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A conservation assessment of the freshwater crabs of southern Africa (Brachyura: Potamonautidae)

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Abstract

Recent taxonomic revisions of the freshwater crabs of southern Africa (Angola, Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe) allow accurate depictions of their diversity, distribution patterns and conservation status. The southern African region is home to nineteen species of freshwater crabs all belonging to the genus *Potamonautes* (family Potamonautidae). These crabs show high levels of species endemism (84%) to the southern African region and to the country of South Africa (74%). The conservation status of each species is assessed using the IUCN (2003) Red List criteria, based on detailed compilations of the majority of known specimens. The results indicate that one species should be considered vulnerable, fifteen species least concern and three species data deficient. The results have been utilized by the IUCN for Red Lists, and may prove useful when developing a conservation strategy for southern Africa's endemic freshwater crab fauna.

Key words: conservation, diversity, endemism, freshwater crabs, Potamonautidae, Red List, southern Africa

Résumé

De récentes révisions de la taxonomie des crabes d'eau douce d'Afrique australe (Afrique du Sud, Angola, Botswana, Lesotho, Mozambique, Namibie, Swaziland, Zambie et Zimbabwe) permettent des descriptions précises de leur diversité, de leur schéma de distribution et de leur statut de conservation. L'Afrique australe accueille 19 espèces de crabes d'eau douce qui appartiennent toutes au genre *Potamonautes* (famille des Potamonautidae). Ces crabes présentent un degré élevé d'endémisme spécifique (84%) pour la région de l'Afrique australe et pour l'Afrique du Sud elle-même (74%). Le statut de conservation de chaque espèce est évalué selon les critères de la Liste rouge de l'UICN (2003), en se basant sur des compilations détaillées de la majorité des spécimens connus. Les résultats montrent qu'une des espèces devrait être considérée comme «vulnérable», 15 autres comme «préoccupation mineure» et trois n'ont que des «données insuffisantes». Les résultats ont été utilisés par l'UICN pour la Liste rouge et peuvent s'avérer utiles pour le développement d'une stratégie de conservation pour la faune des crabes d'eau douce endémiques d'Afrique australe.

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Introduction

The past decade has seen an upsurge of interest in the biology of Africa's freshwater crabs (Cumberlidge, 1997, 1998, 1999; Cumberlidge & Boyko, 2000; Cumberlidge, Clark & Baillie, 2002; Cumberlidge *et al.*, 2002; IUCN, 2003; Cumberlidge & Vannini, 2004; Dobson, 2004; Marijnissen *et al.*, 2004; Reed & Cumberlidge, 2004, 2006a; Marijnissen, Lange & Cumberlidge, 2005; Daniels *et al.*, 2006; Klaus, Schubart & Brandis, 2006; Cumberlidge, Daniels & Sternberg, 2007a; Cumberlidge, Marijnissen & Thompson, 2007b; Yeo *et al.*, 2007) that has resulted in a steep increase in the known biodiversity of the continent. For example, in the southern African region (here defined as Angola, Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe) only ten species of freshwater crabs were recognized as valid 50 years ago (Bott, 1955, 1960), whereas today nineteen species are known, and there is every prospect that the species-count will increase as taxonomic discrimination improves and exploration continues (Stewart, Coke & Cook, 1995; Stewart, 1997a,b; Stewart & Cook, 1998; Daniels, Stewart & Gibbons, 1998; Daniels, Stewart & Burmeister, 2001; Daniels *et al.*, 2002; Gouws, Stewart & Coke, 2000; Gouws, Stewart & Reavell, 2001; Reed & Cumberlidge, 2004, 2006a; Cumberlidge & Tavares, 2006). The single genus

represented in the region, *Potamonautes* MacLeay, 1838, has a wide distribution elsewhere in continental Africa as far north as Egypt (Bott, 1955; Cumberlidge, 1999), but is absent in North Africa north of the Sahara (excepting the Nile basin) and from Madagascar (Cumberlidge & Sternberg, 2002). *Potamonautes* belongs to the Potamonautidae Bott, 1970; a family that is endemic to the Afro-tropical region with representatives in continental Africa and Madagascar (Cumberlidge, 1999; Cumberlidge & Sternberg, 2002; Cumberlidge *et al.*, 2007a). Freshwater crabs were assessed for inclusion in one of the Red List categories based on a combination of data on geographic range and/or population levels and related trends. It is hoped that prioritizing species for conservation action through the Red List assessment process will lead to the development of conservation recovery plans for threatened species in the future.

