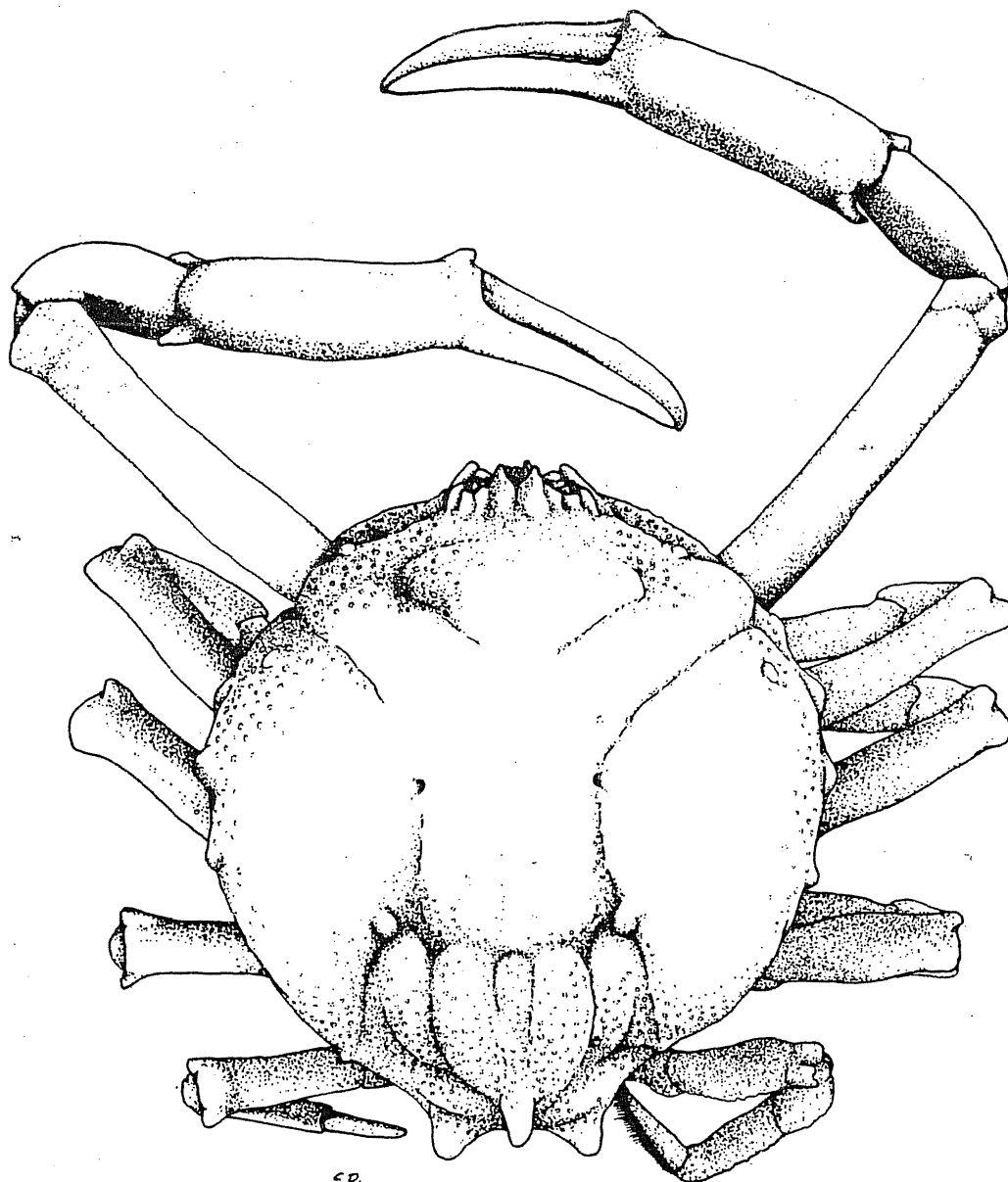


CRABS OF NEW ZEALAND

C.L.McLay



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**BRACHYURA AND CRAB-LIKE ANOMURA
OF NEW ZEALAND**

by

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CHRISTCHURCH, N.Z.**

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PREFACE

The Leigh Laboratory Bulletins began in 1978 with a report on the biological and physical survey of New Zealand's first marine reserve. In 1981 a compilation of existing knowledge on the fish of the marine reserve was printed and proved so useful that further accounts of the local fauna were encouraged. Two groups of molluscs and the common sponges have already been treated in this way.

