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"The status and distribution of freshwater crabs [West Africa]"

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Chapter 6. The status and distribution of freshwater crabs

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Freshwater crabs (Potamonautidae, Potamoidea) are among the most important invertebrates inhabiting African fresh waters, but until recently were poorly known due to a general lack of interest and insufficient taxonomic knowledge (Cumberlidge 1999). Many species from the western African region are represented by only a handful of individuals, while those species that are more plentiful have often proved problematic to identify. These large and conspicuous crustaceans are present in almost all freshwater habitats in western Africa, from montane habitats with mountain streams to large lowland rivers and small water bodies (Cumberlidge 1999). In addition, species that live in seasonally arid areas tend to be semi-terrestrial, live in burrows, and move about on land at night (Cumberlidge 1999). Isolation related to complicated topography and the fragmentary nature of wetland habitats in much of western Africa, and limited dispersal abilities due to reproduction by direct development, are probably responsible for much of the diversity and endemism of these crabs (Cumberlidge *et al.* 2009). Distribution data have been derived from specimen records, but are still likely to be incomplete. Some species are either known only from the type locality or from only a few localities, and further collections are necessary to ascertain their actual distribution. Distributional ranges include point

endemics (such as *Potamonautes senegalensis* and *Liberonautes nimba* from Senegal and Mt Nimba respectively), localised taxa (such as *Sudanonautes kagoroensis*, *S. nigeria*, and *Potamonemus sachsii* from Nigeria and Cameroon), and wide ranging species (such as *Liberonautes latidactylus*, which is found from Senegal to Ghana, *S. africanus*, which is found from Nigeria to the DRC and Gabon, and *S. floweri*, which found from Togo to the DRC, and as far east as Sudan and Uganda).

6.1 Overview of western Africa freshwater crab fauna

The 32 species of freshwater crabs found in west African countries dealt with by Cumberlidge (1999) represent about one-quarter (23%) of the species presently known from the entire Afrotropical region (Bott 1955, 1959, 1960, 1964, 1969, 1970; Monod 1977, 1980; Cumberlidge 1985a, 1997, 1999). The afrotropical region hosts 134 species of freshwater crabs in 20 genera and two families: Potamonautidae Bott, 1970, and Potamidae Ortmann, 1896 (Cumberlidge 1999, Cumberlidge and Sternberg 2002, Daniels *et al.* 2006, Cumberlidge *et al.*

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2008, Yeo *et al.* 2008). The western African region as defined in the present work includes 25 species of freshwater crabs that belong to six genera: *Liberonautes*, *Sudanonautes*, *Globonautes*, *Afrihelphusa*, *Potamonemus*, and *Potamonautes* (Cumberlidge 1999). All of these genera are in the Potamonautidae and all are endemic to western Africa, except for *Sudanonautes* (which ranges into central Africa) and *Potamonautes* (which is poorly represented in western Africa, with the majority of species widely distributed elsewhere in continental Africa (Bott 1955, Cumberlidge 1999) but not in Madagascar (Cumberlidge and Sternberg 2002). Western Africa's freshwater crab fauna is slightly less diverse than that of eastern Africa (35 species, three genera) (Bott 1955; Cumberlidge 1997, 1998, Corace *et al.* 2001, Cumberlidge and Vannini 2004, Reed and Cumberlidge 2004, 2006a), but similar to central Africa (24 species, five genera) (Bott 1955, Cumberlidge *et al.* 2002, Cumberlidge and Boyko 2000, Cumberlidge and Reed 2004), and relatively rich in comparison to southern Africa (19 species, one genus) (Cumberlidge and Daniels 2008), and Madagascar (only 14 species, but seven genera) (Cumberlidge and Sternberg 2002, Reed and Cumberlidge 2006b, Cumberlidge *et al.* 2008). Four additional species of freshwater crabs, *Potamonemus mambilorum*, *P. asylos*, *Sudanonautes chavanesii* and *S. faradjensis*, have a small part of their range within the western Africa region in southwest Cameroon but are not included in this report and will be assessed as part of the central Africa assessment.

6.1.1 Freshwater crab distribution and freshwater ecoregions

Freshwater crab distribution patterns do not conform closely to the majority of the 17 freshwater ecoregions found in the western Africa region (Figure 1.1). Only three ecoregions have endemic species: Northern Upper Guinea, Southern Upper Guinea, and Nimba. Otherwise there is little correspondence between freshwater crab distributions and the ecoregion boundaries. The Northern Upper Guinea ecoregion (Guinea and Sierra Leone) and the Southern Upper Guinea ecoregion (Liberia), which

consist mainly of tropical and subtropical coastal rivers and together comprise the Upper Guinea Forest of west Africa, are both home to endemic species of freshwater crabs. Four species of *Afrihelphusa* are found only in Northern Upper Guinea, while *Globonautes macropus* is an Upper Guinea endemic. The Southern Upper Guinea ecoregion in Liberia is home to three endemic species of *Liberonautes* (*L. nanooides*, *paludicolis*, *L. grandbassa*) and two non-endemic species (*L. latidactylus* and *L. rubigimanus*). The small upland ecoregion of Mount Nimba, situated where the borders of Liberia, Guinea and Côte d'Ivoire meet, is characterized by montane freshwaters and is home to one endemic species of freshwater crab, *L. nimba*, and a second non-endemic species (*L. rubigimanus*) (Cumberlidge and Huguet 2003).

All remaining ecoregions in western Africa exhibit little correspondence between freshwater crab distribution patterns and ecoregion boundaries. For example, there are no endemic species of freshwater crab found in any of the four ecoregions included in the Niger River drainage basin that dominates western Africa. The Niger River basin is characterized by *P. ecorseii*, a widespread and common species of freshwater crab found along its entire length. The Upper Niger River and the Inner Niger Inland delta ecoregions are both home to *L. latidactylus*, another common and widespread species found in western west Africa (but not east of Mali). The Lower Niger-Benue River ecoregion in Nigeria comprises a tropical and subtropical floodplain river with wetland complexes that are home to *P. ecorseii* in the Niger in Nigeria, and *S. floweri* and *S. aubryi* in the Benue River basin in Nigeria and western Cameroon. All of these are widely distributed and common species of freshwater crabs. The Niger River delta in the coastal region of Nigeria is tidal with brackish water, where freshwater is absent, and no species of freshwater crabs are found there (Cumberlidge 2008). It should, however, be noted that the Niger delta is important for its four rare endemic species of camptandrine marine crabs and several rare endemic species of shrimps (Powell 1976, Manning and Holthuis 1981).

The Senegal River/Gambia River ecoregion in Senegal and The Gambia is a largely arid region interspersed with tropical and subtropical floodplain rivers and wetland complexes. There is only one endemic species, *Potamonautes senegalensis*, known from this region, and this is found in the Senegal River near Mauritania. The Gambia River and its drainage basin in western Guinea and Senegal have no endemic species, and only *Liberonautes latidactylus*, a common and widespread species, is found there. The Ebumeo ecoregion (Côte d'Ivoire and Ghana) consists of tropical and subtropical coastal rivers and lies in the overlap zone between *Liberonautes* (at its easternmost limit) and *Sudanonautes* (at its westernmost limit), but there are no endemic species in this region. One species of *Potamonautes*, *P. triangulus*, is endemic to the Volta ecoregion in Ghana. Both the Ashanti ecoregion in coastal Ghana and Togo, and the Bight Drainage ecoregion in coastal Benin and western Nigeria consist of tropical and subtropical coastal rivers but neither has any endemic species of freshwater crabs.

Lake Chad, classified as a xeric freshwater inland lake with an endorheic (closed) basin, is supplied by the Hadejia-Jamaare River in northern Nigeria and the Chare River in Cameroon and the Central African Republic. There are no recorded species of freshwater crabs from the lake itself, although *Sudanonautes monodi*, a dry savanna species, is found in the Hadajia-Jaamare river basin in Nigeria, and Cameroon, but is not endemic to the system (Cumberlidge 1999).

