *Austropotamobius fulcisianus*, relatively little is known about its genetics in Italy, whereas the amount of data from Spain has steadily grown as more individuals and populations have been sampled.

"The result," Clavero points out, "is that recent studies include fewer and fewer Italian samples, with the latest ones representing less than 5% of all individuals and populations. Under those conditions, it makes no sense to argue that Spain has more haplotypes or that some don't appear in Italy. That data simply isn't informative."

The article proposes that rather than focusing on the number and exclusivity of haplotypes, researchers should look at how haplotypes are related to one another to determine whether a species has been introduced. If populations in two regions were both native, their haplotypes would be expected to cluster into two distinct groups—since genetic variants in one area would be more closely related to each other than to those in a distant region.

However, that is not the case with *Austropotamobius fulcisianus*. The haplotypes found in Spain and Italy are interrelated without any clear pattern or geographical separation. "Even with the limited data available from Italian populations, this pattern is enough to indicate that the Iberian populations are introduced," says Clavero.

A pattern similar to the red swamp crayfish

The researchers also compared the genetic patterns found in the Italian crayfish with those of the red swamp crayfish (*Procambarus clarkii*), a North American species introduced to Spain in 1973. Both species exhibit

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numerous haplotypes in the Iberian Peninsula—many of which have not been detected in their native ranges (Italy and the southeastern United States, respectively).

Using the same logic employed by those who argue that the Italian crayfish is native, one could claim that the red swamp crayfish is also native to Iberia. “We know it’s not native because we know who introduced it, why, how, and when,” Clavero explains. “The genetic patterns simply match up with that known history. The same is true for the Italian crayfish.”

In 2024, Spain’s Ministry for the Ecological Transition and the Demographic Challenge approved a national conservation strategy for the Italian crayfish—referred to as the Iberian crayfish and misidentified as *Austropotamobius pallipes*, despite the fact that this species does not exist in Spain.

“The strong, coherent evidence of the Italian crayfish’s historical introduction—supported by multiple lines of inquiry, from history to genetics—should prompt the Ministry to reconsider its priorities,” Clavero concludes. “It is ultimately responsible for protecting Spain’s rich, globally unique freshwater fauna, which remains severely threatened and largely neglected by public agencies.”

Reference

Clavero, M., Bedmar, S., & Oficialdegui, F. J. (2025). How (not) to use genetic data to assess nativeness and the case of the Italian Crayfish in Iberia. http://hdl.handle.net/10261/393044

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