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A new record of the Red swamp crayfish, *Procambarus clarkii* (Girard, 1852) (Crustacea Cambaridae), in Sicily, Italy

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ABSTRACT The Red swamp crayfish, *Procambarus clarkii* (Girard, 1852), is a decapod crustacean native of the United States and Northern Mexico that was introduced in several countries of the world. This species are known to have detrimental effects on invaded ecosystems. The Red swamp crayfish was found for the first time in Sicily in 2012, inside the Nature Reserve "Lago Preola e Gorghi Tondi" (Trapani province). This paper describes the discovery of a second population of this species at the "Rosamarina" reservoir (Palermo province), whose origin appears to be independent of the first one. This new finding emphasizes the need for extensive survey in Sicily and the development of an adequate action plan for containment or eradication of this species.

KEY WORDS monitoring; wildlife management; protected areas; mapping.

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INTRODUCTION

The Red swamp crayfish, *Procambarus clarkii* (Girard, 1852), is a decapod crustacean belonging to the Cambaridae family; it is native to the Southern and Central United States of America, and to Northern Mexico (Souty-Grosset et al., 2006). Because of its frequent use for fishery production and pet/aquarium trade, in the last decades it was introduced in several South-American, African, Asian and European countries (Hobbs et al., 1989).

In Europe, the species was first introduced in 1973 in southern Spain (Ackefors, 1999; Souty-Grosset et al., 2006). It soon became widely spread in the whole Iberian Peninsula and was then introduced in France, Germany, Switzerland, Austria, Belgium, the Netherlands, Czech Republic, United Kingdom and, probably, Cyprus (Souty-Grosset et al., 2006). In Italy, the first reproductive population of the species was found in Piedmont in the early '90s (Del Mastro, 1992); afterwards, it successfully invaded most of the Italian Peninsula and Sardinia (e.g. Froglia, 1995; Mazzoni et al., 1996; Aquiloni et al., 2010).

In Sicily, the first record of a naturalized population of the Red swamp crayfish was reported by D'Angelo & Lo Valvo (2003) for the Nature Reserve "Lago Preola e Gorghi Tondi" (Trapani province). There, despite several attempts aimed at the eradication of this population, the species is still present with a thriving population.

RESULTS

In October 2012 a single, gravid, *P. clarkii* female was collected by an angler (L. Sapienza, pers.

comm.) in the "Rosamarina" reservoir (Palermo province, UTM WGS84 33S 381200 - 4201700), a large man-made lake located approximately 95 km NE of the only other known Sicilian occurrence site of the species (D'Angelo & Lo Valvo, 2003) (Fig. 1). "Rosamarina" is a mesotrophic canyon reservoir, characterised by sulphate-rich waters and scarcely pronounced water-level fluctuations (Naselli-Flores et al., 2003), it was built between 1972 and 1992 through the damming of "San Leonardo" river, and it has a maximum surface area of 5.5 km^2, with a mean depth of 19.2 m and a maximum depth of 61 m (Naselli-Flores et al., 2003).

Following the first sighting of a Red swamp crayfish in "Rosamarina" reservoir, an exploratory trapping campaign was carried out between November and December 2012, but no crayfish was captured nor observed. For the capture was used a home-made funnel trap measuring 25x30x70 cm, baited with fish fillet and canned tuna. The trap was positioned at the same point of first observation, at approximately 70 cm deep in a muddy bottom.

In May 2013 some remains of a preyed crayfish were found near the first observation site (L. Sapienza, pers. comm.) and a second sampling session was thus carried out. The trapping campaign was conducted near the first observation site, in a second site located approximately 1 km SW from the first and in a third site in "San Leonardo" river. The trapping area covered the whole length of the lake (approximately 6 km). In the frame of the second session four individuals of Red swamp crayfish (2 males and 2 females) were trapped in all the three points (Table 1). Their size ranged from 98 to 115 mm in total length.

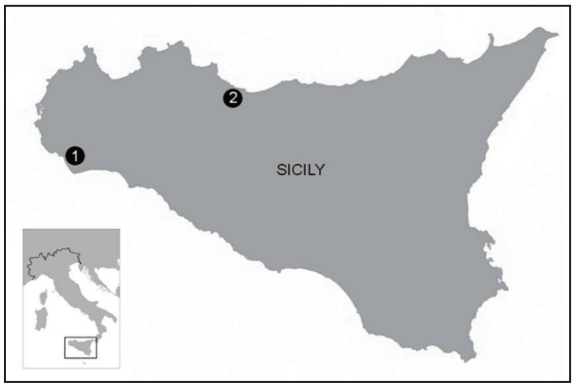

Figure 1. Records of Red swamp crayfish reported in Sicily: 1. Nature Reserve "Lago Preola e Gorghi Tondi" (D'Angelo & Lo Valvo, 2003); 2. "Diga Rosamarina" (present work).

	Date	E	N
1 gravid female*	20/10/2012	33S 381046	4200869
Remains	26/05/2013	33S 381304	4201154
1 male, 1 female**	31/05/2013	33S 381220	4201072
1 female**	07/06/2013	33S 381010	4200181
1 male**	14/06/2013	33S 377762	4196287

Table 1. Observations data and geographic coordinates (UTM WGS84) of Red swamp crayfish in the "Rosamarina" reservoir; *first observation, **individuals detected during the trapping campaign.

CONCLUSIONS

The discovery of several individuals in a wide area of the lake suggests the presence of a naturalized population of Red swamp crayfish. This population probably derives from a different introduction event from the one which originated the other population known for the island (D'Angelo & Lo Valvo, 2003).

Aquatic non-native species are known to have severe adverse effects on invaded ecosystems, as it was verified in Sicily for the African clawed frog, *Xenopus laevis* (Daudin, 1802) (Lillo et al., 2011). Red swamp crayfish is a polytrophic species (Ilhéu & Bernardo, 1993; Momot, 1995; Gutiérrez -Yurrita et al., 1999; Salvi, 1999), that may lead heavy modifications in food webs and specific richness (Statzner et al., 2003; Creed & Reed, 2004). Furthermore, negative effects of feeding behaviour of non-native Cambaridae are known on macrophytes asseblages, amphibians, fish, crustacean and molluscs (Seroll & Coler, 1975; Lodge & Lorman, 1987; Lodge et al., 1994; Diamond, 1996; Gherardi et al., 2001; Renai & Gherardi, 2004; Gherardi & Acquistapace, 2007). The strong burrowing activity of the species is known to cause damages on agricultural areas, dams, dykes, riparian vegetation, and it increases water turbidity (Huner, 1988; Correia & Ferreira, 1995; Anastácio & Marques, 1997; Fonseca et al., 1997).

Keeping in mind the invasiveness and the possible negative effects of the Red swamp crayfish on the already threatened Sicilian autochthonous

biota, this new finding stresses the need for the realization of sound monitoring of the species throughout the island, and the advisability of the planning of adequate management plans.

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