6.2 Conservation status (IUCN Red List Criteria: Regional Scale)

The conservation status of western Africa's freshwater crab fauna was assessed using the IUCN Red List Categories and Criteria at the regional scale (IUCN 2001, 2003, Cumberlidge *et al.* 2009). Although there is a need to collect more comprehensive information, the available data were sufficient to make valid assessments of the conservation status of most species. Of the 25 species of freshwater crabs found in the western African region defined herein, five species (*Afrithelphusa afzelii*, *A. gerhildae*, *A. leonensis*, *Potamonautes senegalensis*, and *Sudanonautes nigeria*) from Guinea, Sierra Leone, Senegal and Nigeria were assessed as Data Deficient (DD, Table 6.1) on account of a lack of sufficient information on their distributions. Of the remaining 20 species, four species (*Liberonautes nimba*, *Potamonautes triangulus*, *P. reidi*, and *Potamonemus sachsii*) (Figure 6.1 and Table 6.1) were listed as Vulnerable (VU), four species (*Afrithelphusa monodosa*, *Globonautes macropus*, *Liberonautes nanooides*, and *L. rubigimanus*) as Endangered (EN), and two (*Liberonautes grandbassa* and *L. lugbe*) as Critically Endangered (CR). Only 10 species, representing 40% of all species of freshwater crabs in western Africa, were assessed as LC. The majority of these LC species live

Figure 6.1 The proportion (%) of freshwater crab species in each regional Red List Category in western Africa. CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LC = Least Concern, DD = Data Deficient.

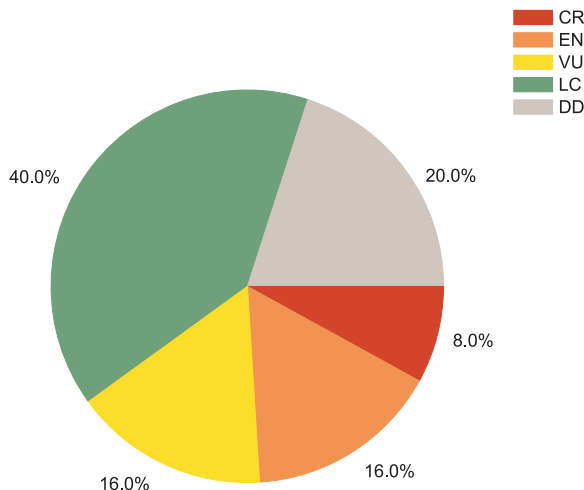


Table 6.1 The number of crab species in each regional Red List Category in the western African region.

Regional Red List Category	Number of species	Number of regional endemics
Extinct	0	0
Regionally Extinct	0	-
Extinct in the Wild	0	0
Threatened categories		
Critically Endangered	2	2
Endangered	4	4
Vulnerable	4	4
Near Threatened	0	0
Least Concern	10	6
Data Deficient	5	5
Not Applicable	0	-
Total	25	21

Note: All species assessed as regionally threatened that are endemic to the region are also globally threatened.

in rivers, marshy lowlands, or mountain streams (Cumberlidge 1999). The relatively low proportion of LC species is due to much of western Africa being affected by agricultural and industrial development and its associated aquatic habitat degradation and pollution. Some 20% of the regions species are Data Deficient, reflecting the lack of collection material, a scarcity that continues to fuel uncertainty about the distribution of little-known species (Bott 1955, Cumberlidge 1999). The presence of DD species means that the current 40% figure for threatened species will be found to be an underestimate should any of these species later be found to be threatened (Cumberlidge *et al.* 2009). No species of freshwater crabs from western Africa could be confirmed Extinct or Extinct in the Wild. However, the DD species from Guinea (*Afrithelphusa afzelii* and *A. gerhildae*) have not been found in recent years and are of concern. These species cannot be formally classified as Extinct until exhaustive surveys probing their disappearance have been carried out.

Given the relatively low number of species of freshwater crabs found within western Africa as compared to the other taxonomic groups treated in this report, the conservation status for each species of freshwater crab is dealt with briefly below.

6.2.1 Species assessed as Critically Endangered

Liberonautes grandbassa (Cumberlidge, 1999), (CR)

This species is endemic to central Liberia where it is known from a single rainforest locality. *L. grandbassa* is only known from a few specimens and there is no information on its population size or abundance. There are no known conservation measures in place for this species, and it is not found within a protected area. The Red List assessment for this species is CR B1ab(iii)+2ab(iii) because its extent of occurrence is less than 100km² and area of occupancy less than 10km², it is

restricted to a single locality, and it is threatened by the habitat disruption associated with deforestation driven by expanding human populations and periods of political unrest.

***Liberonautes lugbe* (Cumberlidge, 1999), Lugbe River Crab (CR)**

Liberonautes lugbe is endemic to Liberia where it is known from only two specimens collected in Lugbe in Nimba County. The specimens were captured in rainforest by hand when the crabs were walking on land close to a stream. The species is assessed as CR B1ab(iii) because its extent of occurrence is less than 100 km² and it is restricted to freshwater streams in the rainforest where it is subject to habitat disruption associated with deforestation driven by expanding human populations and periods of political unrest.

6.2.2 Species assessed as Endangered

***Afrithelphusa monodosa* (Bott, 1959), Monod's Crab (EN)**

Afrithelphusa monodosa is one of only five species in two genera belonging to a rare group of freshwater crabs endemic to the Upper Guinea forest block of western Africa. This species is endemic to Guinea where it is known from less than 20 specimens from two localities. *A. monodosa* lives in farmland, swamps, and year-round wetland habitats in the semi-deciduous moist forest Guinea savanna zone of north-western Guinea (Cumberlidge 1999, 2006). Specimens were collected from cultivated land from burrows dug into permanently moist soil, each with a shallow pool of water at the bottom. The natural habitat of *A. monodosa* is still unknown but presumably this cultivated land was originally a permanent freshwater marsh. There were no nearby sources of surface water and it is evident that these crabs do not need to be immersed in water (as do their relatives that live in streams and rivers), and that they can meet their water requirements with the small amount of muddy water that collects at the bottom of their burrows. The species is clearly a competent air-breather. Despite the recent discovery of a new subpopulation of this species, it is still currently known from only a few specimens from two localities. Threats to the species include habitat loss/degradation (human induced) due to human population increases, deforestation, and associated increased agriculture in north-west Guinea. It is not found within a protected area. The recent discovery of new subpopulations (and the promise of finding others) has led to its Red List status being recently downgraded from CR to EN.

***Globonautes macropus* (Rathbun, 1898), Tree Hole Crab (EN)**

Globonautes macropus is endemic to the Upper Guinea rain forests of western Liberia (Bong, Lofa, and Mesurado Counties) and Guinea, and is presumably also found in the forested parts of Sierra Leone that lie between these two subpopulations. The species is restricted to rainforests where it requires a specialised habitat of rainwater-filled natural holes found in suitably sized trees within closed canopy rainforest. Despite the recent discovery of new subpopulations, it is still currently known from only a handful of specimens and a few localities. In pre-civil war Liberia (before 1989) the species range was estimated to be only 5-10 per km² of closed canopy rainforest, which may well be declining

Afrithelphusa monodosa EN. Photo: © Piotr Naskrecki.



as deforestation linked to the civil war progresses. Threats to its rainforest habitat are ongoing due to human population increases, deforestation, regional wars, political instability and increased agriculture in Liberia. It is not found within a protected area. The recent discovery of new subpopulations (and the promise of finding others) has led to its Red List status being recently downgraded from CR to EN.

***Liberonautes nanoides* (Cumberlidge and Sachs, 1989), Dwarf River Crab (EN)**

Liberonautes nanoides is endemic to Liberia where it is known only from one locality in Bong County (the St. Paul River at the Bong Mine Fishing Club near Haindi). It is only found in the rocky parts of the fast-flowing waters of the St. Paul River in the rainforest zone of Liberia, and is never found in small streams. The species serves as the second intermediate host to the lung fluke *Paragonimus uterobilateralis* but the incidence of infection is low, indicating that the species does not play an important role in the transmission of the parasite to humans. Threats to its river habitat are ongoing due to human population increases, deforestation, regional wars, political instability and increased agriculture in Liberia. It is not found within a protected area. The species is a locally important food source and is subject to a small local fishery.

***Liberonautes rubigimanus* (Cumberlidge and Sachs, 1989), Lobster Claw Crab (EN)**

Liberonautes rubigimanus is endemic to the Upper Guinea Forest zone where it is known from only three localities: two in Liberia and one in Guinea (Cumberlidge and Huguet 2003). It is found in fast-flowing mountain streams in Liberia (Mount Gibi) and Guinea (Mount Nimba, 600m asl), and at lower elevations in forest streams in Grand Gedeh County, Liberia. This is a large species living sympatrically with *L. latidactylus* and *L. paludicolis*. Threats to the species include loss/degradation (human induced) of its mountain stream habitat associated with deforestation and human population increases. Parts of its range lie within a protected area, the Mont Nimba National Park.