This volume, on crabs, by Dr McLay is the latest in the series of descriptions of local fauna and sets new standards of coverage and detail.

Colin McLay spent most of 1984 on sabbatical at Leigh, working mainly on hermit crabs and predation, but he also spent considerable time compiling this review of existing knowledge from the scattered literature and from his own extensive knowledge. All students and other workers will be appreciative of a single volume giving the available information and showing clearly where further work would be useful.

W.J. Ballantine

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c. C.L. McLay

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My thanks also to my colleagues in the Zoology Department, University of Canterbury. To Malcolm Jones (now in Plymouth), to Malcolm Forster and Harry Taylor who helped me to grasp something about crab physiology, and to Bob Pilgrim, Islay Marsden and Graham Fenwick for many valuable discussions. I should also acknowledge the stimulus provided by Baughan Wisely who in 1972 suggested that I might like to go up to Kaikoura and have a look at a spider crab (Notomithrax ursus) which decorates itself with seaweed. This casual suggestion began my interest in crabs. Finally, I must thank all my graduate students of recent years who have provided information and have read parts of the manuscript at various stages. In particular Louise Clark, Paul Creswell, Rob Davidson, Rohan Dewa, Clinton Duffy, Helen Menzies, Tracey Osborne and Julie Pringle.

Helen Spinks and Peter McLay helped to type the manuscript into the wordprocessor and coped wonderfully well with the attempt to eliminate inconsistencies in style and elimination of errors. Any errors which remain must be blamed on the author! I also wish to thank John Black and Clinton Duffy who prepared many of the illustrations and page layouts.

I am grateful to editors of the following publications for permission to reproduce previously published illustrations:

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INTRODUCTION

Crab-like marine arthropods are among the most advanced forms of crustaceans. They have a well developed carapace, usually wider than long, short bodies with the abdomen folded underneath as a segmented flap and the first pair of pereopods chelate. These sometimes fearsome-looking appendages often deter people from handling them but in fact most crabs are easily manipulated once you overcome the initial fear of being bitten. Perhaps this aversion is the reason why there still remains much to be discovered about crabs. Most crabs cannot inflict any sort of damage to a human but those which can are easily handled after a bit of trial and error. The words of Thomson (1932) are probably equally applicable today: '...the sea, which teems with animal and vegetable life, and with unrealized sources of national wealth, has hitherto received very little attention. ... In this general neglect of marine biology the Crustacea have shared. The number of workers who have added to our knowledge of this group is very small...'

The predatory, commensal and mutualistic relationships of crabs with other marine animals, their reproductive and population dynamics and their importance as members of marine communities are fascinating to the marine ecologist. Various aspects of crab behaviour, burrowing, sound production, masking and foraging are intriguing to the animal behaviourist. Physiological adaptations of their osmotic balance, respiration and ventilation, hormonal control of moulting, autotomy and regeneration of lost limbs, and their highly organised nervous systems are exciting to physiologists. The reasons for the apparently low genetic diversity of crustaceans provides a challenge to geneticists. For the great majority of New Zealand crabs we have barely even begun to scratch the surface of the wide range of studies that are possible.

The main habitats and places in which crabs can be found are: 1) Under stones and boulders, sandy and rocky intertidal areas. In addition to daytime low tides, collecting at night in these areas can be especially rewarding.

