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Aquatic Invasions Records

The Australian redclaw crayfish *Cherax quadricarinatus* (von Martens, 1868) (Crustacea: Decapoda: Parastactidae) in the Sea of Galilee, Israel

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Abstract

The Australian redclaw crayfish, *Cherax quadricarinatus*, was introduced to Israel from the U.S.A. in the early 1990s by the Department of Fisheries, Ministry of Agriculture, with no assessment of its potential to establish feral populations. It has been raised in agricultural research and academic facilities and in commercial farms. A warning against its introduction to the temperate part of the country has been ignored. We report the first appearance of the redclaw in the Sea of Galilee, and discuss possible vectors.

Key words: *Cherax quadricarinatus*, Decapoda, Parastactidae, invasive alien species

Introduction

The native range of the redclaw crayfish *Cherax quadricarinatus* (von Martens, 1868) comprises river catchments in northern Australia and south-eastern Papua New Guinea (Lawrence and Jones 2002). As with all freshwater crayfish development is direct, i.e. there are no larval stages. It is a fast growing gregarious species, which withstands wide variations in temperature, pH, and dissolved oxygen concentrations. Its hardiness, flexible diet and fast growth were attractive to the aquaculture industry and it has been introduced worldwide as an economically important aquaculture and ornamental trade species (Karplus et al. 1998; Lawrence and Jones 2002).

Cherax quadricarinatus was introduced to Israel from the U.S.A. in the early 1990s by the Department of Fisheries, Ministry of Agriculture, for aquaculture purposes (Karplus, pers. com., http://www.fao.org/fishery/introsp/288). Experimental stocking and grow out studies were carried out at the Agricultural Research Organization at Bet Dagan and the Aquacultural Research Station, Ministry of Agriculture, Dor (Karplus et al. 1995, 1998; Sagi et al. 1998). In the latter location, in 1994, individuals were discovered to have overwintered in open earthen ponds. Moreover, it was recorded that "in the absence of fences" individuals wandered into adjacent ponds and drainage canals. Karplus et al. (1998) opined that the species is able to survive, disperse and establish in Israel. He considered that "introduction of *C. quadricarinatus* into Israel's southern part, in which the introduction sites are isolated from natural water sources by the desert, seems safer" and cautioned against introducing it into the temperate areas. Karplus' advice went unheeded, the species is now raised in Kfar Monash, on the central coastal plain, where intensive farming is able to provide up to 100,000,000 juveniles to distributors and ornamental shop chains in Israel and Europe (http://www.aquology.com).

Methods and results

On January 2011, a large specimen (total length 187 mm, carapace length 91 mm) was captured in shallow waters (2-3 m depth) at the Sea of Galilee (Lake Tiberias), opposite Tiberias promenade and bathing beach (32.789006N, 35.546951E). The substrate in the area consists of silty-sand with boulders of varying sizes. The specimen was caught by recreational fishermen using a gill net and handed to the senior author. It was kept in a freshwater aquarium for several

Figure 1. *Cherax quadricarinatus*, dorsal view of male, Sea of Galilee, Israel. Total body length 187 mm; cephalothorax length 91 mm. (Photograph: B.S. Galil).

Figure 2. *Cherax quadricarinatus*, cephalothorax of male, Sea of Galilee, Israel. Total body length 187 mm; cephalothorax length 91 mm. (Photograph: B.S. Galil).

weeks. The specimen was conspicuously colored with lateral red and maroon highlights on a blue-green to brown abdomen, and possessed the distinctive bright red patch on the outer surface of the first pair of chelae (Figures 1, 2). The specimen was deposited in the National Collections at Tel Aviv University (TAU AR 29009).

Discussion

Cherax quadricarinatus is widely recognized as an invasive species, and has already established feral populations in several tropical and subtropical countries, e.g., Queensland and New South Wales, Australia, Africa, Mexico, Puerto Rico, Jamaica and Singapore (Williams et al. 2001; de Moor 2002; Bortolini et al. 2007; Coughran and Leckie, 2007; Ahyong and Yeo 2007; Belle and Yeo 2010).

Both the aquaculture and ornamental industries are considered putative vectors. Brood stock had been introduced to Jamaica in 1993, and already in 1999 feral populations were recorded in the Black River (http://jamaicachm.org.jm/PDF/April2005.pdf). In 1995 it was imported by the Universidad Autonoma Metropolitana, Mexico City and subsequently transferred to other research centres and commercial farms. In 2000 culture was initiated in a facility in central Morelos where, after the first heavy rainfall, the species presence was

noted in the adjacent recreational aquatic park (Bortolini et al. 2007). The species was introduced illegally into Puerto Rico in 1997, and following Hurricane Georges in 1998, spread into the wild (Garcia Vazquez 2009). In Singapore it is sold as an ornamental aquarium species readily available in wet markets and aquarium shops, and was recently collected from man-made reservoirs and ponds (Ahyong and Yeo 2007; Belle and Yeo 2010).

Twenty-one alien fish species have been recorded from the Sea of Galilee (Goren and Galil 2005; Roll et al. 2008), together with a single decapod crustacean (Snovsky and Galil 1990). Most fish species were intentionally introduced for commercial purposes or as biocontrol agents, although some were unintentional introductions. *Anguilla anguilla* (Linnaeus, 1758) and *Callinectes sapidus* Rathbun, 1896 were introduced with fry caught in estuaries along the Mediterranean coast of Israel and used to regularly restock the lake. The *C. quadricarinatus* specimen may have originated in an aquaculture facility in the Sea of Galilee catchment area, illegal stocking or "setting free" a pet. Clearly, more extensive monitoring is required to assess its population size and structure and its environmental impacts within the artificial ecosystem of the Sea of Galilee.

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