Methods

Identifications of specimens were made following direct examination of freshwater crabs from southern Africa in the collections of museums in South Africa [the Albany Museum, Grahamstown (AMG), the South African Museum, Cape Town (SAM)], the UK [The Natural History Museum, London (BMNH)], Austria [the Naturhistorische Museum, Wien (NHMW)], Germany [the Senckenberg Museum, Frankfurt (SMF)] and the USA [the Museum of Comparative Zoology, Cambridge, MA (MCZ), the US National Museum of Natural History, Washington D.C. (USNM), Northern Michigan University, Marquette, MINMU]. Specimen-level distributional databases were compiled for all nineteen species for material collected over a period of over 120 years (from 1885 to 2006) and included information from over 250 different localities. Despite the large numbers of specimens examined, very little information is available on population levels and trends except for a qualitative estimate (e.g., whether common or rare) based on the number of sites at which a species is present and its relative abundance at each site (Table 1).

Each of the nineteen freshwater crab species found in the southern African region was evaluated against the IUCN (2003) Red List criteria (version 3.1) to assess their

Table 1 Checklist of freshwater crabs of southern Africa and their conservation status

Species of *Potamonautes*	CS	Criteria used	~EOO (km^2)	~AOO (km^2)	#Loc	PA	Generation time (years)	Frequency
P. anchetiae	LC		>1,000,000	>100,000	23	N	3–6	Common
P. bayonianus	LC		>1,000,000	>100,000	46	N	3–6	Common
P. brincki	LC		<20,000	<2,000	10	N	2–4	Rare
P. calcaratus	LC		>200,000	<20,000	15	Y	2–4	Common
P. clarus	LC		<20,000	<2,000	6	Y	2–4	Common
P. dentatus	LC		<5,000	<500	8	N	3–6	Rare
P. depressus	LC		<20,000	≤2000	5	Y	2–4	Rare
P. dubius	DD		<20,000	≤2,000	1	N	2–4	Very rare
P. granulatus	LC		<20,000	≤2000	12	N	3–6	Rare
P. kensleyi	DD		<100	≤10	1	N	3–6	Very rare
P. lividus	VU	B1a+2a	<20,000	≤2000	9	Y	2–4	Rare
P. macrobrachii	DD		<5000	≤500	4	N	3–6	Very rare
P. obesus	LC		>1,000,000	>100,000	25+	N	3–6	Common
P. parvicorpus	LC		<20,000	≤2000	9	N	1–2	Rare
P. parvispina	LC		<20,000	≤2000	8	N	1–2	Rare
P. perlatus	LC		>100,000	>10,000	16	N	3–6	Common
P. sidneyi	LC		>180,000	>18,000	51	N	3–6	Common
P. unispinus	LC		>200,000	>20,000	33	N	3–6	Common
P. warreni	LC		>200,000	>20,000	29	N	3–6	Common

CS = conservation status; LC = least concern; VU = vulnerable; DD = data deficient; EOO = extent of occurrence, estimation based on distribution polygon of all known specimens; AOO = area of occupancy, estimation based on occupancy of available habitat; #Loc = number of discontinuous localities from which the species was collected; PA = found in a protected area; Y = yes, N = no; generation time = time to reach sexual maturity; frequency = qualitative estimate based on the number of sites at which a species is present and its relative abundance at each site; B1a+2a = IUCN (2003) criteria. See text for taxonomic authorities.

