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# Threatened *Artemia* Biodiversity in the Iberian and Western Mediterranean Region

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Two anthropogenic activities that lead to a decrease in biodiversity are the destruction of habitat and the introduction of exotic species. The autochthonous species of the genus *Artemia* are being eliminated from hypersaline ecosystems in the Old World after the introduction of *A. franciscana* from America. This report summarizes data about the present distribution of the invasive *A. franciscana* populations identified in the Iberian and Western Mediterranean area. In Spain the most important invaded solar saltern complex is located at the Cadiz salt marshes. The recent finding of *A. franciscana* in the salterns of Isla Cristina (Huelva Province) shows its range extension from the Portuguese Algarve District to the East, invading the neighbouring Spanish salterns, and from where it has been likely progressing northward, invading up to the Portuguese Aveiro District salterns. Two more important hypersaline environments in Spain have been invaded by *A. franciscana*, the Fuente de Piedra hypersaline inland lagoon in the province of Málaga, and the river Ebro Delta salterns in the province of Tarragona (Mediterranean shore). These are important hotspots for potential brine shrimp dispersion, being among the most important nesting areas for flamingos in the Iberian Peninsula. The presence of *A. franciscana* in the salt marshes and salterns of Salin de Giraud evidences the spread of the invasive species into the Mediterranean French Departments (Languedoc-Roussillon and Provence), probably as a consequence of their location in the West Mediterranean flyway, East of Gibraltar. We have also recently discovered *A. franciscana* populations in La Guérande salterns in the French Loire Atlantique Department. In the winter and spring of 2007 we used open-air mesocosms to study competitive elimination of the autochthonous species by the invasive *A. franciscana*. In winter when cold temperatures extended maturation to 40 days, both the invasive and native populations coexisted (Figure 1). However, even under a daily thermal range as low as 10º-20ºC, the invasive species reached maturity earlier than the autochthonous species. Other fitness traits (interbrood interval; fecundity) also provide *A. franciscana* a competitive advantage. In mid-April temperatures increased markedly, together with a clear decline on phytoplankton availability. Under these conditions all species, except *A. franciscana*, shifted egg production from ovoviviparous recruitment of nauplii to production of cysts (oviparism). By late May *A. franciscana* females showed balanced levels of ovoviviparism and oviparism as a result of declining phytoplankton availability. All the other competing species had disappeared from the water column (Figure 1). In a four month period the invasive *A. franciscana* species had outcompeted the autochthonous bisexual species *A. salina* and the two parthenogenetic strains.

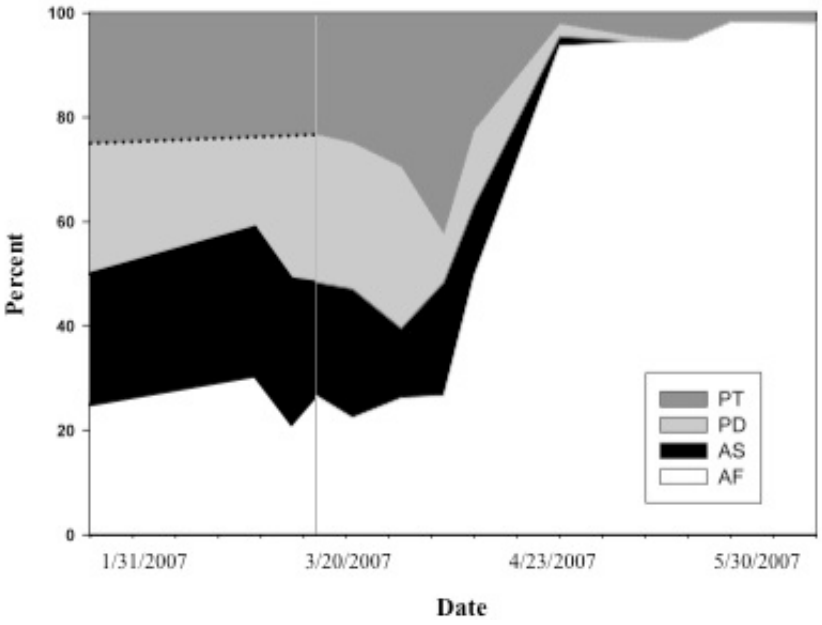


**Figure 1**–Changes in population composition in terms of percentages for the different species present in the competition open air mesocosm experiment conducted during the period January–May 2007: AF (invasive *A. franciscana*), AS (autochthonous bisexual *A. salina*), PD and PT (autochthonous parthenogenetic *Artemia*, diploid and tetraploid, respectively).



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