Occurrence of the red swamp crawfish *Procambarus clarkii* (Crustacea: Cambaridae) in the Crocodile River at Dullstroom, Transvaal

HJ Schoonbee
Research Unit for Aquatic and Terrestrial Ecosystems, Department of Zoology, Rand Afrikaans University, PO Box 524, Auckland Park 2006, South Africa

Abstract

The red swamp crawfish *Procambarus clarkii* (Girard) has been found in the sponge area of the headwaters of the Crocodile River in the Transvaal. Indications are that it occurs in relatively low numbers despite potentially favourable environmental conditions. Predators such as otters may play a role in its control. The danger exists that it may spread further downstream with time or be translocated to other localities by anglers visiting the site.

Introduction

There are presently a number of alien aquatic plant and animal species which were either intentionally or accidentally released over the years into local inland waters in South Africa (Bourquin et al., 1984; Bruton and Merron, 1985; Julien, 1992). Some of these adapted well and established viable populations under a variety of local environmental conditions, while others such as rainbow trout and black bass are exploited commercially or used for angling purposes (Safriel and Bruton 1984; De Moor and Bruton, 1988). Some alien plants introduced here invaded aquatic and terrestrial habitats, and because of their nuisance or pest status, had to be eradicated using mechanical, chemical or biological means of control (Cilliers 1987, 1991; Julien, 1992).

In Africa, the introduction of alien aquatic animals has already caused major disturbances in the ecology of some of the larger lakes (Lowery and Mendes, 1977a,b; Barel et al., 1985), and care is now taken to avoid the further release of potentially harmful species into local waters, even if some of these appear to be potentially suitable aquaculture candidate species. Freshwater crustacea imported into South Africa for aquaculture purposes include the giant Malaysian prawn *Macrobrachium rosenbergii* (De Man) (Taylor et al., 1992) and species of the Australian crayfish genus *Cherax* (De Moor and Bruton, 1988). Because of the high temperature and salinity requirements of the larvae, *M. rosenbergii* was never able to establish itself in local waters. The marron *Cherax tenuimanus* (Smith) has, however, escaped into the Buffalo River in the Eastern Cape (De Moor and Bruton, 1988) and appears to survive there, but has apparently not been able to establish a viable population, probably because of numerous predators present in local waters. The Louisiana red swamp crawfish *Procambarus clarkii* (Girard) which is cultivated on a large scale in North America and in a number of countries outside its native range (Holdich and Lowery, 1988), is known to have caused serious destruction of some aquatic habitats (Parker, 1974; Huner, 1977; Lowery and Mendes, 1977a,b). Despite its apparently sporadic importation into South Africa by the aquarium trade (Van Eeden et al., 1983; Schoonbee, personal observations), it was only in 1988 that the presence of a viable colony of *P. clarkii* in the headwaters of the Crocodile River first indicated its establishment in an inland water ecosystem in the Transvaal. Material collected from the site as well as specimens obtained during the same year from an aquarium shop in Johannesburg were provisionally identified by the author as *P. clarkii*, which was later confirmed by Prof JV Huner, Director of the Crawfish Center of the University of Southwestern Louisiana (Huner, 1990).

In this paper a brief description is given of the locality in which *P. clarkii* occurs (Fig. 1). A brief description of the animal supported by photographs, is given to facilitate its identification, should it already occur elsewhere in local waters in South Africa. Reference is also made to its natural dietary habits.

Description of *P. clarkii.*

The first pair of walking legs are typically enlarged, with strong claws used to capture food and for protection (Fig. 2A). Young

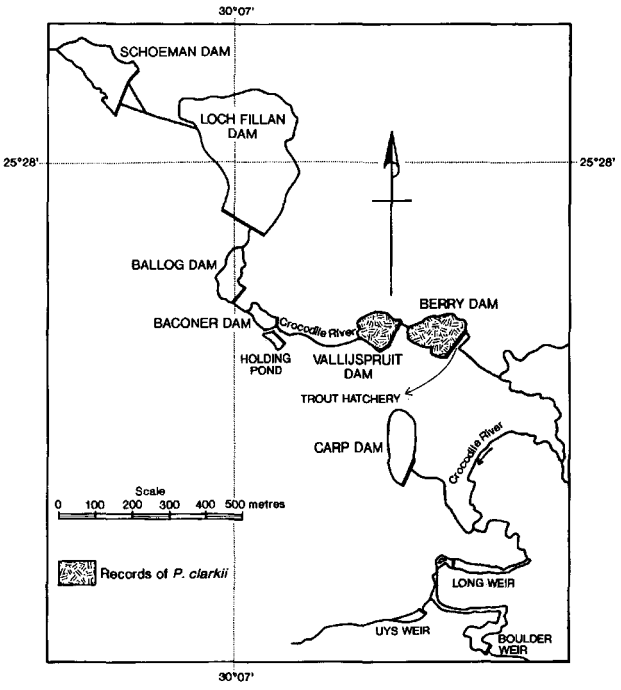

Figure 1
Driehoek Farm Dams with an indication of the present occurrence of Procambarus clarkii