6.2.3 Species assessed as Vulnerable

***Liberonautes nimba* (Cumberlidge, 1999), Nimba Crab (VU)**

Liberonautes nimba is endemic to the slopes of Mount Nimba in Guinea and in Liberia where it is known from several localities. Threats to this species include a decline in the extent and quality of its stream habitat from mining disturbance and pollution, plus deforestation associated with farming and human population increases. Some parts of its range may be protected as they lie within the Mont Nimba National Park.

***Potamonautes reidi* (Cumberlidge, 1999), Reid's River Crab (VU)**

Potamonautes reidi is endemic to the rainforest zone of south-east Nigeria near Calabar, Cross River State, where it is known from only a few specimens from less than ten localities. It lives in the overhanging vegetation at the sides of small slow-flowing streams. Threats to this species include a decline in the extent and quality of its stream habitat from deforestation associated with farming and human population increases. No conservation measures are in place for this species and it is not found in a protected area.

***Potamonautes triangulus* (Bott, 1959), (VU)**

Potamonautes triangulus is a small species of freshwater crab endemic to Ghana where it is known from six localities within the same stream, located about 90 km north of Accra. Threats to this species include a decline in the extent and quality of its stream habitat from deforestation associated with farming and human population increases. No conservation measures are in place for this species and it is not found within a protected area. It was last collected in 1950.

***Potamonemus sachsii* (Cumberlidge, 1993), Sachs's Stream Crab (VU)**

Potamonemus sachsii is known only from the Bamenda highlands in south-west Cameroon, and from the neighbouring Obudu plateau in south-east Nigeria, a steep-sided plateau 1,000 m asl that rises steeply out of the rainforest. The climate on top of the plateau is cool and humid, and supports a tropical montane vegetation, including extensive grasslands. The streams and rivers drain south into the Cross River, just to the east of the Nigeria-Cameroon border. These crabs live under boulders in stretches of the stream shaded by overhanging vegetation and the forest canopy. Threats to this species include a decline in the extent and quality of its stream habitat from deforestation associated with farming and human population increases. No conservation measures are in place for this species and it is not found in a protected area.

6.2.4 Species assessed as Least Concern

***Liberonautes chaperi* (A. Milne-Edwards, 1887), Chaper's River Crab (LC)**

Liberonautes chaperi is a large widespread species common in the major rivers in Ghana, Côte d'Ivoire and Liberia, and

is endemic to this part of the Upper Guinea forest block; it has never been found in small streams (Cumberlidge 1985, Cumberlidge and Sachs 1989). *L. chaperi* serves as second intermediate host to the human lung fluke (*P. uterobilateralis*) in Liberia (Sachs and Cumberlidge 1990). However, the incidence of infection of these crabs in Liberia is low, indicating that this species may not play an important role in the transmission of the parasite to humans. The species is listed as LC in view of its wide distribution, estimated stable population size, abundance, and the lack of known widespread threats.

***Liberonautes latidactylus* (De Man, 1903), Common Creek Crab (LC)**

Liberonautes latidactylus is the most common and most frequently caught freshwater crab throughout the rainforest and savanna zones of western Africa with a distributional range from Senegal and Mauritania to Ghana, in a vast area bounded to the north by the Sahara desert and to the south and west by the Atlantic Ocean. The species lives in rivers and streams in rainforest in Sierra Leone, Liberia, Guinea, Côte-d'Ivoire and Ghana, as well as in savanna in Senegal, Mauritania, Guinea, Sierra Leone, Liberia, and Côte-d'Ivoire. During the day these crabs remain inactive, lying hidden under stones or in crevices in the streambed and at night they leave their resting places to feed on dead organic material or on small aquatic animals, such as molluscs. They also eat vegetable matter, and are attracted into traps baited with cassava, palm nuts, red papaya, or meat. This species is economically important, forming part of the diet of many people in western Africa. It is also medically important as the predominant second intermediate host of *P. uterobilateralis*, the human lung fluke that causes human paragonimiasis in Liberia, Guinea (Sachs and Voelker 1982) and Côte-d'Ivoire (Nozais *et al.* 1980). *L. latidactylus* also serves as the host of the larvae of biting blackflies (*Simulium*) that are the vectors of *Onchocerca volvulus*, the parasite that causes river blindness (onchocerciasis) in parts of Liberia and Guinea and elsewhere in western Africa.

***Liberonautes paludicolis* (Cumberlidge and Sachs, 1989), Pale Swamp Crab (LC)**

Liberonautes paludicolis is a fairly common species known only from the rainforest zone in Liberia and Côte d'Ivoire, and is endemic to this part of the Upper Guinea forests of western Africa. It is found in or near forest streams, or in low-lying areas of cleared forest that have permanent surface water, such as fish farm excavations, swamp rice farms, and ditches. The species also occurs in sites that become inundated with shallow water during the rainy season (May to October). These crabs spend a good deal of time resting in burrows dug into the banks of streams, swamps, marshland, or the forest floor. Burrows are usually sited next to, or in the vicinity of, water and are usually absent from those parts of the forest where there is no nearby surface water. Swamp crabs have often been encountered crossing the road during daytime rainstorms or at night, when they leave their resting places to look for food on the nearby land and occasionally venture into streams. The ecology of

the swamp crab is distinct from that of *L. latidactylus*, but there is an area of geographic overlap, because the two species occur together in the small streams of the rainforest zone of Liberia. *L. paludicolis* is also an important second intermediate host to *P. uterobilateralis* in Liberia and therefore also plays a key role in the transmission of the human lung fluke parasite to humans.

***Potamonautes ecorseii* (Marchand, 1902), Ecorse's River Crab (LC)**

Potamonautes ecorseii is a widespread species common in the major rivers in the western part of western Africa with a distributional range including Mauritania (Guidimaka), eastern Senegal, The Gambia, Mali (river Niger and Mali, Lac Téli, near to Goundam), Burkina Faso, Côte-d'Ivoire, Ghana, Togo, and Nigeria. It is the subject of small-scale local fisheries in Mali, where it is captured in nets or in baited fish traps. This species is found within the Parc National de Niokolo-Koba in Senegal.

***Sudanonautes africanus* (A. Milne-Edwards, 1869) African River Crab (LC^{RG})**

Sudanonautes africanus is a widespread and abundant large-bodied species common in the eastern part of western Africa, with a distributional range which includes the more humid areas of the coastal rainforest belt from south-east Nigeria, Cameroon, and central Africa. The western boundary of its distributional range is east of the Niger River in south-east Nigeria. The species is not known from the rest of the western African region (from western Nigeria to Senegal). *S. africanus* occurs in a range of permanent aquatic habitats including large rivers and small streams (with both fast- and slow-flowing water), draining mature forest shaded by overhanging climbing palms or by emergent vegetation, and ponds and temporary water sources such as drainage culverts and ditches. It is capable of breathing air and is often found on land at night where it digs burrows near waterways. *S. africanus* also serves as an important second intermediate host to the human lung flukes *P. uterobilateralis* and *P. africanus* in Nigeria and Cameroon (Voelker and Sachs 1977).

***Sudanonautes aubryi* (H. Milne Edwards, 1853), Aubry's River Crab (LC^{RG})**

Sudanonautes aubryi is a widespread and abundant large-bodied species common in western and central Africa, with a distributional range that includes Côte-d'Ivoire, Ghana, Togo, Benin, and the humid coastal areas of Nigeria, Cameroon, Gabon, and Equatorial Guinea. The western boundary of its distributional range is in Côte-d'Ivoire and it is not known from the rest of the western African region (from Liberia to Senegal). *S. aubryi* is found in the Guinea and woodland savanna regions, where it inhabits streams, rivers, and ponds, and digs burrows near waterways; at night and during rainstorms it is often found on land and is capable of breathing air. This species also serves as an important second intermediate host to the human lung flukes *P. uterobilateralis* and *P. africanus* in Nigeria and Cameroon (Voelker and Sachs 1977).

***Sudanonautes floweri* (De Man, 1901), Flower's Stream Crab (LC^{RG})**

Sudanonautes floweri is a widespread and abundant large-bodied species common in western and central Africa, with a distributional range that includes Nigeria, Cameroon, Bioko, Central African Republic, Chad, Sudan, Uganda, DRC, Congo, Gabon, Cabinda (Angola) and Equatorial Guinea. The wide range of this species includes localities in the Nile River system, the Congo River system, and the Chari River system, including Lake Chad. *S. floweri* is found in the Guinea and woodland savanna regions where it inhabits streams, rivers, and ponds, and digs burrows near waterways; at night and during rainstorms it is often found on land either next to water or some distance away, since it is capable of breathing air, and functions well for long periods out of water. This is another species which serves as an important second intermediate host to the human lung flukes *P. uterobilateralis* and *P. africanus* in Nigeria and Cameroon (Voelker and Sachs 1977).