risk of extinction and the results were evaluated by two outside authorities. The conservation assessment was based on estimates of the Extent of Occurrence (EOO, the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the sites of occurrence), the Area of Occupancy (AOO, the area within the EOO that is actually occupied by the taxon), plus the number of sites, abundance at each site, threats and (where possible) estimations of population levels and trends. The geographic range was estimated using the EOO and the AOO. The generation time was estimated based on the number of years it takes a species to reach sexual maturity, with small species (e.g., *P. parvicorpus* Daniels *et al.*, 2001) maturing in 1–2 years and large species [e.g., *P. perlatus* (Milne Edwards, 1837)] taking 3–6 years to reach reproductive age (Ejike, 1972; Cumberlidge & Sachs, 1989; Cumberlidge, 1999). Threats were inferred if a species was potentially subject to anthropogenic impacts such as habitat destruction or pollution, especially if it was either not found in a protected area, or if it was found in a protected area for only part of its range.

Results and discussion

Southern Africa's freshwater crab fauna (nineteen species, one genus) is relatively impoverished in comparison with other areas of the Afro-tropical region such as East Africa (35 species, three genera) (Bott, 1955; Corace, Cumberlidge & Garms, 2001; Cumberlidge & Vannini, 2004; Reed & Cumberlidge, 2004, 2006a), Central Africa (24 species, five genera) (Bott, 1955; Cumberlidge *et al.*, 2002, 2002; Cumberlidge & Reed, 2004), West Africa (33 species, seven genera) (Cumberlidge, 1999) and Madagascar (only fourteen species, but seven genera) (Cumberlidge & Sternberg, 2002; Reed & Cumberlidge, 2006b; Cumberlidge *et al.*, 2007b) (Table 2). The distributional data indicate that there is a high degree of endemism in southern Africa's freshwater crab fauna at the species level (sixteen of nineteen species, 84%), but not at the genus or family levels. This region has its own distinctly recognizable freshwater crab fauna, with only three species [*P. bayonianus* (Brito-capello, 1864), *P. anchetiae* (Brito-capello, 1871) and *P. obesus* (Milne-Edwards, 1868)] occurring outside of the southern African region.

Table 2 Distribution of the freshwater crabs found in the southern African region by country

Species of *Potamonautes*	Angola	Botswana	Lesotho	Mozambique	Namibia	South Africa	Swaziland	Zambia	Zimbabwe	#
P. anchetiae	P									1
P. bayonianus	P	P		P	P	P		P	P	7
P. brincki						E				1
P. calcaratus				P		P				2
P. clarus						E				1
P. dentatus						E				1
P. depressus			P			P				2
P. dubius	P				P					2
P. granulatus						E				1
P. kensleyi	E									1
P. lividus						E				1
P. macrobrachii	E									1
P. obesus									P	1
P. parvicorpus						E				1
P. parvispina						E				1
P. perlatus					P	P				2
P. sidneyi				P		P	P			3
P. unispinus						P			P	2
P. warreni		P			P	P				3
Total SP. (# endemic)	5 (2)	2	1	3	4	14 (7)	1	1	3	

The numbers in parentheses represent the number of endemic species in that country.
P = present, E = endemic to a country, # = number of countries where a species occurs.
See text for taxonomic authorities.

The majority of freshwater crabs found in this region (fourteen of nineteen species, 74%) occur in South Africa, of which 50% (seven of fourteen species) are endemic to that country. Interestingly, four of the South African endemics (*P. brincki* (Bott, 1960), *P. granularis* Daniels *et al.*, 1998, *P. parvicorpus,* and *P. parvispina* Stewart, 1997b) are found in the isolated mountain streams and the middle stretches of rivers associated with the fynbos vegetation zone in the Cape Fold Mountains of the Western Cape Province. Three other South African endemic species are found in KwaZulu-Natal in mountain streams (*P. clarus*), the middle stretches of the rivers (*P. dentatus* Stewart *et al.*, 1995), and the marshy, low-lying wetlands (*P. lividus*). In the rest of the southern African region Angola emerges as the second most specious country (with five of nineteen species, 26%) with a rate of endemism of 40% (two of five species). The lowest species richness (one to three species) is found in a vast area of the region that includes Botswana, Lesotho, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe, none of which have endemic species of freshwater crabs (Table 2). Perhaps not surprisingly, freshwater crab diversity is also low in the Namib and Kalahari deserts in Namibia, Botswana and South Africa where there are no endemic species, and where crabs are restricted to permanent water sources (such as the Cunene (=Kunene), Okavango and Orange River basins) on the margins of these arid lands (Table 2). Interestingly, freshwater crab diversity is unexpectedly low in the major aquatic ecosystems of the region such as the Orange, Limpopo, Cunene, Okavango and Zambezi River basins where there are only common widespread species [*P. bayonianus* and *P. warreni* (Calman, 1918)] and no endemics (Table 2).