- 2) In similar areas to those in above but sub-tidally, using SCUBA gear.
- 3) In deep water on all types of bottoms (rocky, sandy and muddy) using dredges, nets or pots from boats.
- 4) Among seaweeds and seagrass.
- 5) Among shells of mussel beds and inside these and other shellfish.
- 6) At higher levels on the shore exposed to waves and sun.
- 7) In estuaries, brackish lagoons, tidal rivers, under stones or in burrows.
- 8) In freshwater lakes and rivers.
- 9) In stomachs of fish, birds or marine mammals.

- 10) Along the drift line on beaches, among seaweed cast up on the shore (dead adults or moults).
- 11) In the open sea as plankton (larval stages), swimming adults or clinging to drifting weed.
- 12) Cretaceous or Tertiary fossil beds.

The first crabs to be described from New Zealand may have been the hymenosomatid Haliscarcinus planatus (Fabricius 1775) and the majid Notomithrax ursus (Herbst 1788) collected during one of Cook's voyages (Andrews 1986). The first fossil crab described from New Zealand was the xanthid Tumidocarcinus tumidus (Woodward 1876). Early contributors to the study of our crab fauna were H. Milne Edwards (1834-1853), White (1843-1847), Dana (1851-1852), A. Milne Edwards (1860-1876) and Heller (1868). The first attempt to list the New Zealand fauna was by Miers (1876b) followed by Filhol (1886) and Hutton (1904) but these authors included many incorrect records and contributed to a great deal of early confusion. One of the early, longer term and most valuable contributions to the study of New Zealand crabs was made by Charles Chilton in his papers from 1882 to 1919. An important amateur contribution was made by G.M. Thomson (1898-1922) who taught biology at Otago Boys' High School and was also a member of parliament. A significant attempt to sort out the confusion was made by Chilton & Bennett (1929) although they did not deal with the entire fauna. (E.W. Bennett was a student of Chilton's before going to Perth, W.A.) In 1932 G.M. Thomson announced that he was in the process of preparing a natural history of the whole group of New Zealand Crustacea, having listed over 750 species and prepared over 400 line drawings, but to my knowledge this was never completed or published (see Thomson 1932). Later, Richardson (1949a, 1949b, 1949c) provided keys to some families. Bennett completed a more thorough review in 1936 but this was not published until 1964, although it was annotated up to 1962 by Elliot Dawson, Richard Dell and John Yaldwyn. The popular little book 'Native Crabs' by Dell (1963a) brought together much of this early work. Two brachyuran families were a source of continued difficulties, Hymenosomatidae and Pinnotheridae, and it was not until Mary Gordon (1968, published as Melrose 1975) and Roderic Page (1983) completed their work that this problem was solved. The most significant modern contributions came from Des Griffin's papers (1963-1973) and Richard Dell (1963-1972). The work Bill Stephenson (1968-1972), Takeda & Miyake (1969), John Lucas (1980) and papers by Elliot Dawson and John Yaldwyn helped to clarify and expand our knowledge of the crab fauna. The extensive and valuable work on larval stages by Robert Wear (1964-1985) has relied upon earlier taxonomic work and has greatly contributed to our understanding of crab larval stages. Biogeographic analysis of the fauna has been most recently done by Yaldwyn (1965), Dell (1968b) and Knox (1975) although this is based on only part of the fauna. The most significant contribution to the study of brachyuran ecology and physiological adaptations was made by Malcom Jones (1976-1983) and his students at the University of Canterbury.

Although fossil crabs of New Zealand are not dealt with separately in this book the interested reader can consult Feldman (1986), Fleming (1979, 1981), Glaessner (1960, 1969, 1980) and Jenkins (1974). Where there are extinct, fossil species in

genera with modern representatives these have been mentioned at the end of each section, but all known fossil species have been included in the Checklist.

