{rokbox title=|Example of spread measurements for three non-native macrophytes from temperate :: Image: Authors| thumb=|images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-increasing-tropical-non-native-macrophytes-mediterranean-wesselmann-et-al-2024-thumb.jpg|}images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-increasing-tropical-non-native-macrophytes-mediterranean-wesselmann-et-al-2024.jpg{/rokbox}

Marlene Wesselmann, Iris E. Hendriks, Mark Johnson, **Gabriel Jordà**, Frederic Mineur, Núria Marbà, 2024.
Increasing spread rates of tropical non-native macrophytes in the Mediterranean Sea
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Glob Change Biol. 2024;30:e17249. https://doi.org/10.1111/gcb.17249

Abstract: Warming as well as species introductions have increased over the past centuries, however a link between cause and effect of these two phenomena is still unclear. Here we use distribution records (1813–2023) to reconstruct the invasion histories of marine non-native macrophytes, macroalgae and seagrasses, in the Mediterranean Sea. We defined expansion as the maximum linear rate of spread (km year−1) and the accumulation of occupied grid cells (50 km2) over time and analyzed the relation between expansion rates and the species' thermal conditions at its native distribution range. Our database revealed a marked increase in the introductions and spread rates of non-native macrophytes in the Mediterranean Sea since the 1960s, notably intensifying after the 1990s. During the beginning of this century species velocity of invasion has increased to 26 ± 9 km2 year−1, with an acceleration in the velocity of invasion of tropical/subtropical species, exceeding those of temperate and cosmopolitan macrophytes. The highest spread rates since then were observed in macrophytes coming from native regions with minimum SSTs two to three degrees warmer than in the Mediterranean Sea. In addition, most non-native macrophytes in the Mediterranean (>80%) do not exceed the maximum temperature of their range of origin, whereas approximately half of the species are exposed to lower minimum SST in the Mediterranean than in their native range. This indicates that tropical/subtropical macrophytes might be able to expand as they are not limited by the colder Mediterranean SST due to the plasticity of their lower thermal limit. These results suggest that future warming will increase the thermal habitat available for thermophilic species in the Mediterranean Sea and continue to favor their expansion.

Keywords: climate change, expansion, geographic occurrences, invasive species, native range, seaweed, temperature, thermal tolerance