***Sudanonautes granulatus* (Balss, 1929), Granulated River Crab (LC^{RG})**

Sudanonautes granulatus is a widespread and abundant large-bodied species common in the tropical rainforest zone of western and central Africa, with a distributional range that includes Côte-d'Ivoire, Ghana, Togo, Nigeria, Cameroon, including the island of Bioko (Equatorial Guinea), and the Central African Republic. The distribution of this species is fragmented, divided by the drier savannas of the Dahomey Gap. In the Oban Hills in south-east Nigeria, north-east of Calabar, this species is found in small streams flowing through mature rainforest, where it lives among grass, under stones, and among root material.

***Sudanonautes monodi* (Balss, 1929), Monod's Savanna Crab (LC)**

Sudanonautes monodi is a widespread and abundant large-bodied savanna species found only in the Sudan and Guinea savanna zone of western Africa in Chad, Cameroon, Nigeria, Republic of Benin, and Togo, where it is locally common. The western boundary of its distributional range is in Togo and it is not known from the rest of the western African region (from Ghana to Senegal). This species is not found in the Sahel savanna regions or in the tropical rainforest zone. In Nigeria, *S. monodi* is associated with three major river systems draining the savanna region: the Benue River basin, the Hadejia-Jama'are River/Lake Chad basin, and the Kaduna River/Niger River basin. The most northerly record is from Hadejia in northern Nigeria, a locality close to the border between the Sudan savanna and Sahel regions. In Togo and Benin, *S. monodi* occurs in the upper reaches of the Volta River basin that drains savanna country. The southern boundary of the distribution lies between the Guinea savanna and woodland savanna zones, and it is found from Togo to Cameroon. This species is found in seasonal wetlands in Sudan savanna and its respiratory physiology and ecology are modified for a semi-terrestrial existence (Cumberlidge 1986). In the Guinea and

Sudan savanna regions of western Africa the dry season lasts from October to April, so to survive in this arid environment, each crab digs a burrow. Tunnels and burrows up to one meter long are dug into dried stream banks, waterless swamp beds and cracked water holes, which are all sited in low-lying areas where the water table is close to the surface. This species is found living in colonies of up to a hundred, with one crab per burrow. During the dry season this species is inactive in its burrow by day and active on land at night.

***Sudanonautes kagoroensis* (Cumberlidge, 1991), Kagoro Stream Crab (LC)**

Sudanonautes kagoroensis is a large-bodied species that is locally common in central Nigeria, where it is endemic. It lives in streams and rivers of the Guinea savanna zone of western central Nigeria draining the western slopes of the Jos plateau, and in the rivers close to the western base of the plateau. *S. kagoroensis* is known only from the Mada River and its tributaries, which collect water from the Jos plateau before joining the Benue/Niger River. This species is known from a series of specimens collected in 1984 as part of the national biodiversity survey, from seven sites in central Nigeria.

6.2.5 Species assessed as Data Deficient

***Afrithelphusa afzelii* (Colosi, 1924), Afzeli's Crab (DD)**

Afrithelphusa afzelii is one of only five species in two genera that belong to a rare group of freshwater crabs endemic to the upper Guinea forest block of western Africa. The habitat and ecology of this species are not known because the information on the single collection locality is vague, and is listed only as "Sierra Leone". It is listed here as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats. It is of great concern that this species is known only from two specimens that were collected in 1790-1800 from the same locality in Sierra Leone, and that no new specimens have come to light since then. However, there is not enough known about this species to make a thorough assessment at this time, so the Red List status of this species was recently changed from CR to DD.

***Afrithelphusa gerhildae* (Bott, 1969), Gerhilda's Crab (DD)**

Afrithelphusa gerhildae also belongs to the group of freshwater crabs endemic to the upper Guinea forest block of western Africa. As for *A. afzelii* above, the habitat and ecology of this species are not known because the information on the single collection locality is vague, and is listed only as "Kindia, Guinea". It is also listed as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats. This species is also known from only a very few specimens (three), collected in 1957 from the same locality in Guinea. No new specimens have come to light since then. There is not enough known about this species to make a

thorough assessment at this time, so the conservation status of this species was changed recently from CR to DD.

***Afrithelphusa leonensis* (Cumberlidge, 1987), (DD)**

Afrithelphusa leonensis is endemic to Sierra Leone in freshwater habitats in the Upper Guinea Forest zone. This species is still currently known from specimens collected from the same locality in Sierra Leone. *A. leonensis* is also listed here as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats. It is known only from three specimens all collected in 1955, and no new specimens have come to light since then.

***Potamonautes senegalensis* (Bott, 1970), Senegal River Crab (DD)**

Potamonautes senegalensis is known only from one locality in the Senegal River, Senegal, and is endemic to that country. In 1970, when the species was collected, the Senegal River was saline for more than 250 km inland. In 1985, a dam was built at Diama to prevent the invasion of saltwater upstream of the dam. The collection locality is not specific but it seems likely that it was collected in the freshwater zone of the river that was, at that time, upstream of Podor. The locality was probably somewhere between Podor and the border with Mali. The highly arched and rounded carapace of this species is typical of freshwater crabs that live a semi-terrestrial life and breathe air as well as water (Cumberlidge 1999). *P. senegalensis* is listed here as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats. It is of concern that this species is known only from two specimens collected in 1960, and that no new specimens have come to light since then.

***Sudanonautes nigeria* (Cumberlidge, 1999), (DD)**

Sudanonautes nigeria is known only from one locality in southern Nigeria and it is endemic to the rainforest zone of south-east Nigeria in the western part of the Lower Guinea forest block. *S. nigeria* is listed here as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats. It is of concern that this species is known only from four specimens collected in 1973, and that no new specimens have come to light since then.

6.3 Patterns of species richness

Most of the species dealt with in the present study occur exclusively in western Africa (from Senegal to Nigeria), while the range of several species of *Sudanonautes* also extends into central Africa. This latter area includes Cameroon, Chad, southern Sudan, Uganda, the Central African Republic, the DRC north of the Congo River, the Republic of the Congo, Gabon, and Equatorial Guinea (including the island of Bioko). The taxonomic diversity of the western African region at the

genus level (six genera) is higher than that of the whole of the rest of continental Africa (five genera) and is comparable with Madagascar (seven genera). Species diversity within the western African region clearly depends on vegetation cover, with the highest number of species occurring in rainforest ecosystems, and the fewest in savanna ecosystems. One species (*Potamonautes ecorseii*) is even found in the desert zone in Mali, but only where the river Niger flows through Timbuktu. Eight of the 29 species of western African freshwater crabs have a wide distribution over an extensive area, while most (21 out of 29 species) have a restricted distribution. Three species (*Sudanonautes aubryi*, *S. granulatus*, and *Potamonemus sachsi*) have a fragmented distribution pattern, occurring in two geographically separated forested areas, but not in the savanna zone between them.

6.3.1 All freshwater crab species

The western African region has a distinctly recognisable freshwater crab fauna, whereby only three species (*S. africanus*, *S. floweri* and *S. aubryi*) have a distribution that extends significantly outside of the region (Cumberlidge 1999). *S. granulatus* occurs just outside the region, in Bioko (Equatorial Guinea) and parts of Cameroon. The tropical rainforest zone in the western African region supports the richest freshwater crab fauna, and consists of two main parts, the Upper Guinea forest block (in Guinea, Sierra Leone, Liberia, Côte-d'Ivoire, Ghana and Togo) and the Lower Guinea forest (a much larger forest block in south-east Nigeria, south Cameroon, Gabon, Congo, Central African Republic and DRC). These two forests are separated by the Dahomey Gap, a stretch of coastal savanna in Ghana, Togo and Benin. Each forest block supports its own distinct freshwater crab fauna (Figure 6.2). The freshwater crab fauna of the Upper Guinea forest (15 species in five genera) is completely different from that of the Lower Guinea forest (18 species in five genera), and only two species (*Sudanonautes aubryi* and *S. granulatus*) occur in both areas.

The western Lower Guinea forest in Nigeria falls within the western African region as considered here, and its freshwater crab fauna consists of seven species (four of which are not included in the assessment, see section 6.1) in three genera (*Sudanonautes*, *Potamonautes* and *Potamonemus*), and includes two endemic species (*Sudanonautes nigeria* and *Potamonautes reidi*). This forest completely lacks representatives of *Liberonautes*, *Globonautes* and *Afrithelphusa*.