The modern New Zealand fauna of crab-like crustaceans consists of 10 species of Anomura (3 Porcellanidae, 6 Lithodidae, 1 Paguridae) and 77 species of Brachyura (1 Dromiidae, 4 Homolidae, 2 Tymolidae, 1 Raninidae, 3 Leucosiidae, 22 Majidae, 14 Hymenosomatidae, 2 Atelecyclidae, 1 Cancridae, 7 Portunidae, 4 Xanthidae, 1 Belliidae, 2 Goneplacidae, 10 Grapsidae, 2 Pinnotheridae and 1 Ocypodidae) giving a total of 87 species. With the declaration of the 320km Exclusive Economic Zone the Kermadec Islands naturally become part of the New Zealand region although in the past they have been considered part of the Australian region. Our knowledge of the crab fauna of these islands is incomplete and has not been reviewed since the work of Chilton (1910) but eventually they should be included in the New Zealand fauna. Inclusion of the Kermadec crabs will bring a distinctly tropical element to our fauna and may add a further 20-30 species. Undoubtedly, there remain many unrecorded or even undescribed species from deep water to be added to the N.Z. fauna. Thus the total modern fauna may well be around 120-130 species.

There are no known anomuran fossils from New Zealand but there are 24 fossil brachyurans (2 Torynommidae, 5 Raninidae, 4 Majidae, 1 Atelecyclidae, 3 Portunidae, 5 Xanthidae, 2 Goneplacidae, 1 Grapsidae and 1 Ocypodidae). There are many undescribed fossil crabs from New Zealand. Thus the total known fossil and modern fauna is 111 species in 72 genera and 20 families.

The information in this book is presented under each species and is based upon both published papers and unpublished theses as well as my own research. Each crab is given its scientific name and author as well as a common name, where this is appropriate. A more or less complete synonymy lists older names and is followed by the type locality where this is known. World-wide distribution is expanded into more detail for New Zealand and its offshore islands. Some species are so widespread that it is no use listing specific localities around New Zealand but for less well known species details of the few known sites are listed. For some species my own records are used to expand the known range, otherwise I have relied upon previous authors, especially Dell (1968a). However, statements that 'species occur throughout New Zealand' really only conceal the fact that we know very little about the precise fauna that is likely to be found at a point on the coastline. Given two widely separated occurrences it has been assumed that the species occurs everywhere in between those limits. There is still a need for exact faunal records, especially from the west coasts of both main islands.

A diagnostic description of each species follows a standard format, dealing with the carapace, chelipeds, walking legs and abdomen in that order. Accompanying each description are one or more illustrations of the whole crab and enlargements of various critical morphological features. I have provided a key to identify post-larval stages of the modern crab-like crustaceans from the New Zealand region. Remember that if you cannot get anywhere using the key, you can always resort to the tactic of

matching your specimen with an illustration. For larval stages the reader is referred to Wear & Fielder (1985) who provide an identification key along with excellent illustrations.

Colour notes are given for each species but it must be remembered that crustacean colours are notoriously variable and it is unlikely that all possible variations have been included. Maximum sizes are given for each species, separately for males and females when known, and the abbreviations of CW for carapace width and CL for carapace length, in mm, have been used. The habitat and depth information for each species should be useful for confirming an identification and also for suggesting where to look for a particular species.

Under breeding all the information about the times when ovigerous females are found, their egg numbers, egg size, egg development, egg colour and any latitudinal variations are given. Also size at maturity, relationships between egg numbers and female size and the likely maximum number of broods per year or per maximum lifetime are suggested. This is followed by development and growth in which the number of larval stages and their occurrence in the plankton are recorded. When known growth, moulting and relative growth of the benthic phase are discussed.

The section on behaviour covers feeding, burrowing, mating, territoriality, social interactions, sound production, masking, swimming and other behaviours characteristic of each species. Where no information is available, I have relied upon information about related overseas species. This at least suggests what kinds of behaviours we might expect to find for New Zealand species.

