

## 5. Freshwater Crustacea Decapoda of New Guinea

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Although the Decapoda are the best known freshwater Crustacea of New Guinea, knowledge of their taxonomy, distribution and ecology is still very fragmentary, and a clear picture of their biogeography and ecology can not yet be given, but some interesting features can be observed.

The Decapoda inhabiting the freshwaters of New Guinea belong to three distinct categories: (1) shrimps belonging to the families Atyidae and Palaemonidae, (2) crayfish of the family Parastacidae and (3) crabs of the families Sundathelphusidae, Grapsidae, and Hymenosomatidae. Of these 6 families only the Parastacidae and Sundathelphusidae are exclusively freshwater inhabitants; the other families contain species that spend their entire life or part of it in the sea or in brackish water, the percentage of true freshwater species in each family is variable, being quite high in the Atyidae and extremely low in the Grapsidae.

### 1. Historical

As late as the second half of the 19th century the first freshwater Decapoda were reported from New Guinea, when De Man (1879:167, 168) mentioned *Palaemon Rosenbergii* [= *Macrobrachium rosenbergii* (De Man, 1879)] and *Palaemon ornatus* [= *Macrobrachium lar* (Fabricius, 1798)] from Andai in the Vogelkop. Earlier in the same year De Man (1879a:63) mentioned the freshwater crab *Parathelphusa convexa* De Man, 1879, from New Guinea, but his material was incorrectly labelled and probably came from Java. The above shrimps of the genus *Macrobrachium* were collected at Andai by C. B. H. von Rosenberg. Most of the early zoologists who visited New Guinea concentrated their attention on vertebrates, but some also collected Crustacea, like the Italian zoologists L. M. d'Albertis (1872–1878) and L. Loria (between 1889 and 1895) and the Hungarian zoologist L. Biró (1896–1901).

In the twentieth century well organized expeditions made it possible to penetrate deeper into the unknown areas and to obtain important scientific information. These expeditions usually were sponsored by public or private bodies with support of the governments of the three areas involved: Irian Jaya — until 1962 Netherlands New Guinea (Nederlands Nieuw Guinea); Territory of

New Guinea (until 1918 Kaiser Wilhelmsland) and Papua. For each of these three territories the explorations that yielded Decapod Crustacea will be dealt with separately. Of the various expeditions the years are given as well as the name of the leader, the title under which it is best known, the name of the zoologist (if pertinent), the area explored, and the paper(s) in which the results of the study of its Decapod Crustacea can be found.

I. Irian Jaya (=Nederlands Nieuw Guinea). If not Dutch, the nationality of the expedition or private traveller is mentioned.

- 1858–1870 C. B. H. von Rosenberg, German naturalist, 1858–1870 made extensive collections in and near New Guinea for Rijksmuseum van Natuurlijke Historie, Leiden. Collected freshwater Decapoda at Andai near Manokwari (Vogelkop). In Manokwari (then called Dorci) around 14 May 1858, 1–18 January and 3–7 June 1869, and 18–20 February 1870; only certain dates on which he visited Andai: 2 June 1869 and 19 May 1870 (De Man 1879a; Holthuis 1950).
- 1872–1873 L. M. d'Albertis (1841–1901), Italian zoologist, made several trips to New Guinea. Only on the first of these (1872–1873) he visited present day Irian, collecting freshwater Decapoda near Andai, where he stayed off and on between early August and November 1872 (Nobili 1899).
- 1898 C. W. R. Renesse van Duivenbode, a Dutch trading company at Ternate (Moluccas), had many interests and several trading posts in New Guinea. The British Museum obtained from them a Parastacid from Charles-Louis Range; no further details known (Holthuis 1949).
- 1903 C. F. A. Wichmann's North New Guinea Expedition (zoologists: L. F. de Beaufort and H. A. Lorentz) explored entire northern part, from Vogelkop to Hollandia (Roux 1917; Holthuis 1949; Bott 1974).
- 1904–1905 R. Posthumus Meyes and E. J. de Rochemont's Southwest New Guinea Expedition (zoologist: J. W. R. Koch) explored the south and SW coast, Merauke to Etna Bay (Holthuis 1949).
- 1907 H. A. Lorentz's First Southwest New Guinea Expedition (zoologist: H. A. Lorentz) went up Noord River (=Lorentz River) in effort to reach Mt Wilhelmina (Roux 1921; Holthuis 1949).
- 1907–1908 J. Roux (1876–1939), Swiss zoologist and specialist in freshwater Decapoda, and H. Merton (1879–1939) German zoologist, undertook an expedition to Aru and Kai Is, visiting the Aru group from January to May 1908; several freshwater Crustacea were collected (Roux 1919; Holthuis 1949; Bott 1970).
- 1909–1910 H. A. Lorentz's Second Southwest New Guinea Expedition (zoologist: H. A. Lorentz) followed again Noord River and succeeded in reaching summit of Mt Wilhelmina in Central Mountain Range (Roux 1921; Holthuis 1949; Bott 1974).
- 1910 L. Schultze's German-Netherlands Border Commission