The results of the application of the IUCN (2003) Red List criteria to southern Africa's freshwater crab species are presented in Table 1. The assessment found one species (*P. lividus* Gouws *et al.*, 2001) to be vulnerable (VU), fifteen species to be of least concern (LC), and three species (*P. kensleyi* Cumberlidge & Tavares, 2006*; P. dubius* (Brito-capello, 1873) and *P. macrobrachii* Bott, 1955) to be data deficient (DD). With only one of nineteen species of freshwater crabs from the southern African region assessed as threatened with global extinction, the region's largely endemic freshwater crab fauna does not appear at first sight to be in immediate trouble compared with other aquatic groups found in the same freshwater habitats that have been assessed (e.g., fish, molluscs and dragonflies). Some of the common species of southern African freshwater crabs judged to be in the LC category (e.g., *P. anchetiae*, *P. bayonianus*, *P. calcaratus* (Gordon, 1929), *P. obesus*, *P. perlatus, P. sidneyi* (Rathbun, 1904), *P. warreni,* and *P. unispinatus* Stewart & Cook, 1998) have a wide distribution in the rivers, lakes and mountain streams of the region and are clearly tolerant of changes in land use that affect aquatic ecosystems.

Threats to freshwater crabs include habitat destruction driven by increasing agriculture, the demands of increasing industrial development and the alteration of fast flowing rivers for the creation of hydroelectric power. It should be noted that even species assessed here as LC could suffer a catastrophic decline should there be abrupt changes in land development, hydrology or pesticide-use regimes. Many of the species assessed here as LC are rare [e.g., *P. brincki, P. clarus* (Gouws *et al.*, 2000)*; P. dentatus, P. depressus* (Krauss, 1843), *P. dubius, P. granularis, P. parvicorpus,* and *P. parvispina*] and have only a relatively narrow distribution. Species with a narrow distribution are vulnerable to extreme population fragmentation and could suffer a rapid decline and even extinction in a relatively short time should dramatic changes in land-use affect their habitat. It is therefore of immediate concern that eleven (51%) of the region's nineteen crab species are known from an estimated EOO of <2000 km^2 (three of which have an estimated EOO of <500 km^2, Table 1). Despite these low EOOs, only one species (*P. lividus*) was assessed as threatened (VU), with the rest being assessed as either DD (three species) or LC (seven species). Given the danger of population fragmentation, the current population levels of those species assessed as LC with a restricted EOO are nevertheless estimated to be stable, many are found in a protected area at least for part of their range and there are no identifiable major widespread threats to their long-term existence. The three species of freshwater crabs from the region that were assessed as DD (*P. kensleyi, P. macrobrachii* and *P. dubius*) are all rare species that will be re-evaluated once more information on them comes to light.

This study represents a first step toward the identification of threatened species within this region and toward the development of a conservation strategy for the freshwater crabs endemic to southern Africa. The restricted range of many species of *Potamonautes* from the southern African region, together with the on-going human-induced loss of habitat in many parts of the region are a cause for concern for the long-term security of elements of this fauna. Conservation activities should therefore be aimed primarily at preserving the integrity of sites and habitats while at the same time closely monitoring key

populations. It should be remembered that significant areas of this vast region still remain insufficiently explored, and that new species of freshwater crabs are sure to be discovered as collection efforts intensify in remote areas, and as taxonomic skills become more refined.

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