Under ecology I have dealt with population dynamics, abundance, life history and longevity, factors affecting distribution within the crab's habitat, (including such information about physiological adaptations of osmoregulation and respiration that seem relevant), diet, dispersal, predators (including fish, birds, mammals, other crabs, starfish, sea anemones, etc) and commercial exploitation. In this section I have drawn upon studies often done outside the region and therefore predators, diet and details of life history may be different. After all, New Zealand is approx. 1600km long and covers 13° of latitude. Where nothing is known I have presented results of studies of related overseas species.

Finally at the end of each species' section I have listed the major references which were used and which might provide additional information for those who want to know more. But I would like to suggest that you might be better advised to embark on your own study and add to what little is known about many species. Most of the information is presented here! I have tried to indicate where the major gaps in our knowledge are but undoubtedly others will think of equally interesting questions to answer. I have made extensive use of overseas studies in the belief that these can be used to fill in many of these gaps or at least indicate what we should look for. If we ignore this work we will simply spend most of our time 'reinventing the wheel' rather than making significant progress.

BRACHYURA AND CRAB-LIKE ANOMURA OF NEW ZEALAND

Checklist of Recent and Fossil Species

Order: Decapoda

Sub Order: Pleocyemata

Infra Order: Anomura

Family Lithodidae (6 spp, 1 undescribed)

Lithodes murrayi Henderson, 1888

Lithodes longispina Sakai, 1971

Neolithodes brodiei Dawson & Yaldwyn, 1970

Paralomis zelandica Dawson & Yaldwyn, 1971

Paralomis hystrix (De Haan, 1849)

Paralomis n.sp.

Family Paguridae (1 sp.)

Porcellanopagurus edwardsi Filhol, 1885

Family Porcellanidae (3 spp.)

Petrolisthes elongatus (H. Milne Edwards, 1837)

Petrolisthes novaezelandiae Filhol, 1886

Petrocheles spinosus Miers, 1876

Infra Order: Brachyura

Section: Podotremata

Family Dromiidae (1 sp.)

Petalomera wilsoni (Fulton & Grant, 1902)

Family Homolidae (4 spp.)

Homola orientalis Henderson, 1888

Latreillia australiensis Henderson, 1888

Paromola petterdi (Grant, 1905)

Paromola spinimana Griffin, 1965

Family Raninidae (1 sp. + 5 fossil spp.)

Hemion novozelandicum Glaessner, 1980 (fossil)

Laeviranina perarmata Glaessner, 1960 (fossil)

Lyreidus elegans Glaessner, 1960 (fossil)

Lyreidus tridentatus De Haan 1841

Lyreidus waitakiensis Glaessner, 1980 (fossil)

Ranilia pororariensis Glaessner, 1980 (fossil)

Family Tymolidae (2 spp.)

Cymonomus bathamae Dell, 1971

Cymonomus aequilonius Dell, 1971

Family Torynomidae (2 fossil spp.)

Torynomma (Torynomma) flemingi Glaessner, 1980 (fossil)

?Eodorippe spedeni Glaessner, 1980 (fossil)

Section: Heterotremata

Family Leucosiidae (3 spp.)

Ebalia laevis (Bell, 1855)

Merocryptus lambriformis A. Milne Edwards, 1873

Randallia pustulosa Wood-Mason, 1891

Family Majidae (22 spp., 1 undescribed + 4 fossil spp.)