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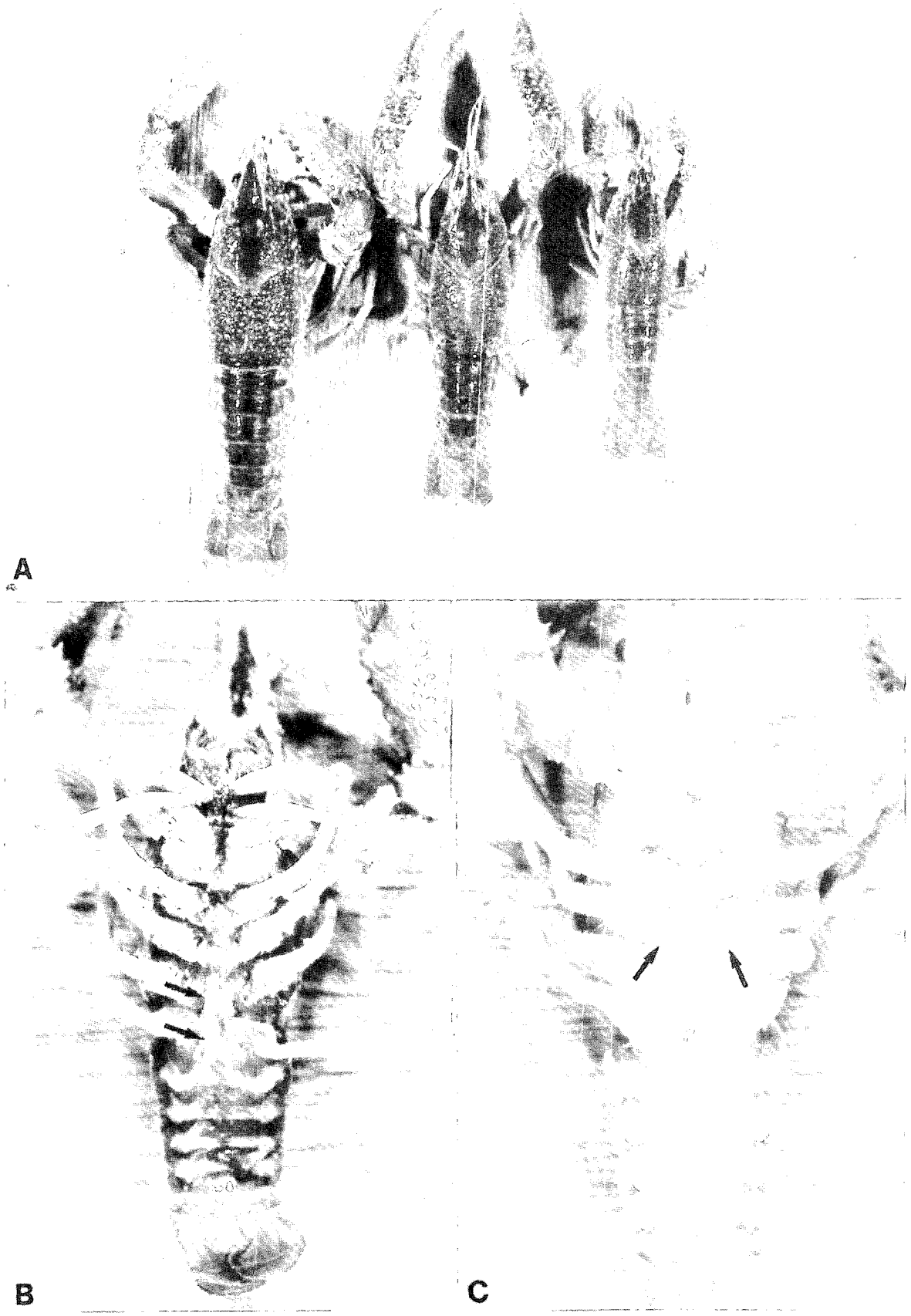

Figure 2
Procambarus clarkii *showing (A) from left to right dorsal views of mature female, mature male and young male; (B) ventral view of male with distinct hooks on walking legs 3 and 4 and modified first two pairs of pleopods (arrows); (C) ventral view of female showing reproductive openings (arrows) at base of third pair of walking legs*

TABLE 1
PHYSICAL AND CHEMICAL CONDITIONS OF THE POND AND RIVER WATER AT THE DRIEHOEK FARM DULLSTROOM, SAMPLED IN 1989 AND 1991

