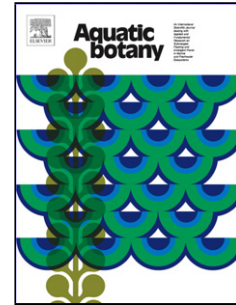


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Title page

Riding invasion waves: spatial and temporal patterns of the invasive *Lemna minuta* from its arrival to its spread across Europe

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Highlights

- The European invasion history of *Lemna minuta* was spatio-temporally reconstructed
- Initial introduction events occurred along Atlantic coastal areas
- *Lemna minuta* occupied the UK and Central Europe by the 1980's
- Southern Europe invasion around 1990s and still moving eastward
- Invasion routes and future invasion areas identified by georeferenced-temporal data

Abstract

In Europe, the duckweed *Lemna minuta* is an invasive alien that can cause severe abiotic-biotic alterations of lentic aquatic ecosystems. Its invasion history across Europe was spatio-temporally reconstructed from its various introductions to its present distribution by analyzing georeferenced historical records obtained from different sources (bibliography, national-international digital databases). Fuzzy clustering, a form of classification in which an element belongs to different clusters according to a degree of belonging, was used to identify the most important temporal invasion events (pulsations). Geographical representation of these pulsations in invasion maps simplified the detection of the main dynamics of *L. minuta* movements across Europe. Based on the analyses of the historical data, five main invasion pulsations were identified (1965, 1982, 1991, 2000, 2010). Invasions in Europe began along the Atlantic coasts around the 1950s- 1960s. Around the 1980s, *L. minuta* spread extensively across the United Kingdom and Central Europe. After this, it started to invade Southern and also Eastern Europe, mainly stabilizing around the 2000s. In the last decade, *L. minuta* consolidated its occurrence in Western and Central Europe, while it continues to colonize new Mediterranean and Eastern European regions. This analysis type is effective in determining spatial-temporal dynamics of invasive alien plants using georeferenced historical data and it also offers

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