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Aquatic Invasions Records

First record of the Japanese shore crab *Hemigrapsus sanguineus* (de Haan, 1835) (Brachyura: Grapsoidea: Varunidae) from the Black Sea

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Abstract

The Japanese shore crab *Hemigrapsus sanguineus* is recorded for the first time from a Black Sea locality: Tomis Marina in Constanţa, Romania. The suggested vector of introduction is as adults in the hull fouling of yachts. The species has not established and salinity requirements for larval development make it unlikely that it will ever establish in the Black Sea.

Key words: *Hemigrapsus sanguineus*, Black Sea, Romania, not established

Introduction

The Japanese shore crab *Hemigrapsus sanguineus* (de Haan, 1835) is native to the North-Western Pacific, where it is distributed from Peter the Great Bay, Russia to Hong Kong, including the coasts of Japan, Korea, China and Taiwan (McDermott 1998a). It lives in high energy habitats, usually in crevices between boulders of rocky shores, but also on sand provided some rocks are present (Fukui 1988; Benson 2005).

The species already has a history of transoceanic invasions. In September 1988 *H. sanguineus* was first discovered in New Jersey, on the Atlantic coast of the United States and by 1990 a breeding population was already established (Williams and McDermott 1990; McDermott 1991). At present it ranges from Maine to North Carolina (Delaney et al. 2008).

In 1999 it was recorded from the Atlantic coasts of Europe, in Le Havre, France and the Oosterschelde estuary in The Netherlands (Breton et al. 2002). It has established there and now is present in Germany, The Netherlands, Belgium and France (Obert et al. 2007; d'Udekem d'Acoz and Faasse 2002; Faasse 2004; d'Udekem d'Acoz 2006; Kerckhof et al. 2007; Dauvin 2009; Dauvin et al. 2009).

In 2003 a single adult male *Hemigrapsus sanguineus* was recorded from the northern Adriatic Sea (Schubart 2003) and this remains the only known Mediterranean record to date.

Material and methods

In August 2008 we studied the rocky midlittoral and sublittoral crustacean fauna around Constanţa, Romania by snorkeling and SCUBA diving. Samples were fixed in 10% buffered seawater-formalin for 24 h and then transferred to 70% ethanol for storage.

During this investigation one adult male *Hemigrapsus sanguineus* was collected inside Tomis Marina (N 44°10'43", E 28°39'37") on 27 August 2008, from under a rock just above the waterline (Figures 1-2). The specimen has been deposited at the National Museum of Natural History "Naturalis", Leiden, under accession number RMNH D 53141.

Intense efforts to catch additional specimens were unsuccessful in spite of the large extent of the searches. Tomis Marina was subsequently surveyed bimonthly by one of the authors, from August 2008 to October 2009. The search was extended to the adjacent commercial harbour Constanţa-Sud Agigea and other harbours along the Romanian coast (Midia Harbour, Eforie Marina, Mangalia Harbour) which were examined repeatedly over this same period. No other specimens of *H. sanguineus* were found.

Figure 1. The Black Sea with the general study area - yellow rectangle - and the sampling site - white arrow (satellite image from Google Maps).

Figure 2. *Hemigrapsus sanguineus* ♂ specimen from the Black Sea collected inside Tomis Marina on 27 August 2008 (divisions on the scale bar are millimeters). Photograph by D.Micu.

Results and discussion

The single specimen of *Hemigrapsus sanguineus* was found inside the marina, where only yachts and small fishing craft are berthed, and nowhere else, including commercial harbours (notwithstanding these come first to the mind as potential areas of introduction). This leads us to the assumption that yachts have been the vector of introduction in the Black Sea. The smaller yachts operated in the region do not carry ballast water, so the possibility of larval transport in ballast water should be excluded. The relatively large size of the individual found (carapace width 20.7 mm) corresponds probably to an age of two years (Fukui 1988). If *Hemigrapsus sanguineus* was introduced as larvae two years before, one would expect the occurrence of a larger number of individuals possibly over a greater area.

The transport of decapod crustacean larvae in bilge water of small craft has been documented previously (Darbyson et al. 2009). However the transport of living larvae from the Atlantic coast

of Europe (from France to Germany, the only part of Europe where self-sustaining populations of *H. sanguineus* occur nowadays) to the Black Sea in the bilge water of a yacht is highly unlikely. A yacht voyage includes frequent stopovers, some of them rather long. Even in the absence of stopovers it is not possible to make the voyage from the North Sea to the Black Sea, via the Mediterranean, in a single month, which is the maximum extent of the crab's larval stage (Epifanio et al. 1998; McDermott 1998b; Benson 2005). Consequently we conclude that larval introduction, by whatever means, should be excluded.

Hull fouling is another important vector for invasions, a large proportion of the known exotics arriving in this way (Minchin and Gollasch 2003). Recreational boats too, not only large commercial ships, can transport exotic species in their hull fouling. Yacht traffic is not an important vector for transoceanic transport of non-native species but may become a highly significant vector for shorter range transport, once a successful transoceanic transplantation has been made by other means (Minchin et al. 2006; Wasson et al. 2001). The role of yacht hull fouling in the spread of several other non-native species has already been recognized (Farrell and Fletcher 2006; Griffith et al. 2009; Lambert 2006). For *H. sanguineus* the likely way of introduction in Tomis Marina was the movement of adults in the hull fouling of a yacht. This is consistent with the large size and very small number of individuals found (single specimen).

The absence of any other *Hemigrapsus sanguineus* at the site of first record and in all other potential areas of introduction (commercial and leisure ports) for more than a year shows that only very few individuals were introduced, not enabling the species to establish itself.

However, in the event of a more substantial re-introduction, is it possible for *Hemigrapsus sanguineus* to establish in the Black Sea? The Black Sea has a maximum surface water salinity of 18.5 PSU, while in the Romanian sector the surface water salinity varies between 17 PSU and 13 PSU (Sorokin 2002). Adults of *H. sanguineus* have an optimal salinity range of 24-35 PSU (Ledesma and O'Connor 2001) but can survive in salinities as low as 10 PSU (McDermott 1995, 1998a) due to their strong osmoregulatory capacity (Watanabe 1982).

Experiments on the effects of salinity and temperature on larval survival of *H. sanguineus* have shown that, while it is capable of developing to the megalopa stage in salinities as low as 15 PSU, no megalopa larvae can survive to the first crab stage at salinities below 25 PSU or at temperatures below 20ºC (Epifanio et al. 1998).

In conclusion, while *Hemigrapsus sanguineus* settled stages introduced in the Black Sea may survive for the length of their natural life, larvae (either released by ballast water or resulting from reproduction of introduced adults) are unable to complete their development. This prevents the Japanese shore crab from becoming established in the Black Sea.

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