- Expedition (zoologist: L. Schultze) explored border area between northern part of Netherlands New Guinea and Kaiser Wilhelmsland (Roux 1927).
- 1910 M. Moszkowski's Expedition to basin of Mamberamo River. The German Moszkowski expedition was more like individual enterprise of travellers of 19th century (Roux 1927).
- 1910–1911 W. Goodfellow's British Ornithologist's Union Expedition to West New Guinea (zoologists: W. Stalker, G. C. Shortridge, A. F. R. Wollaston) went up Mimika River to foothills of Central Mountain Range (Calman 1911, 1914; Holthuis 1949).
- 1910–1912 O. D. Tauern's Second Freiburg Moluccas Expedition (zoologist: E. Stresemann). A German Expedition; explored eastern part of Indonesia. August–October 1911 the leader, geologist O. D. Tauern (but not the zoologist) visited Misool and collected freshwater crayfish (Roux 1914; Holthuis 1949).
- 1911 J. F. C. ten Klooster's Northeast New Guinea Expedition (zoologists: K. Gjellerup, P. N. van Kampen) explored extreme NE part, from Tami River to border with Territory of New Guinea (De Man 1915; Roux 1927).
- 1912–1913 M. A. Franssen Herderschee's Southwest New Guinea Expedition (zoologist: P. Versteeg) followed Noord River up and reached Mt Wilhelmina (Roux 1921).
- 1912–1913 A. F. R. Wollaston's British Expedition to West New Guinea (zoologists: A. F. R. Wollaston, C. Boden Kloss) went up Utkwa River to Central Mountain Range (Calman 1914; Roux 1927; Bott 1974).
- 1920–1921 A. J. A. van Overeem's Expedition to North and Central New Guinea (zoologist: W. C. van Heurn) explored Mamberamo basin and went up northern slopes of Central Mountain Range (Roux 1927).
- 1923 P. Wirz (1892–1955), Swiss anthropologist, from 1916 to about 1922 in Merauke area of southern New Guinea, sent Decapoda to Basle Museum in 1923. Later travelled extensively, often visiting New Guinea, and died in 1955 in Maprik region of Territory of New Guinea (Holthuis 1949).
- 1928–1929 Voyage to Netherlands East Indies by Prince and Princess Leopold of Belgium (zoologist: V. van Straelen) visited a large part of Netherlands East Indies, including northern and NW Netherlands New Guinea (Roux 1933).
- 1938–1939 R. Archbold's Netherlands-American North New Guinea (=Third Archbold) Expedition (zoologists: A. L. Rand, W. B. Richardson, L. J. Toxopeus) collected near Hollandia and in central mountainous area near Idenburg River and in Baliem basin (Holthuis 1950a).
- 1939 C. C. F. M. Le Roux's Expedition to Central Mountain Range of New Guinea (zoologist: H. Boschma) explored Wissel Lakes area (Holthuis 1949; Bott 1974).

- 1948–1949 S. Bergman's Swedish-Netherlands New Guinea Expedition (zoologists: S. Bergman, ornithologist; M. A. Lieftinck, entomologist). September–October 1949 Dr Lieftinck visited Misool I.; special attention to aquatic fauna; several Decapoda collected (Holthuis 1949).
- 1952 L. D. Brongersma's collecting trip to New Guinea with W. J. Roosdorp. Mostly in northern New Guinea, including Vogelkop and Wissel Lakes, but also Merauke (Bott 1974).
- 1954 L. van der Hammen's collecting trip to northern New Guinea (Vogelkop; Geelvink Bay; Sentani Lake; Hollandia area; Wissel Lakes) (Bott 1974).
- 1954–1955 L. D. Brongersma's second collecting trip to New Guinea, with M. Boesman and L. B. Holthuis. Special attention to freshwater fauna: Vogelkop (Ajamaroe Lakes); Jamoer Lake; Biak; Japen; Hollandia; Sentani Lake; Wissel Lakes; Tanah Merah (Digul River); Merauke (Bott 1974).
- 1959 L. D. Brongersma and G. F. Venema's Expedition to the Sterrengebergte (zoologists: L. D. Brongersma, W. Vervoort) explored eastern part of Central Mountain Range and Digul River (Bott 1974).

## H. Territory of New Guinea (=Deutsch Neu Guinea=Kaiser Wilhelmsland).

The greater part of our knowledge of the freshwater Decapoda of this territory is due to collecting activities of individuals, rather than to that of expeditions.

- 1896–1901 L. Biró (1856–1931) Hungarian zoologist, collected for the National Museum at Budapest at numerous localities (Nobili 1905).
- 1906 H. Schoede collected for the Berlin Museum near Aitapé (Roux 1927).
- 1910 L. Schultze's German-Netherlands Border Commission Expedition (see under Irian Jaya).
- 1912–1913 Stollé's German New Guinea Expedition of Reichskolonialamt, Königliche Museen and German Kolonialgesellschaft (zoologist: Th. J. O. Bürgers) explored Sepik River basin (Roux 1927; Bott 1974).
- 1924 E. A. Briggs, zoologist, University of Sydney, collected in Wakip River basin, east of Aitapé (Rathbun 1926). Material in Australian Museum, Sydney.
- 1955 R. D. Hoogland, Dutch botanist in service of Australian CSIRO, collected in Madang District (Bott 1974).
- 1962–1963 D. C. Gajdusek, medical scientist of National Institutes of Health, Bethesda, Maryland, U.S.A., during a survey of food of natives of Eastern Highland District, collected freshwater crabs (Bott 1974).