Actinotocarcinus chidgeyi Jenkins, 1974 (fossil)
Eurynome bituberculata Griffin, 1964
Cyrtomaia lamellata Rathbun, 1906
Platymaia maoria Dell, 1963
Platymaia n.sp.
Pyromaia tuberculata (Lockington, 1877)
Achaeopsis ramusculus (Baker, 1906)
Acheus curvirostris (A. Milne Edwards, 1873)
Rochinia riversandersoni (Alcock, 1895)
Eurynolambrus australis H. Milne Edwards & Lucas, 1841
Leptomaia tuberculata Griffin & Tranter, 1986
Trichoplatus huttoni A. Milne Edwards, 1876
Notomithrax minor (Filhol, 1885)
Notomithrax peronii (H. Milne Edwards, 1834)
Notomithrax ursus (Herbst, 1788)
Leptomithrax atavus Glaessner, 1960 (fossil)
Leptomithrax australis (Jacquinot, 1853)
Leptomithrax garricki Griffin, 1966
Leptomithrax irirangi Glaessner, 1960 (fossil)
Leptomithrax longimanus Miers, 1876
Leptomithrax longipes (Thomson, 1902)
Leptomithrax tuberculatus mortenseni Bennett, 1964
Leptomithrax uruti Glaessner, 1960 (fossil)
Teratomaia richardsoni (Dell, 1960)
Thacanophrys filholi (A. Milne Edwards, 1876)
Jacquilotia edwardsi (Jacquinot, 1853)

Family Atelecyclidae (2 spp., + 1 fossil sp.)

Pteropeltarion novaezealandiae Dell, 1972
Trichopeltarion fantasticum Richardson & Dell, 1964
Trichopeltarion greggi Dell, 1969 (fossil)

Family Cancridae (1 sp.)

Cancer novaezealandiae (Jacquinot, 1853)

Family Portunidae (7 spp., + 3 fossil spp.)

Ovalipes catharus (White, 1843)
Ovalipes mollerii (Ward, 1933)
Ovalipes sp. A. Glaessner, 1960 (fossil)
Portunus pelagicus (Linnaeus, 1766)
Liocarcinus corrugatus (Pennant, 1777)
Nectocarcinus antarcticus (Jacquinot, 1853)
Nectocarcinus bennetti Takeda & Miyake, 1969
Pororaria eocenica Glaessner, 1980 (fossil)
Rhachiosoma granulifera (Glaessner, 1960) (fossil)
Scylla serrata (Forsk., 1775)

Family Xanthidae (4 spp., + 5 fossil spp.)

Menippe sp. Glaessner, 1960 (fossil)
Ozius truncatus H. Milne Edwards, 1834
Pilumnopeus serratifrons (Kinahan, 1856)
Pilumnus lumpinus Bennett, 1964
Pilumnus novaezealandiae Filhol, 1886
Pseudocarcinus sp. Glaessner, 1960 (fossil)
Tumidocarcinus dentatus Glaessner, 1960 (fossil)
Tumidocarcinus giganteus Glaessner, 1960 (fossil)
Tumidocarcinus tumidus (Woodward, 1876) (fossil)

Family Belliidae (1 sp.)Heterozius rotundifrons A. Milne Edwards, 1867Family Goneplacidae (2 spp., + 2 fossil spp.)Carcinoplax victoriensis Rathbun, 1923Galene proavita Glaessner, 1960 (fossil)Glaessneria arenicola (Glaessner, 1960) (fossil)Neommatocarcinus huttoni (Filhol, 1886)Section: ThoracotremataFamily Grapsidae (10 spp. + 1 fossil sp.)Leptograpsus variegatus (Fabricius, 1793)Plagusia chabrus (Linnaeus, 1758)Plagusia tuberculata Lamarck, 1818Hemigrapsus crenulatus (H. Milne Edwards, 1837)Hemigrapsus edwardsi (Hilgendorf, 1882)Mioqrapsus papaka Fleming, 1981 (fossil)Helice crassa Dana, 1851Cyclograpsus insularum Campbell & Griffin, 1966Cyclograpsus lavauxii H. Milne Edwards, 1853Planes cyaneus Dana, 1852Planes marinus Rathbun, 1914Family Pinnotheridae (2 spp.)Pinnotheres atrinicola Page, 1983Pinnotheres novaezelandiae Filhol, 1885Family Ocypodidae (1 sp., + 1 fossil sp.)Macrophthalmus hirtipes (Heller, 1862)Macrophthalmus ?major (Glaessner, 1960) (fossil)Family Hymenosomatidae (14 spp.)Amarinus lacustris (Chilton, 1882)Elamena longirostris Filhol, 1885Elamena momona Melrose, 1975Elamena producta Kirk, 1878Halicarcinus cookii (Filhol, 1885)Halicarcinus innominatus Richardson, 1949Halicarcinus ovatus Stimpson, 1858Halicarcinus planatus (Fabricius, 1775)Halicarcinus tongi Melrose, 1975Halicarcinus varius (Dana, 1851)Halicarcinus whitei (Miers, 1876)Halimena aoteoroa Melrose, 1975Hymenosoma depressum Jacquinot, 1853Neohymenicus pubescens (Dana, 1851)