The Upper Guinea forest is the largest forest in western Africa, and extends along the coast from Guinea to southern Togo. The distribution of the flora and fauna of the Upper Guinea forest is not entirely uniform, and there is a notable faunal division between the western Upper Guinea forest (the 'Liberian' zone, from western Côte-d'Ivoire west of the Bandama River to Guinea) and the eastern Upper Guinea forest (the 'Ghanaian' zone, from eastern Côte-d'Ivoire east of the Bandama River to Togo). The freshwater crab fauna

of the western part of the Upper Guinea forest (in Guinea, Sierra Leone and Liberia) consists of 13 species in three genera (*Liberonautes*, *Globonautes* and *Afrithelphusa*), of which 11 species and two genera (*Globonautes* and *Afrithelphusa*) are endemic. This forest is dominated by species of *Liberonautes* but also includes representatives of the rare and threatened species that belong to *Globonautes* and *Afrithelphusa*. Notably, *Potamonautes* and *Sudanonautes* are absent from this part of the forest. Two species (*Liberonautes latidactylus* and *L. chaperi*) range east of this area, but only as far as south-west Ghana in the eastern Upper Guinea forest. Here, freshwater crabs are found in lowland forest streams, large rivers, swampy regions of the forest floor and mountain streams, while in Liberia and Guinea *Globonautes macropus* lives in holes in trees. The freshwater crab fauna of the eastern part of the Upper Guinea forest (in Côte-d'Ivoire, Ghana and Togo) consists of six species in three genera (*Liberonautes*, *Potamonautes* and *Sudanonautes*) and only one species, *Potamonautes triangulus*, is endemic. This part of the forest supports two species in each of these three genera, while *Globonautes* and *Afrithelphusa* are absent. The fauna of the eastern Upper Guinea forest includes elements of both the western Upper Guinea forest and of the Lower Guinea forest, and its species diversity is probably a function of its being an area of faunal overlap.

The moist savanna zone in western Africa bounded by the Niger River in Nigeria and the Volta River in Ghana represents an area of species paucity as far as the freshwater crabs are concerned, as does the drier more northern Sudan savanna, which stretches from Burkina Faso to southern Sudan. Forest and savanna ecosystems in western Africa support different freshwater crab faunas, and there is little overlap between the species found in these two regions. The highest numbers of species of freshwater crabs in western Africa are found in rainforest ecosystems despite the fact that the savanna zone covers by far the largest area in the region. The western part of the savanna zone, from northern Côte-d'Ivoire, Guinea, Mali, to Senegal and The Gambia, is home to only three species of freshwater crabs (*Liberonautes latidactylus*, *Potamonautes ecorseii* and *P. senegalensis*); the former two species are widespread, the latter species is endemic to Senegal.

The rivers of western Africa and the northern part of central Africa are home to a distinct freshwater crab fauna that includes species of *Potamonautes*, *Sudanonautes* or *Liberonautes*. The Niger and the Volta Rivers that flow through the savanna regions of western Africa support two species of river crabs, *Potamonautes ecorseii* and *P. triangulus*, with the latter species being endemic to the rivers of Ghana.

In conclusion, the distributional data indicate that there is a high degree of endemism in western Africa's freshwater crab fauna at the species level (21 out of 25 species are endemic, 84%), and the genus level (five out of six), but this is not the case at the family level (all belong to the Potamonautidae (Cumberlidge *et al.*, 2008)). Thirteen species occur within the

Figure 6.2 Freshwater crab species richness in western Africa. Species richness = species per hexagonal grid cell (289 km²).

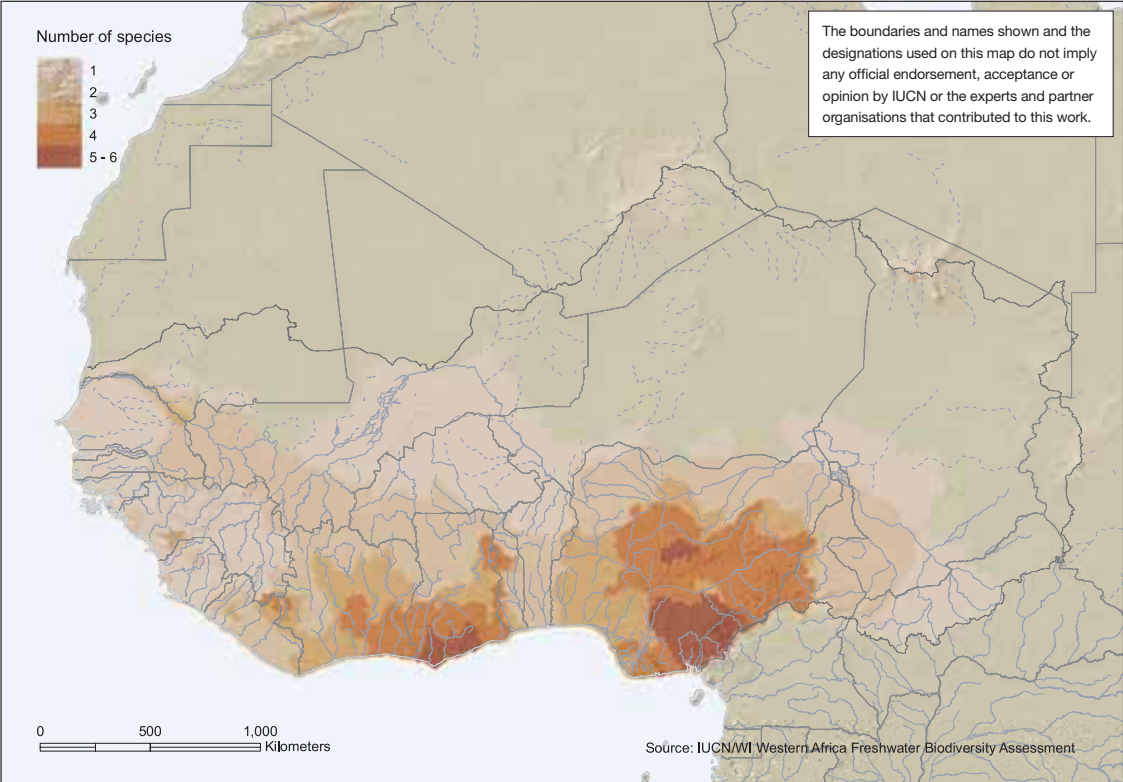
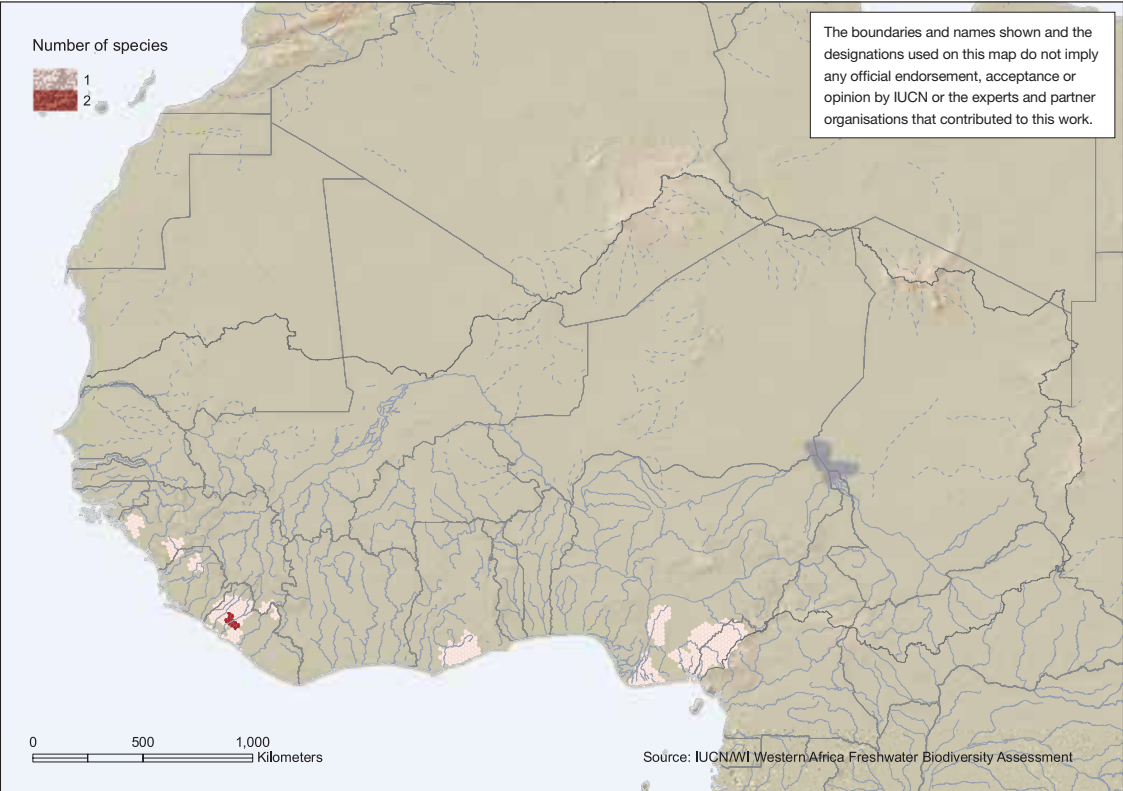