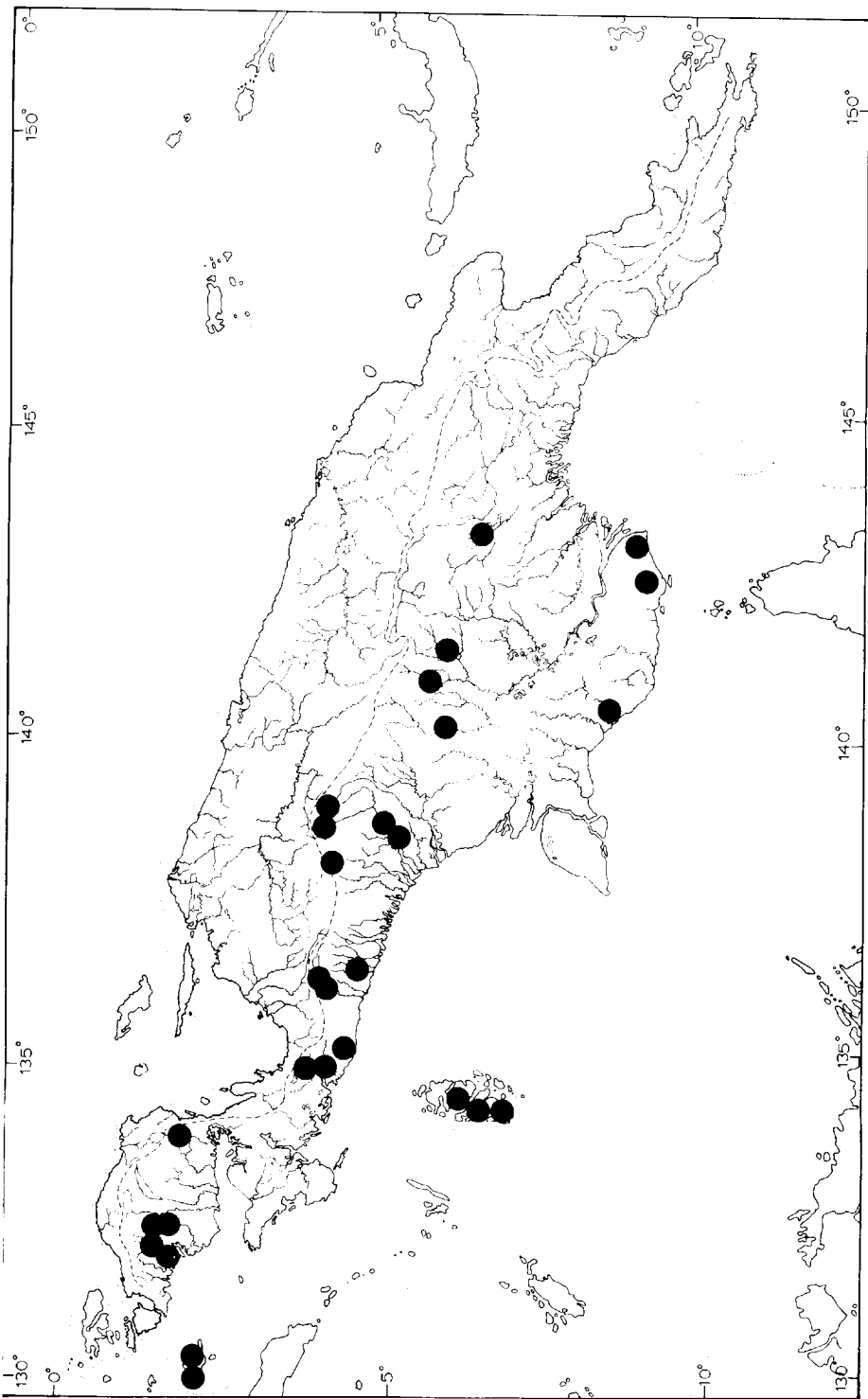


Fig. 1. Map of New Guinea showing the known localities of Parastacidae. The interrupted line indicates the main watershed of the island; the dotted line is the 200 m depth line delimiting the shelf around the island.

### III. Territory of Papua.

- 1889–1895 L. Loria (1855–1913), Italian ethnologist and zoologist, collected in a wide area around Port Moresby, near Samarai, and at Goodenough and Trobriand Is (Nobili 1899).
- 1875–1878 L. M. d'Albertis, Italian zoologist and ethnologist, visited Yule Island area (1875); also made 3 expeditions up Fly River, 1875–1878 (Nobili 1899, 1903; Bott 1974).
- 1904–1906, 1909 W. Stalker worked at gold mines on Mambare River in Papua; collected for British Museum. Later collected for Sir William Ingram in Australia and (1909) in New Guinea. Member of 1910–1911 British Ornithologists' Union Expedition to western Irian Jaya (see there); drowned in 1910 during that expedition (Calman 1909; Bott 1974).
- 1936 I. Champion and C. T. J. Adamson's Bamu-Purari Expedition traversed Southern Highlands District and visited Lake Kutubu (Holthuis 1949).
- 1936–1937 R. Archbold's New Guinea Expedition (=Second Archbold Expedition) (zoologists: A. L. Rand, G. H. H. Tate) explored Fly River from mouth to Central Mountain Range (Holthuis 1950a).
- 1953, 1954 R. D. Hoogland, Dutch botanist in service of Australian CSIRO, collected in Northern District (Bott 1974).
- 1959 A Mr Reimer or Reimers collected in Kikori Subdistrict of the Gulf District. Of this collector, who probably was German and who collected for the Museums at Munich and Frankfurt, not even the correct name is known (Bott 1974).
- 1966 The botanical New Guinea Expedition of Rijksherbarium (Leiden), and Department of Forests (Lae, New Guinea) (zoological collector: W. Vink) explored the area of Doma Peaks in Tari Subdistrict of Southern Highlands District (Holthuis 1968; Bott 1974).

Of course, on other occasions freshwater Decapoda must have been collected in New Guinea, but so far these have not yet been reported upon.

## 2. Taxonomy and zoogeography

The various groups of freshwater Decapoda found in New Guinea will now be dealt with in taxonomic order, and their importance for zoogeography discussed.

### 2.1 *Decapoda Natantia* (shrimps)

#### 2.1.1 *Atyidae*

For a long time all shrimps of the family Atyidae were considered to be characteristic freshwater animals, and as such were thought to be of great value

in zoogeography. In recent decades, however, some species have been found in brackish or salt water, while others were found to pass part of their life in water of high salinity. Nevertheless, the great majority of the species are true fresh water animals and have never been observed anywhere but in fresh water.

