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## Further translocation of the Redclaw, *Cherax quadricarinatus* (Decapoda: Parastacidae), to Lake Ainsworth in northeastern New South Wales, Australia

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Jesse C. Leland, Jason Coughran and James M. Furse

**Abstract.**—The native Australian crayfish *Cherax quadricarinatus* (or Redclaw) is a large, highly fecund and fast growing species that has been widely translocated both interstate and internationally. This paper describes a translocated population of the species in Lake Ainsworth, an acidic coastal window lake in New South Wales. This population now represents the southern–most extent of its translocated range within Australia, and coincides with two native crayfishes, *Cherax cuspidatus* and a highly imperilled species of *Tenuibranchiurus*. Consistently high trap catches and collection of berried females indicates that the population in Lake Ainsworth is large, well established and self-sustaining. The probable pathway of introduction to the lake was by human action (deliberate or accidental), rather than natural dispersal from previous sites of introduction. Native crayfish were not captured in the lake, but their presence was confirmed in ephemerally connected habitats ~2–3 km away. There are serious concerns about the further spread of the highly invasive *C. quadricarinatus* and its potential to displace native species.

### INTRODUCTION

The Redclaw crayfish *Cherax quadricarinatus* (von Martens) is native to Queensland, the Northern Territory and New Guinea (Kailola *et al.*, 1993; Lawrence & Jones 2002; Wingfield, 2008) and is listed as Least Concern on the IUCN Red List (Austin *et al.*, 2009). This tropical species is highly fecund, grows rapidly (harvestable size of 50–90 g in 8–12 months), matures quickly (between ~30–70 g in 6–9 months), and can reach substantial weights of up to 590 g (Wingfield, 2002). Combined with

its tolerance of extreme environmental conditions (e.g. water temperatures up to 34°C and poor water quality, including brackish water), these intrinsic qualities have facilitated the worldwide translocation of *C. quadricarinatus* for aquaculture research, commercial farming, recreational fishing (Horwitz, 1990; Kailola *et al.*, 1993) and the aquarium trade (Peay *et al.*, 2010). Recipient regions include the Americas, Europe, Asia and the Middle East (Lawrence & Jones 2002) and, more recently, areas within Australia beyond its natural range (Coughran & Leckie, 2007; Doupé, 2007; Doupé *et al.*, 2007; Wingfield, 2008).

Translocation of crayfish species of commercial aquaculture potential (e.g. *Procambarus clarkii* (Girard) and *Pacifastacus leniusculus* (Dana)) (Anastacio *et al.*, 1999; Gherardi *et al.*, 2002; Peay *et al.*, 2010) have been replicated in the Australian state of New South Wales (NSW), where both *C. quadricarinatus* and *Cherax destructor* Clark have been introduced (Coughran & Leckie 2007; Coughran *et al.*, 2009; Coughran & Daly, 2012). Coughran & Leckie (2007) described the first invasion of a NSW waterway (Emigrant Creek) by *C. quadricarinatus* and discussed the need for monitoring the translocation of this species. However, it appears that no funding or effort has been allocated to this objective, and no further reports of *C. quadricarinatus* translocation have been made since that time.

The presence of *C. quadricarinatus* in Lake Ainsworth, NSW was brought to the authors' attention in April 2011, when a recreational fisher was observed removing large adult crayfish from his traps. Lake

Ainsworth (28.78327°S 153.591936°E) is a relatively uncommon lake-type (perched freshwater window lake) that occurs along the east coast of central Australia (Timms, 1982). The geology of the area is dominated by basaltic and rhyolitic bedrock and soils from the former Tweed Volcano (Willmott, 1986). Lake Ainsworth was formed by coastal siliceous sand deposits overlaying the bedrock, and has a surface area of ~0.12 km<sup>2</sup> with a maximum depth of ~10 m. As is typical in perched window lakes, pH is usually acidic (~pH 5.0) and salinity is low (70–115 ppm) (Timms, 1982).