Analysis	March 1989		March 1991
	Mean*	Range	Mean**
Temperature (°C)	21,7	16-25	23,0
pH		8,4-9,6	7,7
Conductivity ($\mu S \cdot cm^{-1}$)	115,9	69-129	99
Total alkalinity as $CaCO_3$ ($mg \cdot \ell^{-1}$)	37,0	23-57	26
Total hardness as $CaCO_3$ ($mg \cdot \ell^{-1}$)	-		25
Calcium hardness as $CaCO_3$ ($mg \cdot \ell^{-1}$)	-		46
Chloride Cl ($mg \cdot \ell^{-1}$)		<2-3	8
Turbidity (FTU)	-		2,5
Ammonia-N ($mg \cdot \ell^{-1}$)	0,158	0,039-0,150	0,215
Nitrate-N ($mg \cdot \ell^{-1}$)	0,071	0,41-0,134	6,085
Orthophosphate PO_4 ($mg \cdot \ell^{-1}$)	0,019	0,012-0,025	0,028

* N=7 (Ashton, 1989) ** Composite sample

immature *P. clarkii* are largely olive green in colour with sexually mature specimens becoming more reddish brown, with orange to reddish coloured claws. The thorax has a distinct middorsal groove which runs over much of its length, branching laterally near the posterior margin of the carapace (Fig. 2A). The first two pairs of pleopods (swimmerets) are strongly modified into rodlike structures in the male (Fig. 2B) and are used to facilitate the transfer of sperm during mating. These structures are absent in *Cherax*, where all the pleopods in both sexes are almost filamentous. Mature *P. clarkii* may reach a size of 6,5 to 12,5 cm, and females are capable of producing 100 to 700 eggs annually depending upon size (Avault and Huner, 1985). *P. clarkii* matures between 3 and 9 months of age, depending upon factors such as water temperature and food availability. It can live for 3 to 4 years (Avault and Huner, 1985).

Locality description and environmental conditions

At its head waters on the Driehoek farm Dullstroom (25°28'S, 30°07'E), the Crocodile River typically forms a relatively narrow sponge area with streams in which a number of dams were constructed to retain water for trout-stocking purposes (Fig.1).

Investigation of the physical and chemical conditions of the water in the area where the *P. clarkii* occur reflect some mineralisation of the water at the source with electrical conductivity exceeding 90 $\mu S \cdot cm^{-1}$ (Table 1). The water of the streams is largely alkaline with signs of mild organic enrichment, as reflected by concentrations of ammonia, nitrates and phosphate present (Table 1). This may be partly due to trout stocking activities in the dams constructed in the river (which occur over a distance of more than 2 km (Fig. 1)), and partly due to agricultural activities in the proximity of the sponge area. The submerged aquatic weeds *Potamogeton pusillus* and *P. thunbergii* which form dense mats in the sponge areas and in most of the dams, clearly obstruct trout angling activities. Semi-aquatic weeds which also occur there include *Typha capensis* and species of *Cyperus* and *Scirpus*. The flow in the streams is variable, but was measured in 1991 as fluctuating between 0,5 and 1 $m^3 \cdot s^{-1}$. During recent droughts the flow rate has diminished considerably, with virtual stagnant conditions prevailing in some of the streams, creating conditions for the concentration of the nutrients N and P and other ions in the water.

Factors which may affect the occurrence and establishment of *P. clarkii*

Investigations in 1991 showed that *P. clarkii* were largely confined to the Vallijspruit and Berry Dam areas (Fig. 1), as well as in the river downstream of these two dams from where some of the crawfish occasionally migrated via a canal from the river into the pond area of the trout hatchery on the farm. Even though there was an abundance of aquatic weeds, which may serve as food, and the substrata in the area were soft, making the environment suitable for colonisation by *P. clarkii*, it was surprising to find the numbers of crawfish to be relatively low.

Based on its natural dietary habits, *P. clarkii* can be described as an opportunistic omnivore (Avault and Huner, 1985). It not only feeds on microbially-enriched plant detritus, but also lives on animal material such as benthic macro-invertebrate organisms and zooplankton. A variety of aquatic plants are taken as food.

There are a number of predators which may restrict the population numbers of *P. clarkii* in the area where it occurs. Apart from the trout *Onchorynchus mykiss* which will most likely feed on the smaller crawfish, there are also relatively large numbers of the fish-eating birds *Phalocrocorax africanus* and *Anhinga melanogaster*, as well as the clawless otter *Aonyx capensis*. Faecal pellets of the otter were found to contain remnants of the freshwater crab *Potamonautes* as well as of *P. clarkii*.

Since *P. clarkii* occurs in the sponge area of the Crocodile River, the application of insecticides to eradicate it, as has been done in California (Chang and Lange, 1967) and Japan (Suko, 1986) is not recommended as it will devastate the ecology of the area.

Present indications are that the numbers of juvenile *P. clarkii*

are low and that the above-mentioned predators may be important in preventing a population explosion of the crawfish. The danger exists, however, that trout anglers may obtain live specimens of *P. clarkii* and distribute them to other trout waters in the Transvaal. The situation with regard to *P. clarkii* should therefore be closely monitored to observe its possible further development at the site and at its possible downstream distribution along the Crocodile River.

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