So far two genera are known from New Guinea, viz., *Atya* Leach 1816, and *Caridina* H. Milne Edwards 1837. Both species of New Guinea *Atya* have a very wide distribution in the Indo-West Pacific area. *Atya spinipes* Newport 1847, which is known from all three parts of New Guinea, has a range that extends at least from India to Japan and Polynesia; it is considered a good freshwater species, but its life history still is incompletely known and the possibility exists that the juveniles live in brackish or salt water. *Atya pilipes* Newport 1847, in New Guinea reported so far from Irian Jaya only, has a known range that extends from Madagascar to Polynesia; it is very likely that the juveniles of this species pass their life in the sea. The second genus, *Caridina*, has many more species than *Atya* and so far 10 have been reported from New Guinea. Four of these, *Caridina nilotica* (P. Roux 1833), *C. serratirostris* De Man 1892, *C. gracilirostris* De Man 1892, and *C. typus* H. Milne Edwards 1837, are widely distributed throughout the Indo-West Pacific region. *C. opaensis* Roux 1919, has been reported from Celebes and the Aru Islands, but not from New Guinea proper. The other five species are endemic to New Guinea: *Caridina papuana* Nobili 1905, (= *C. weberi papuana*), *C. demani* Roux 1911, *C. fecunda* Roux 1911, *C. cognata* De Man 1915, and *C. rouxi* De Man 1915. Most of these endemic species are only known from original descriptions, and as the systematics of the genus *Caridina* is still quite unsettled, very little can be said of their status. The study of the New Guinea Atyidae has been much neglected and it is almost certain that when the collections in museums are better studied and when new collections are made, it will become clear that we know at present only a fraction of the species actually occurring in the island.

In New Guinea Atyidae have thus far been found in the lowlands only. They occur there both in running and stagnant water. Many species of *Caridina* can be found among aquatic weeds and between finely branched denuded tree roots hanging in the water. *Atya spinipes* is known to live under rocks in fast flowing, often torrential streams.

### 2.1.2 Palaemonidae

All known New Guinea freshwater Palaemonidae belong to the subfamily Palaemoninae. Only two genera of that subfamily are represented in New Guinea fresh waters, viz., *Macrobrachium* Bate 1868, and *Palaemon* Fabricius 1798. The two species of *Palaemon* found in fresh water in New Guinea are *P. debilis* Dana 1852, and *P. concinnus* Dana 1852. Both species have been found in fresh, brackish and salt water, and both have a very extensive range in the Indo-West Pacific region (Red Sea to Polynesia). The genus *Macrobrachium* is generally considered a rather characteristic freshwater genus, although it contains a few species that seem to prefer brackish water or even a marine environment. Of a number of species of that genus it has been shown that the

very young stages need to be passed in an environment with a high or rather high salinity, even though the adults are usually met with in pure fresh water. As the life history of only a few species is known, it is impossible to say how many species do spend part of their life in the sea or in brackish water. Some species are found so far from the sea that it seems very unlikely that they would migrate all the way downstream to the sea-coast for the hatching of the eggs. At least 18 species of *Macrobrachium* are now known from New Guinea. A number of these have a wide geographical distribution, e.g., from India (or localities more to the west) to New Caledonia (or localities more to the east): *Macrobrachium lar* (Fabricius 1798), *M. australe* (Guérin 1838), *M. equidens* (Dana 1852) and *M. latimanus* (Von Martens 1868). These species can be found in water with rather high salinities, either as adults (*M. equidens*), or as juveniles (*M. lar*, *M. australe*, and possibly *M. latimanus*). *Macrobrachium rosenbergii* (De Man 1879), also a species that is often found in water with a rather high salinity, occurs from India to New Guinea and northern Australia. A number of other species also reach in New Guinea the eastern limit of their range, like *M. idae* (Heller 1862) (Madagascar to New Guinea), and the Malaysian species *M. mammillodactylus* (Thallwitz 1892), *M. oenone* (De Man 1902), *M. placidulum* (De Man 1892), *M. weberi* (De Man 1892), *M. horstii* (De Man 1892), *M. latidactylus* (Thallwitz 1891), and *M. bariense* (De Man 1892); some of these species have also been reported from the Bismarck Archipelago. Two Malaysian species have their range extending beyond New Guinea and reach Polynesia: *M. lepidactyloides* (De Man 1892), and *M. gracilirostre* (Miers 1875). So far only three species are considered to be endemic to New Guinea: *Macrobrachium lorentzi* (Roux 1921), *M. minutum* (Roux 1917) and an undescribed species from the Central Mountain Range near Wissel Lakes.

Most species of *Macrobrachium* have been found in the lowlands of New Guinea, but the genus is known from altitudes up to 1700 m. The species live both in stagnant water (lakes and pools) and in streams (small creeks as well as large rivers and estuaries). Some of the species grow to considerable size and are used as food.

The picture provided by the two families of New Guinea freshwater shrimps (Decapoda Natantia) is practically the same. The majority of the species has a very wide geographic distribution, a smaller percentage shows a more restricted range (which in several species reaches its eastern limit in New Guinea, but in none of the species New Guinea forms the western limit of the range), and a very small number is endemic in New Guinea. There is no clear indication that for zoogeographic purposes the Central Mountain Range forms a barrier here. The status of our knowledge of these groups being very imperfect, it is impossible to draw any definite conclusions.

## 2.2 Decapoda *Macrura Reptantia* (crayfishes)

One of the spectacular features of the freshwater fauna of New Guinea is the presence of freshwater crayfishes of the family Parastacidae. The Parastacidae, a family restricted to the southern hemisphere, has a remarkable disjoint

distribution: (1) Southern South America (genera *Parastacus* Huxley 1879, and *Samastacus* Riek 1971), (2) Madagascar (*Astacoides* Guérin 1839), (3) Australian region (= Australia, Tasmania, New Guinea) (many genera, including *Cherax* Erichson 1846), (4) New Zealand (*Paranephrops* White 1842). Each Parastacid genus is restricted to one of these 4 regions. All New Guinea Parastacidae belong to the genus *Cherax*, a genus that occurs also throughout the Australian continent, but not in Tasmania. At present 13 described species of *Cherax* are known from New Guinea. They may be divided into 2 subgenera: (1) *Astaconephrops* Nobili 1899 with 5 species: the type species *Cherax albertisii* (Nobili 1899), and the species *C. lorentzi* Roux 1911 (with the subspecies *C. lorentzi aruanus* Roux 1911), *C. misolicus* Holthuis 1949, *C. monticola* Holthuis, 1950a, and *C. papuanus* Holthuis 1949; (2) *Cherax* Erichson, 1846, the nominate subgenus, of which the Western Australian species *Astacus (Cheraps) preissii* Erichson 1846, is the type species. This subgenus is represented in New Guinea by 8 species: *Cherax pallidus* Holthuis, 1949, *C. murido* Holthuis 1949, *C. buitendijkae* Holthuis 1949, *C. longipes* Holthuis 1949, *C. communis* Holthuis 1949, *C. boschmai* Holthuis 1949, *C. paniaicus* Holthuis 1949, and *C. solus* Holthuis 1949.