TOTALS: 87 recent species (2 undescribed), in 58 genera, in 19 families.

24 fossil species, in 19 genera, in 9 families.

Overall 111 species, in 72 genera, in 20 families.

IDENTIFICATION KEY FOR NEW ZEALAND CRAB-LIKE CRUSTACEA

1. Last two pairs of legs reduced, abdomen not folded underneath the thorax.

Fig. 6 - Porcellanopagurus edwardsi Filhol, 1885

At least the first three pairs of legs well developed, abdomen folded underneath the thorax

. 2

2. Carapace oval-shaped, chelipeds well developed, eyes median to antennae, only 3 pairs of walking legs visible dorsally, fourth pair reduced and concealed.

. 7

Four pairs of walking legs visible dorsally, chelipeds not excessively flattened, eyes usually lateral to antennae, abdomen somewhat reduced and not used in locomotion.

. 3

3. Last two pairs of walking legs reduced and dorsally placed.

. 14

Last two pairs of walking legs may be reduced but they are not sub-chelate. First segment of antennal peduncle not freely movable.

. 4

4. Carapace granulate and orbits minute. Disto-lateral margin of epistome prolonged forward or channelled. Third maxilliped narrowing anteriorly.

. 20

Disto-lateral margin of epistome not prolonged forward or channelled. Third maxilliped not narrowing anteriorly.

. 5

5. Carapace oblong or rounded, not narrowed anteriorly. Orbits formed, usually complete, in which the eyes can be concealed.

. 55

Carapace narrowed anteriorly and produced as a rostrum between the eyes.

. 6

6. Orbits generally more or less incomplete, chelipeds especially mobile, rarely much larger than walking legs. Hooked hairs almost always present. Male genital openings coxal.

. 22

Small crabs, CW <20mm, carapace thin and flat, chelipeds not long or especially mobile. Male genital openings sternal. No orbits, hooked hairs usually absent.

. 42

7. Carapace flattened, rostrum blunt, chelipeds elongate, broad and depressed.

. 8

Carapace convex, rostrum well developed, chelipeds elongate, massive.

.10

8. Antero-lateral margins of carapace bearing 10-12 spines, rostrum extending past eyes and 6 small spines on each side.

Fig. 9 - Petrocheles spinosus Miers, 1876

Antero-lateral margins of carapace without spines.

.9

9. Antero-lateral margins of carapace convex but interrupted by 2 oblique notches in hepatic and branchial regions. Cheliped carpus flattened, inner margin with 2 small spines, outer margin with 4 small spines.

Fig.8 - Petrolisthes novaezelandiae Filhol, 1886

Antero-lateral margins of carapace convex, without teeth or interruptions. Cheliped carpus flattened, inner margin with a single small proximal spine, outer margin with 3 small distal spines.

Fig. 7 - Petrolisthes elongatus (H.Milne Edwards, 1837)

10. Second abdominal segment divided by sutures into five plates.

Fig. 3 - Neolithodes brodiei Dawson & Yaldwyn, 1970

Second abdominal segment not divided into five plates.

.11

11. Median area of third to fifth abdominal segments membranous with calcified nodules (but not median plates)

.12

Median area of third to fifth abdominal segments not membranous, entire.

.13

12. Carapace bearing about 18 long spines, carpi of first three pairs of walking legs each bearing a pair of long spines, rostrum elongate but slender and with widely divergent, long terminal bifurcation.