Figure 6.3 Threatened freshwater crab species richness in western Africa. Species richness = species per hexagonal grid cell (289 km²).



whole of Cameroon, but only seven of these fall within the region covered in the present work. After this, Nigeria hosts the most species (10 out of 24, 40%), of which four are endemic. Three of the Nigerian endemics (*P. reidi*, *S. nigeria*, and *P. sachsii*) are found in the streams and rivers associated with the rainforest zone of the Oban Hills. This endemism may reflect the past isolation of this region, and the relatively easy isolation of crab populations in the rivers that drain these hills. The other Nigerian endemic species, *S. kagoroensis*, is associated with the streams draining the Jos Plateau. Liberia is the second most speciose country in the western African region (nine out of 25 species, 36%) and with a rate of endemism of 56% (five out of nine species). The lowest species richness (one to three species) is found in a vast arid area of the region that includes Mauritania, Mali, Burkina Faso, Niger and Chad, none of which have any endemic species of freshwater crabs. Here crabs are restricted to permanent water sources (such as the Senegal, Niger and Hadejia-Jama'are River basins) on the margins of these arid lands (Cumberlidge 1999).

The areas that contain the highest freshwater crab species richness in western African region are found in Nigeria, Cameroon, Ghana and Côte D'Ivoire. Liberia also contains high numbers of crab species but many of them have very restricted ranges that do not overlap, so that the species richness shown in Figure 6.2, where species richness is measured using a hexagonal grid and not by country, is relatively low. The lowest areas of species richness are in the more arid savanna areas. Nigeria, Cameroon and Liberia are the most thoroughly surveyed in the region, which no doubt accounts for the recent increase in species descriptions and new distribution records, while the freshwater crab faunas of the other countries in the region have only been lightly sampled by comparison. Nevertheless, the general pattern of species-rich faunas in the Upper Guinea and Lower Guinea rainforests, and

low species richness in the more arid parts of the savanna from Senegal to Chad, is probably real, rather than an artefact resulting from under-collection. The low species richness in the savanna countries with large areas of Sahel and desert ecosystems is not entirely unexpected because these countries include vast areas of arid land, but it is harder to explain the low number of species in the better-watered areas of Guinea and Sierra Leone (and it is likely that at least some of this may be due to under-sampling). Further exploration is needed throughout western Africa, where it is probable that the species-count for the freshwater crab fauna of the region will increase substantially as taxonomic discrimination improves and collection efforts intensify.

6.3.2 Threatened species

Ten species of freshwater crabs were placed in threatened categories (see section 6.2). The two CR species, the four EN species, and one of the VU species are all from the Upper Guinea forest, notably the rainforests of Liberia and Guinea, while two of the VU species are from the rainforests of south-east Nigeria, and one VU species from southern Ghana (Figure 6.3).

6.3.3 Restricted range species

Species with restricted ranges are irregularly distributed in the region (Figure 6.4). Excluding Data Deficient species, 11 species of freshwater crab from western Africa have a restricted range (<20,000 km²), and the majority of these (eight) are found in the Upper and Lower Guinea forest zones (Table 6.2). These species fall into three groups: (1) eight endemic species from the Upper Guinea forest zone; (2) two species from the Lower Guinea forest zone; and (3) one species in the savanna zone. The limited distribution of these species is likely not an anomaly because a great deal of collecting has been done throughout the region

Table 6.2 Freshwater crabs of western Africa restricted to single river basins, excluding those considered to be Data Deficient.

Species	RL Category	Range (km ²)	Loc	PA	Zone
<i>Potamonautes reidi</i>	VU	< 20,000	<10	Y	LG
<i>Potamonemus sachsii</i>	VU	< 20,000	<10	Y	LG
<i>Sudanonautes kagoroensis</i>	LC	< 5,000	7	N	SAV
<i>Liberonautes nimba</i>	VU	< 20,000	4	Y	UG
<i>Potamonautes triangulus</i>	VU	< 20,000	6	N	UG
<i>Afrithelphusa monodosa</i>	EN	< 5,000	2	N	UG
<i>Globonautes macropus</i>	EN	< 5,000	5	N	UG
<i>Liberonautes nanoides</i>	EN	< 5,000	1	N	UG
<i>Liberonautes rubigimanus</i>	EN	< 20,000	3	Y	UG
<i>Liberonautes grandbassa</i>	CR	~ 100	1	N	UG
<i>Liberonautes lugbe</i>	CR	~ 100	1	N	UG

RL = Red List status; LC = Least Concern, VU = Vulnerable; Range = estimation of species distribution range based on distribution polygon of all known specimens; # Loc = Number of discontinuous localities from which the species was collected; PA = found in a protected area; Y = yes, N = no, LG = Lower Guinea forest zone, UG = Upper Guinea forest zone, SAV = savanna zone.

Figure 6.4 Freshwater crab species with severely restricted ranges (<20,000 km²) in western Africa. Species richness = species per hexagonal grid cell (289 km²).

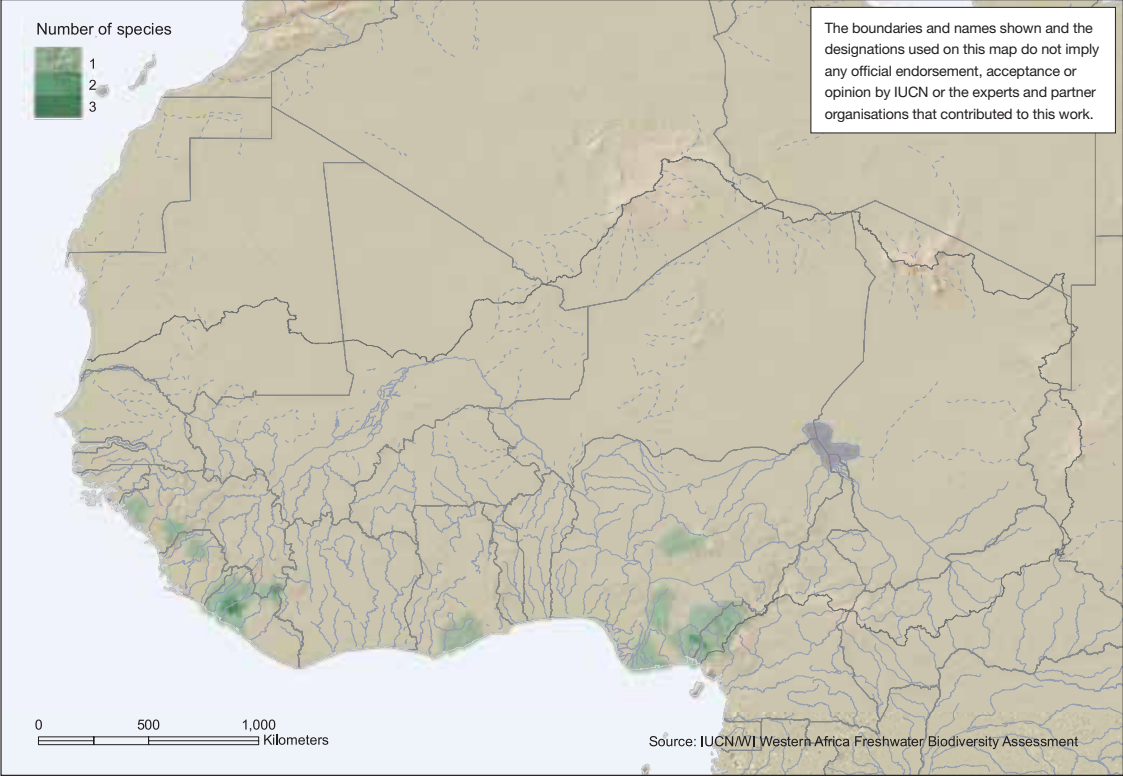


Figure 6.5 Data Deficient freshwater crab species richness in western Africa. Species richness = species per hexagonal grid cell (289 km²).