All 8 species of the subgenus *Cherax* inhabit the Central Mountain Range in the Wissel Lakes region of Irian, between altitudes of 1650 and 1750 m. Of the species of *Astaconephrops*, 3 (*Cherax lorentzi*, *C. albertisii* and *C. misolicus*) are found at low altitudes (below 100 m), while *C. papuanus* was taken at 850 m and

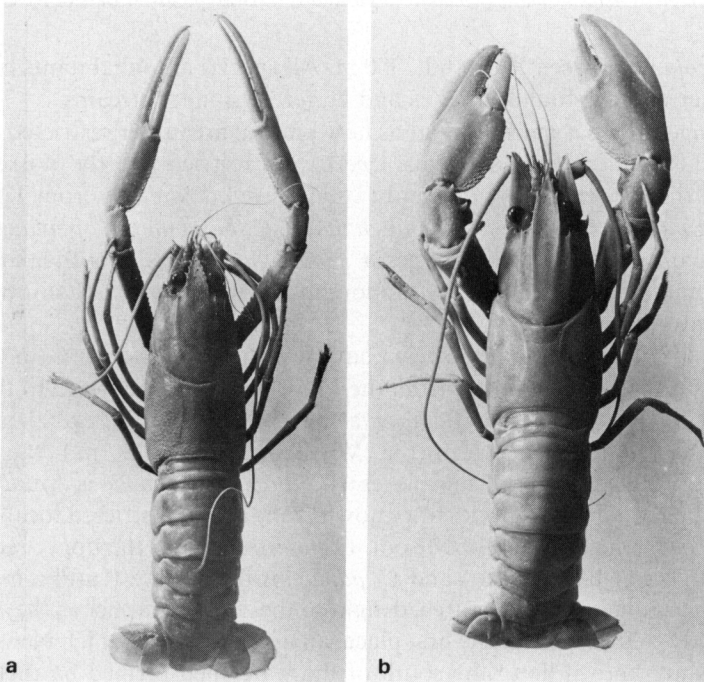


Fig. 2a. *Cherax (Cherax) boschmai* Holthuis, ♂ paratype from Paniai Lake  $\times 0.6$ . b. *Cherax (Astaconephrops) lorentzi* J. Roux, ♂, from Bivak I., Noord (=Lorentz) River,  $\times 0.75$ .

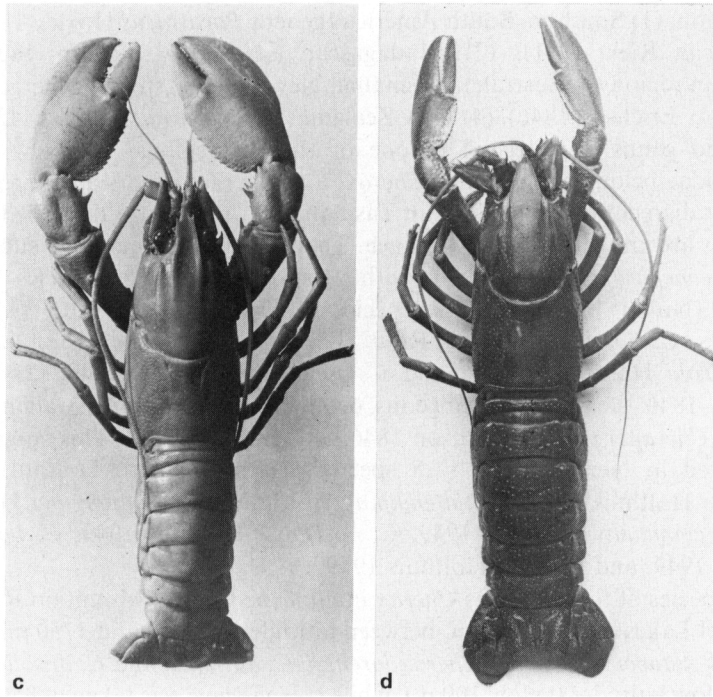


Fig. 2c. *Cherax (Astaconephrops) lorentzi aruanas* J. Roux, ♂ paratype, from Pobdietur, Aru Is,  $\times 0.75$ . d. *Cherax (Astaconephrops) monticola* Holthuis, ♀ paratype, from Baliem River,  $\times 0.56$ .

*C. monticola* at between 1700 and 3300 m. All species are inhabitants of purely fresh water and are found in lakes and larger or smaller streams.

The ranges of most species, so far as now known, are rather restricted. As said above, all 8 species of the subgenus *Cherax* are restricted to the Wissel Lakes area: 2 of the species (*C. longipes* and *C. solus*) are known only from Tigi Lake, and 5 (*C. pallidus*, *C. murido*, *C. buitendijkae*, *C. boschmai*, *C. paniaicus*) only from Paniai Lake. The eighth species, *C. communis* occurs in both lakes and in the surrounding area, but a study of more material may prove that it has to be split up into more species.