Riparian vegetation includes various grasses and macrophytes, and the northern and southern landward extents of the lake are bordered by extensive coastal swamp and floodplain. The bordering *Melaleuca* swamps are inhabited by the native crayfish species *Cherax cuspidatus* Riek and *Tenuibranchiurus* sp. Riek (authors unpublished data and Coughran 2006a, 2006b). The former is classified as Least Concern, while the latter is considered an “Evolutionarily Significant Unit” (ESU, Moritz, 1994) by Dawkins *et al.* (2010) and therefore a very high conservation priority.

To our knowledge there have been no initiatives in funding, education, or field effort to reduce the spread of this exotic species since it was first reported in NSW. Of particular concern regarding this new population in Lake Ainsworth is that the species is now in immediate proximity to the only known site inhabited by the previously outlined *Tenuibranchiurus* sp., a highly imperilled native crayfish (Dawkins *et al.*, 2010). In this paper, our aim was to (i) formally report the presence of the species and (ii) briefly discuss the implications for native crayfish in Lake Ainsworth.

## DISCUSSION

To our knowledge, this is the first formal record of a *C. quadricarinatus* population in an acidic coastal window lake. The pathway of the species’ introduction to Lake Ainsworth is unknown, but the lake is in the same catchment as the Emigrant Creek population, so a combination of

movement through local waterways and overland migration is possible. However, more probable pathways include inadvertent “bait–bucket” transfer, aquarium discards, and intentional (and illegal) translocation/stocking by recreational fishers.

Extensive trapping surveys and opportunistic observations of recreational fishers, indicate that large numbers of mature *C. quadricarinatus* can be captured irrespective of season and suggest that the population is well established (Leland unpublished data). Reproduction is occurring within the population as evidenced by the capture of berried females, which are extremely rare in trap catches, probably because of trap avoidance (Brown & Brewis, 1978). Compared with males, females are disproportionately common and low numbers of juveniles in catches probably indicate similar behaviour, due to the presence of larger adult crayfish in or around the traps (i.e. trap size–selectivity Mitchell *et al.*, 1994; Rabeni *et al.*, 1997). Further studies to quantify the population characteristics are needed, with a view towards identifying best practises for controlling *C. quadricarinatus* in Lake Ainsworth.

The absence of native crayfish in catches is of some concern. It may be that *C. quadricarinatus* has displaced the smaller, native *C. cuspidatus*, which is otherwise ubiquitous in the area. However, it is also possible that native crayfish are present in the lake, and were simply avoiding the traps in the presence of the larger *C. quadricarinatus*. During 2010 and 2011, trapping and sweep–netting surveys of the adjacent *Melaleuca* swamp habitat (~2–3 km north of Lake Ainsworth) confirmed the presence of the native *C. cuspidatus* and *Tenuibranchiurus* sp. in the area (Furse unpublished data). During that time, *C. cuspidatus* were captured with the same bait traps in the *Melaleuca* swamp, which establishes the species was not generally ‘trap shy’ at that time. To date *C. quadricarinatus* have not been captured in any adjacent habitat by the authors or our colleagues.

Freshwater crayfish (including *C. quadricarinatus*) are well known for their ability to move overland (Riek, 1951;

Olszewski, 1980; Furse *et al.*, 2004; Coughran & Leckie, 2007), and we are concerned about the further spread of this species. In particular, there is a serious concern regarding the potential of this species to disperse into adjacent, ephemeral interconnected swamps and waterways, especially to the north where the only known locality of the ESU *Tenuibranchiurus* sp. is situated, ~2–3 km away from Lake Ainsworth. At a broader level, it also appears that the species may be being deliberately translocated in the northeastern NSW region, where it appears capable of establishing feral populations. This region supports several rare and endangered crayfish, fish and other aquatic species (e.g. amphibians): and introduced crayfish are well known for their capacity to displace native crayfish, fish and amphibian species (Horwitz, 1990; Harlioğlu & Harlioğlu, 2006).

Research, management and public education imperatives for this exotic species were outlined by Coughran & Leckie (2007), and we emphasise the need for the Local and State Government to address the previously outlined measures. Urgent action is needed to assess and monitor the spread of this highly invasive species in the northeastern NSW region.

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