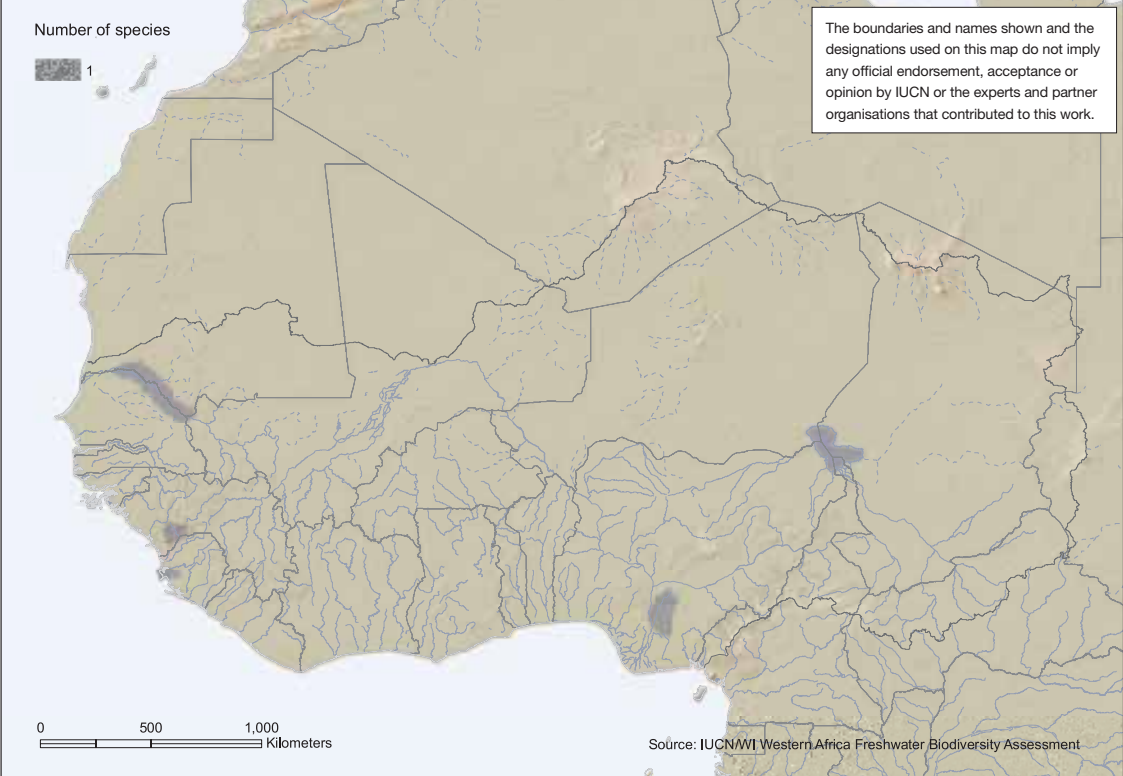


Table 6.3 Summary of the most important threats to freshwater crab species in the western African region.

	Species	Main threats	Conservation Status: Category
1	<i>Liberonautes nimba</i>	Habitat destruction	VU
2	<i>Potamonautes triangulus</i>	Habitat destruction	VU
3	<i>Potamonautes reidi</i>	Habitat destruction	VU
4	<i>Potamonemus sachsi</i>	Habitat destruction	VU
5	<i>Liberonautes chaperi</i>	No major threats	LC
6	<i>Liberonautes latidactylus</i>	No major threats	LC
7	<i>Liberonautes paludicolis</i>	No major threats	LC
8	<i>Potamonautes ecorseii</i>	No major threats	LC
9	<i>Sudanonautes africanus</i>	No major threats	LC ^{RG}
10	<i>Sudanonautes aubryi</i>	No major threats	LC ^{RG}
11	<i>Sudanonautes floweri</i>	No major threats	LC ^{RG}
12	<i>Sudanonautes granulatus</i>	No major threats	LC ^{RG}
13	<i>Sudanonautes kagoroensis</i>	No major threats	LC
14	<i>Sudanonautes monodi</i>	No major threats	LC
15	<i>Afrithelphusa monodosa</i>	Habitat destruction	EN
16	<i>Globonautes macropus</i>	Habitat destruction	EN
17	<i>Liberonautes nanooides</i>	Habitat destruction	EN
18	<i>Liberonautes rubigimanus</i>	Habitat destruction	EN
19	<i>Afrithelphusa afzelii</i>	Unknown	DD
20	<i>Afrithelphusa gerhildae</i>	Unknown	DD
21	<i>Afrithelphusa leonensis</i>	Unknown	DD
22	<i>Potamonautes senegalensis</i>	Unknown	DD
23	<i>Sudanonautes nigeria</i>	Unknown	DD
24	<i>Liberonautes grandbassa</i>	Habitat destruction	CR
25	<i>Liberonautes lugbe</i>	Habitat destruction	CR

over the years and they have not shown up in other localities. Any development of the Upper and Lower Guinea forest zones could thus potentially impact a number of species. Ten of the restricted range species were assessed as threatened, with the remaining species being Least Concern, despite its relatively narrow distribution. Nevertheless, species with a restricted range 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 suddenly affect their habitat. It is, therefore, of immediate concern that eleven (44%) of the region's 25 crab species are known from distribution ranges of less than 2,000 km² (two of which have an estimated range of less than 500 km², Table 6.2). Despite the danger of population fragmentation, the current population levels of those stenotopic species (able to tolerate a narrow range of environmental conditions) assessed as Least Concern are estimated to be stable; many are found in at least one protected area, and there are no identifiable immediate threats that would impact the health of those streams and endanger their long-term existence. The reasons for the restricted ranges of these species are largely unknown, but it is thought to be more likely that they have speciated relatively recently in response to isolation in a specialised (marginal) habitat, rather than their being the remnant populations of formerly widespread species now in decline.

6.3.4 Data Deficient species

The five species of freshwater crabs from the western African region assessed as Data Deficient are all from the Upper and Lower Guinea forests, except for *P. senegalensis* from the Senegal River, in the savanna zone of Senegal (Figure 6.5). This status is due to insufficient information, either on their taxonomic distinction (for example, *A. gerhildae* and *A. afzelii*), or because they are known from only one or a few localities (*A. leonensis* and *P. senegalensis* and *S. nigeria*), thought to be a possible product of under-sampling. Further research is needed on all of these species, which may prove to be restricted range endemics that are vulnerable to habitat loss.

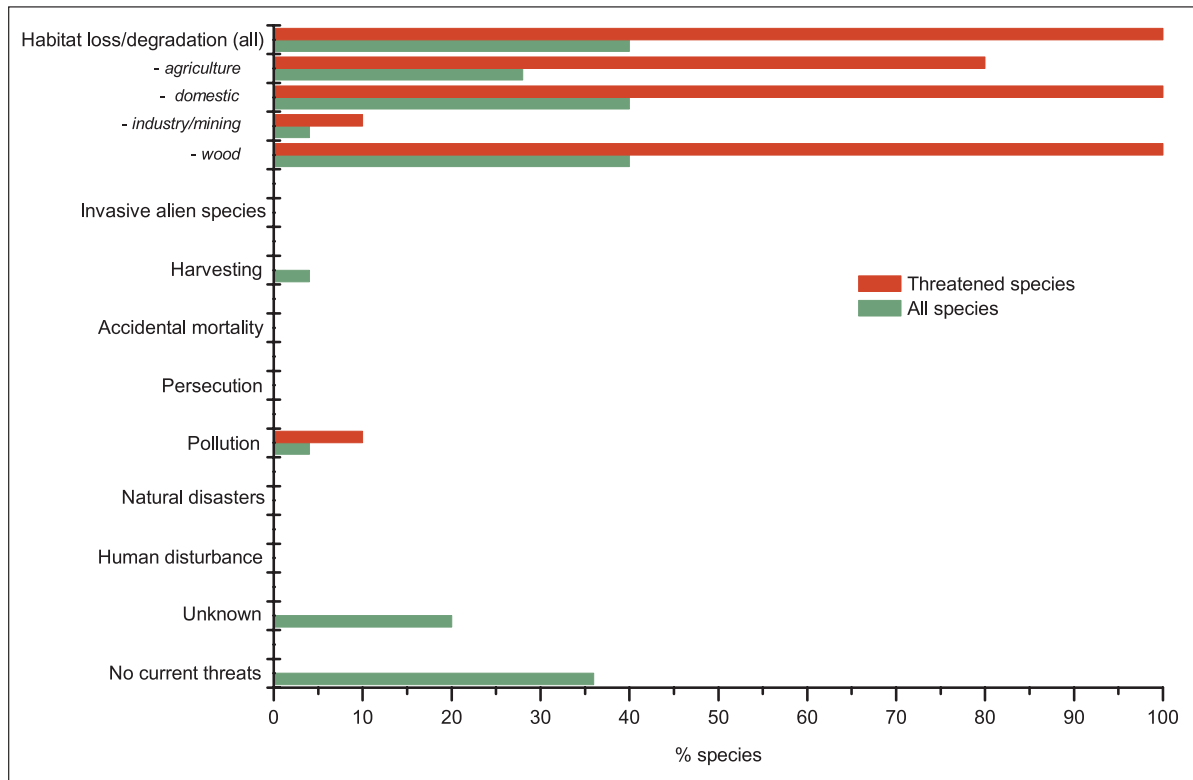
6.4 Major threats to freshwater crabs

The main current threats to the freshwater crabs of western Africa are habitat loss due to population and agricultural expansion and deforestation (see Figure 6.6). The main threats to individual species are listed in Table 6.3.