Of the species of *Astaconephrops* 2 have a rather wide range: *C. albertisii* is found in southern New Guinea from the Fly River basin westward to the basin of the Digul River in Irian. *C. lorentzi* has been taken at several places in western New Guinea between the Vogelkop Peninsula and the Noord (=Lorentz) River, while a subspecies (*C. lorentzi aruanus*) is found in the Aru Is. The remaining 3 species are known from a very restricted locality only: *C. misolicus* from the island of Misool, *C. monticola* from the upper reaches of the Baliem River basin (Irian) and *C. papuanus* from Lake Kutubu in Papua.

The New Guinea crayfishes are a delight to the zoogeographer as they seem to keep strictly to the rules. In the first place, all localities from which New Guinea crayfishes are known lie to the south of the watershed formed by the Central Mountain Range, which runs roughly East-West (or SE-NW) and divides the island in two. Notwithstanding a quite thorough exploration of the northern

half of New Guinea (by the 1903, the two 1910, the 1911, the 1920–1921, and the 1954–1955 expeditions, the latter making a special effort to obtain Parastacidae from the northern half of New Guinea) no crayfish have so far been collected in any of the rivers or lakes north of the watershed. Evidently the divide forms a formidable barrier here.

Zoogeographically interesting also is the fact that Parastacidae occur on islands on the Sahul shelf (Aru Is, Misool), but not on nearby islands (like Kai Is, Waigeo) which are separated from the shelf by sea depths of more than 200 m.

The distributions of New Guinea Parastacidae form a strong support for the theory that the island has once been connected with Australia by Sahul land and that the rivers that now flow into the Arafura Sea once formed a single drainage with northern Australian rivers. The evidence as now available is almost too perfect to be true, so that one fearfully waits for the day that a Parastacid is found north of the continental divide or on one of the islands outside the Sahul shelf.

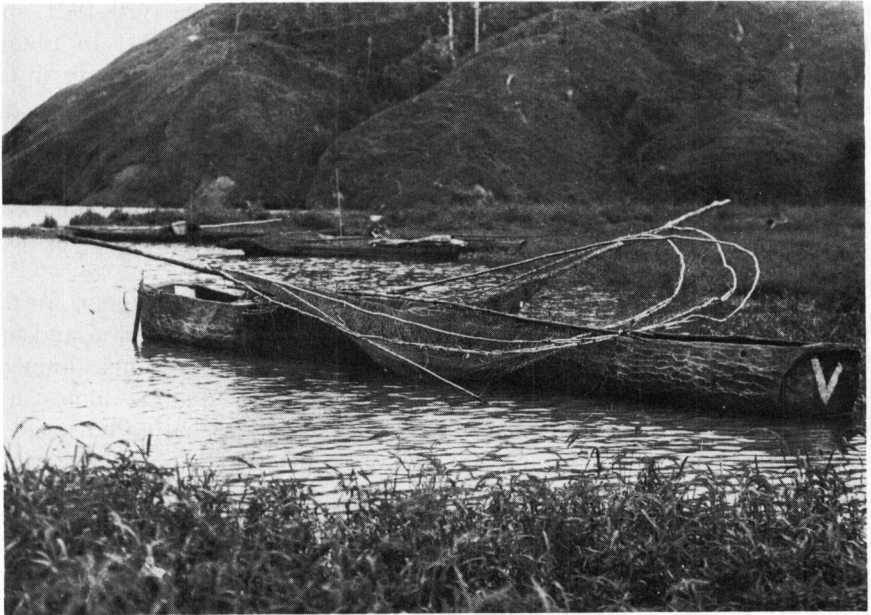
### 2.3 *Brachyura* (crabs)

*2.3.1 Grapsidae: Sesarminae.* Several species of the genus *Sesarma* Say 1817 (s.l.) have been reported from New Guinea, but usually there are no or only vague indications concerning the habitat in which the animals were collected. Most species of *Sesarma* live on mud flats, in mangroves or salt marsh areas, often near the mouths of rivers, which they sometimes may go up for a considerable distance. It is possible for them to be found in brackish or even fresh water, but hardly any *Sesarma* species can be classified as truly freshwater form. Therefore they are not further discussed here, even though Nobili (1899:267–269) and Roux (1917:619–621; 1921:605–616) mentioned some from rivers in New Guinea or from other localities which perhaps have fresh water.

*2.3.2 Grapsidae: Varuninae.* Four species of this subfamily have been found in New Guinea fresh waters. The commonest of them is *Varuna litterata* (Fabricius 1798), known from many records from northern and western Irian (Nobili 1899; Roux 1917, 1921; own observations), from NE New Guinea (Rathbun 1926) and from Papua (Northern District; own observations). Although the species does inhabit fresh water, it also is found in brackish and marine habitats and certainly does not qualify as a true freshwater species. Its geographic range is very wide (East Africa to Japan and Polynesia).

*Pseudograpsus crassus* A. Milne Edwards 1868, and *Ptychognathus riedelii* (A. Milne Edwards 1868) were both reported by Nobili (1899:267) from Andai, Vogelkop. Both species have reliably only been reported from fresh water (Tesch's 1918 record of both from a coral reef in the Talaud Is is highly dubious). *Pseudograpsus crassus* is known from eastern Indonesia (Celebes, Talaud Is, Moluccas, Lesser Sunda Is and Irian), *Ptychognathus riedelii* from the Andaman Is and the greater part of Indonesia (Sumatra, Celebes, Talaud Is, Lesser Sunda Is and Irian). Roux (1917:615) described a new species,



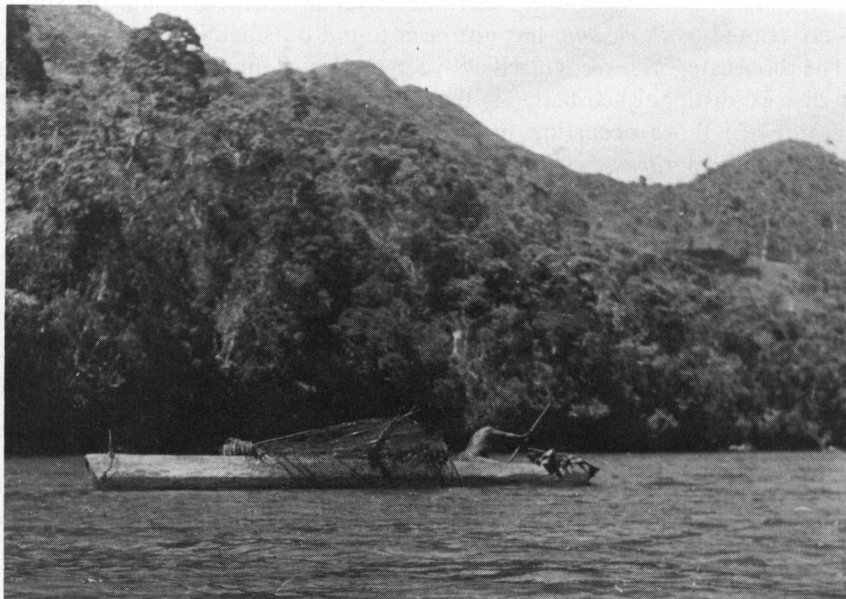


*Fig. 3a.* Paniai Lake (Wissel Lakes complex) near Enarotali, Central Mountain Range, Irian. Boats used for fishing Parastacidae; the foremost boat carries sink nets.

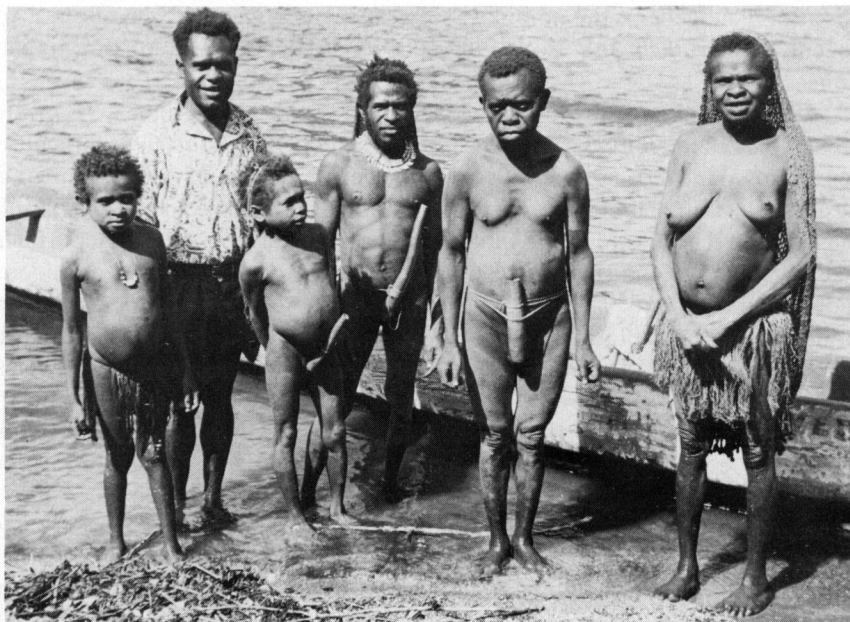


*Fig. 3b.* Paniai Lake near Enarotali. Boats used for fishing crayfish.





*Fig. 4.* Jawej River near Paniai Lake. Woman returning home from crayfish fishing.



*Fig. 5.* Jawej River near Paniai Lake. Kapauku Papuan family and their boat.

*Ptychognathus demani*, from a freshwater river in northern Irian; the species, closely related to *P. riedelii*, has not been found outside New Guinea.

The three categories recognized above in the New Guinea freshwater shrimps can also be distinguished here: (1) the species with a very wide range (*Varuna litterata*); (2) those occurring in Malaysia with their eastern limit in New Guinea (*Pseudograpsus crassus*, *Ptychognathus riedelii*), and (3) endemics (*P. demani*).

2.3.3 *Hymenosomatidae*. The Hymenosomatidae contain many genera and species, most of which are marine. Six species (belonging to two genera), however, have been reported from fresh water, and one of these occurs in New Guinea: *Halicarcinus angelicus* Holthuis 1968. This species so far is only known from the type material, which was collected in the Southern Highlands District of Papua, at an altitude of 1600 m in pure fresh water of a watercress swamp. Other freshwater species of the genus *Halicarcinus* inhabit New Zealand, Norfolk and Lord Howe islands and SE Australia (*H. lacustris* (Chilton)), northern Mindanao, Philippines (*H. wolterecki* Balss), and New Caledonia (*H. pilosus* (A. Milne Edwards)).

2.3.4 *Sundathelphusidae*. In contrast to the two other families of Brachyura, the Sundathelphusidae contain only true freshwater species. The family as such therefore should be of great interest to zoogeography.

A revision of the New Guinea Sundathelphusidae was recently published by Bott (1974), with 3 genera: *Rouxana* Bott 1969, with 5 species, *Geelvinkia* Bott 1974, with 3 species, and *Holthuisana* Bott 1969, with 5 species. *Rouxana* and *Geelvinkia* are restricted to New Guinea. *Holthuisana* was considered by Bott to consist of 2 subgenera: the nominate subgenus is confined to New Guinea, the subgenus *Austrothelphusa* Bott 1969, occurs in Australia, but not in New Guinea.