6.4.1 Natural predators

Freshwater crabs are the largest of the macro-invertebrates in African aquatic ecosystems and when conditions are right can dominate benthic invertebrate communities. Crabs are omnivores with a preference for herbivory over carnivory, and typically consume plant matter and scavenge detritus, making them important detritivores (Dobson 2002, 2004; Dobson *et al.* 2007a, b). Freshwater crabs also form an integral part of

Figure 6.6 Percentage of freshwater crab species affected by each major current threat. Note that many species have more than one threat listed.



the food chain in the river systems of western Africa because they are vital components of the diet of a number of natural mammalian and avian predators. For example, freshwater crabs represent a common food resource for the yellow-necked otter, the water mongoose, and the African civet, as well as for kites, egrets, herons, and the giant kingfisher. Other animals that prey on crabs include monitor lizards and crocodiles. In many rural parts of western Africa freshwater crabs form an important part of the diet of humans. It is clear that freshwater crabs are important members of freshwater communities in the aquatic ecosystems of western Africa, and it is vital to the health of these ecosystems that fishery managers consider measures that specifically include the conservation and sustainable use of local populations of river crabs.

6.4.2 Pollution

Pollutants from mining activities (such as bauxite, iron, and gold) in Guinea and Liberia and from organic wastes from leaking sewage systems in urban areas can accumulate in rivers and other freshwater bodies and affect crab populations. These pollutants impact freshwater crabs because they are benthic feeders, ingesting invertebrates and detritus that have high levels of contaminants. Immediate attention should be given to the improvement of the water quality in these areas, not least because the bioaccumulation of metals in crabs could pose an increasing problem for the health of people who may eat them.

6.4.3 Threats in the Upper Guinea and Lower Guinea forests

Threats to the endemic species in the Upper Guinea and Lower Guinea forests include habitat destruction in the form of deforestation, driven by increasing agriculture, the demands of increasing industrial development, the alteration of fast flowing rivers for the creation of hydroelectric power, and the drainage of wetlands for farming and other uses. Other threats that result in deforestation and habitat destruction include political unrest. In addition, excessive water abstraction leaves rivers with little or no flow in the drier months, and sedimentation associated with farming activities further decreases habitat quality. Potential future threats to aquatic communities in rivers associated with cities and towns include pollution by sewage and industrial and general waste. Agricultural pesticides used by farmers may prove to be lethal to freshwater crabs, but more research needs to be carried out. All of the above combine to increase the overall level of threat to range-restricted endemic species of freshwater crabs, and the careful management of water resources in the future will have the biggest impact on their survival.

6.4.4 Taxonomic issues

The evolving taxonomy of freshwater crabs may prove a challenge for conservation planning in the future as some taxa currently assumed to be widespread and common may prove to

Plantain (*Musa sp.*) planted in a freshly deforested area near the village of Kamaso and the town of Asankrangwa in the region of the Upper Guinean Rainforest in Western Ghana. Photo: © Johannes Förster.



be complexes of several distinct cryptic taxa, each with specific ecologies and distributions requiring direct conservation action. One such possibility is *S. granulatus*, currently assessed as Least Concern primarily on account of its wide distributional range. However, this range consists of many relatively isolated subpopulations that show a great deal of morphological and genetic variation, and further investigations may show *S. granulatus* to be a species complex, as is probably the case for *P. perlatus* in South Africa (Daniels *et al.* 2002).

6.5 Conservation recommendations

As the biology and distribution patterns of the freshwater crabs of western Africa become better known, so are the potential threats to their long-term survival. With 12 of the 29 species of freshwater crabs from the western African region currently

assessed as being at risk of global extinction, the region's largely endemic freshwater crab fauna appears to be in immediate trouble. Nevertheless, it is hoped that conservation recovery plans for threatened species will be developed for those species identified to be in need of conservation action through the Red List assessment process.

The conservation of many species of freshwater crabs depends primarily on the preservation of patches of natural habitat large enough to maintain the water quality of the upper catchment streams. Although it is not yet known exactly how sensitive freshwater crabs in Africa are to polluted or silted waters, there is evidence from Asia that crabs are not likely to survive when exposed to these factors (Ng and Yeo 2007). Development, agriculture and exploitation of natural products are necessary realities in developing economies, but compromises may have to be made if freshwater crab species are not to be extirpated

in the future. Judicious and careful use of resources is unlikely to cause species extinctions as long as water drainages are not heavily polluted or redirected, some forest and vegetation cover is maintained, and protected areas are respected.

Common species of western African freshwater crabs assessed as Least Concern have a wide distribution in the rivers, lakes, and mountain streams of the region and so far have proved to be relatively tolerant of changes in land-use affecting wetland ecosystems. The persistence of these more adaptable species in lowland rivers and streams that are already disturbed and visibly polluted in parts is encouraging. Loss of natural vegetation and pollution as a result of land development and agriculture is, however, likely to affect the lowland rivers, and many of the wholly aquatic species that live there could be vulnerable. Even species assessed as Least Concern could suffer catastrophic declines should there be abrupt changes in land development, hydrology, or pesticide-use regimes. It is not known how the highland taxa will cope with habitat disturbance and pollution, but considering their specialised habitat requirements it is likely that most of these species will not adapt as readily as the more widespread lowland species. In many countries with a rapid pace of development, often only a fine line separates a species assessed as Least Concern from one assessed as Vulnerable, or a Vulnerable species from one that is assessed as Endangered. The numerous development projects in place or in planning could have a dramatic impact on species of freshwater crabs with specific habitat requirements and a restricted distribution. Conservation activities should, therefore, be aimed primarily at preserving the integrity of sites and habitats while at the same time closely monitoring key freshwater crab populations.

The Data Deficient status of the five species of freshwater crabs from western Africa is primarily a product of insufficient field survey. The scarcity of available specimens is in a large part due to the long-term poor security situation in that area, and little is known of the habitat needs, population trends, or threats to these species. For example, *A. leonensis* came to light only recently during examination of unidentified museum specimens. When more information has been gathered, all five DD species will probably prove to have a relatively restricted distribution and all will likely prove to be endemic to the river basin where they are found.

The conservation assessment of freshwater crabs in western Africa represents a first step toward the identification of threatened species within the region and toward the development of a conservation strategy for endemic species. The restricted range of many species of freshwater crabs from western Africa, together with the on-going human-induced loss of habitat in many parts of the region, are primary causes for concern for the long-term survival of this fauna.

Western Africa's freshwater crabs have a high degree of endemism, with many species living in specialised habitats such as highland streams and lowland marshes. Although many species live in protected areas and may not be under immediate threat, their inherent fragility and specific habitat requirements

support the need to establish reserves specifically aimed at the inclusion and protection of freshwater ecosystems. Additional research is recommended to determine the minimum effective size and design of protected areas for freshwater species such as crabs. Finally, watershed conservation, in particular in the upper catchment areas, is an immediate priority.

Significant areas of this vast region still remain insufficiently explored, and new species of freshwater crabs are sure to be discovered as collection efforts in the remote areas intensify and taxonomic skills become more refined. Although taxonomic knowledge has advanced considerably in recent years, and museum collections of freshwater crabs have improved, a great deal of work still needs to be done. There is a need for further surveys to discover new species, refine species distributions, define specific habitat requirements, describe population levels and trends, and identify specific threats to western Africa's important and unique freshwater crab fauna.

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