A difficulty in assessing the zoogeography of the New Guinea freshwater crabs is that the identity of previously recorded specimens often is difficult or even impossible to ascertain without direct examination of the specimens in question. Bott, in his revision, tried to examine as many specimens as possible, but many records are still indicated by him as "unbestätigte frühere Meldungen", and one species, "*Potamon loriae* Nobili 1899," was considered unidentifiable by him. Even when excluding all uncertain records, the distribution (both geographical and ecological) of New Guinea fresh water crabs remains confusing. As pointed out by Holthuis (1974:43), the beautifully clear picture shown by the Parastacidae is not at all matched by that of the Sundathelphusidae. Could the Parastacidae be divided in lowland and mountain species, in the New Guinea Sundathelphusidae there is no such distinct division. Only one species (*Rouxana roushdyi* Bott 1974) is exclusively known from high altitudes (1640–1740 m), and 2 (*Geelvinkia ambaiana* Bott 1974, and *G. holthuisi* Bott 1974) are only reported from below 100 m altitude. Six others have been reported from both the lowlands (below 100 m altitude) and from more than 200 m: *Rouxana ingrami* (Calman 1909), *R. papuana* (Nobili 1899), *Holthuisana festiva* (Roux 1911), *H. biroi* (Nobili 1905), *H. boesemani* Bott

1974, and *H. subconvexa* (Roux 1927). Of the remaining species the exact altitudes of their occurrence are unknown.

Also the geographic distribution of the freshwater crabs within New Guinea does not show a clear pattern. The Central Mountain Range, which gave the impression to be an unsurmountable barrier to the Parastacidae, does not seem to be so to the freshwater crabs. Only a few Sundathelphusid species are known from one side of the watershed only: *Rouxana minima* (Roux 1927) (2 localities; both north of the watershed), *R. roushdyi* Bott 1974 (4 localities in a restricted area; south), *Geelvinkia calmani* (Roux 1927) (1 locality; south), *G. holthuisi* Bott 1974 (1 locality; south), *Holthuisana festiva* (Roux 1911) (13 localities; north), *H. biroi* (Nobili 1905) (21 localities; north), and *H. wollastoni* (Calman 1914) (5 localities; south). All 6 other species have been reported from both north and south of the watershed.

The possibility exists, of course, that the picture is obscured by wrong specific assignments and incorrect identifications, and that a re-examination of previously published material, and the study of carefully documented new material from numerous localities will lead to better understandable results.

As to the zoogeographic relation of the New Guinea Sundathelphusidae to the other Australasian taxa of that family, here too the Sundathelphusidae offer a picture totally different from that shown by the Parastacidae. The close relation between the species of the Aru Is and those of New Guinea proper, as shown by the Parastacidae, is totally lacking in the Sundathelphusidae. The freshwater crabs of the Aru Is were assigned by Bott (1970:75) to the species *Sundathelphusa aruana* (Roux 1911), thus to a genus entirely different from any of the genera of New Guinea Sundathelphusidae. Bott (1974) evidently did not consider the Aru species to belong to the New Guinea fauna and therefore did not include it in his revision of the New Guinea freshwater crabs. *Sundathelphusa aruana* was mentioned by Bott (1970) from the "Aru- und Kei Inseln, Kleine Sunda-Inseln." The mention of the species from the Kai Is must be a slip of the pen, as both Nobili (1899:263) and Roux (1911:91; 1919:345) reported it only from the Aru Is, while also Bott saw no Kai Is material. Bott, however, did examine specimens from the Lesser Sunda Is (Lombok, Sumbawa, Flores). As to the genus *Sundathelphusa*, this was reported by Bott (1970) from the Philippines, Celebes, the Moluccas, the Aru Is and the Lesser Sunda Is. The Aru Is freshwater crabs thus seem to have closer links to the species from the eastern Malay Archipelago (Philippines, Moluccas, and especially Lesser Sunda Is) than to those of New Guinea, a most unexpected phenomenon.

Bott (1974:6-8) rather extensively propounds a theory concerning the "colonization" of New Guinea by freshwater crabs and gave as his opinion that this has occurred in several "Besiedlungsschübe" (invasions). The species of *Rouxana* are considered by him to have reached New Guinea before the other genera and in several invasions from the west; those of *Geelvinkia* were supposed by him to have reached New Guinea in an invasion from the North(west) and those of *Holthuisana* were the most recent to invade New Guinea and came from the west. The invasions, according to Bott, took place between the early Tertiary and the late Pleistocene. Bott's theory is so speculative and based on so few hard facts, that it is totally unacceptable to me.

With our very imperfect knowledge of the systematics, distribution and ecology of the New Guinea freshwater crabs, and with the confusion and evident errors in these disciplines, it is altogether unrealistic to theorize about the way in which the crabs reached New Guinea, it is even not certain that they actually did come from somewhere else. I regret not to be able to give a more constructive opinion about this problem.

### 3. Summary

We can say that Decapods can be found in practically all New Guinea fresh waters, from the lowlands to the high mountains, in lakes, swamps and slow flowing rivers, but also in small fast flowing streams with cataracts and riffles. They are found in waters with sandy, muddy or rocky bottoms, among living waterplants and dead leaves, under stones, etc. Some species seem to be restricted to certain altitudes, while others evidently occur both in the mountains and the lowlands. For a number of species (especially the Parastacidae) the Central Mountain Range seems to be a very important zoogeographic barrier, but others occur both to the north and the south of it.

Zoogeographically the New Guinea freshwater Decapoda can be arranged in 3 groups: (1) the species with a very wide distribution in the Indo-West Pacific region (western Indian Ocean to Polynesia); (2) the species with a restricted distribution which find in New Guinea the eastern limit of their range, the western limit being in eastern, central or western Malaysia; and (3) the endemic species, known only from New Guinea itself.

When considered at generic level, most New Guinea freshwater Decapoda belong to genera with a wide distribution throughout the Indo-West Pacific (*Atya*, *Caridina*, *Palaemon*, *Macrobrachium*, *Sesarma*, *Varuna*, *Pseudograpsus*, *Ptychognathus*, and *Halicarcinus*), two have clear affinities with Australia (*Cherax*, *Holthuisana*), and two are endemic (*Rouxana*, *Geelvinkia*). It is interesting that the latter two categories are formed by the genera of the only 2 families of true freshwater Decapoda of New Guinea.

The picture still is far from clear and much more collecting and research is needed before a satisfactory account of the zoogeography and ecology of the New Guinea freshwater Decapoda can be given.

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