Fig. 2 - Lithodes longispina Sakai, 1971

Carapace bearing more than 18 prominent spines, carpi of first three pairs of walking legs without a pair of long spines, rostral spines short.

Fig. 1 - Lithodes murrayi Henderson, 1888

13. Whole crab covered in acute spines.

Fig. 5 - Paralomis hystrix (De Haan, 1849)

Whole crab covered in short, blunt spines.

Fig. 4 - Paralomis zelandica Dawson & Yaldwyn, 1971

14. Carapace quadrate, rostrum short and triangular, first three abdominal segments visible dorsally, last two pairs of legs reduced and placed sub-dorsally.

.15

The previous combination of characters do not apply.

.16

15. Carapace surface finely granular, rostrum about one-twelfth of total carapace length.

Fig. 16 - Cymonomus bathamae Dell, 1971

Carapace surface with few, fine, rounded granules, rostrum about one-quarter of total carapace length.

Fig. 17 - Cymonomus aequilonius Dell, 1971

16. Last 2 pairs walking legs with propodal spines opposing the dactyls (i.e. sub-chelate). Carapace much wider than long and covered with a sculptured layer of short hairs.

Fig. 10 - Petalomera wilsoni (Fulton & Grant, 1902)

Last pair of legs may be sub-chelate but the penultimate pair are not.

.17

17. Carapace pyriform (pear-shaped) with anterior part narrowed like a neck, ocular peduncles very long and bearing bulbous eyes.

Fig. 12 - Latreillia australiensis (Henderson, 1888)

Carapace quadrangular, urn-shaped or longitudinally oval without its anterior part conspicuously narrowed like a neck.

.18

18. Rostrum without lateral spine, carapace dorsally convex with high lateral sides, rostrum distally bifurcate, supra-orbital spine short and acute. Neither of last 2 pairs of walking legs sub-chelate.

Fig. 11 - Homola orientalis (Henderson, 1888)

Dactyls of last pair of legs expanded, flattened and triangular. Carapace smooth, antero-lateral margins with a single prominent, forwardly-directed spine, third pair of walking legs shortest.

Fig. 15 - Lyreidus tridentatus (De Haan, 1841)

Last pair of walking legs sub-chelate.

.19

19. Supra-orbital spines acute and long, projecting forward like a pair of antlers.

Fig. 13 - Paramola petterdi (Grant, 1905)

Anterior half of carapace armed with many long, sharp spines. Chelipeds also armed with many acute spines.

Fig. 14 - Paramola spinimana Griffin, 1965

20. Carapace globular, posterior margin has a pair of lobes on either side of a conspicuous intestinal spine.

Fig. 20 - Randallia pustulosa Wood-Mason, 1891

Carapace rhomboidal and/or sculptured.

.21

21. Carapace much wider than long, with a stout laterally-directed process on the branchial region.

Fig. 19 - Merocryptus lambriformis A. Milne Edwards, 1873

Carapace as wide as long, antero-lateral margin with 2 concavities, posterior margin with 3 short blunt processes.

Fig. 18 - Ebalia laevis (Bell, 1855)

22. Carapace much wider than long, broadly triangular, alate (winged), produced as flanges overhanging the legs. Rostrum very short and faintly notched.

Fig. 28 - Eurynolambrus australis H. Milne Edwards & Lucas, 1841

Carapace oval or broadly pyriform (pear-shaped).

. 23

23. Carapace pyriform, narrowed and neck-like anteriorly, rostrum consisting of 2 very short spines. No post-orbital spines. Legs very long and spindly.

Fig. 26 - Achaeus curvirostris (A. Milne Edwards, 1873)

Carapace oval or pyriform, post-orbital spines present.

. 24

24. Rostrum consisting of 3 spines, median spine longest.

. 25

Rostrum consisting of either a single spine or a pair of stout spines.

. 26

25. Carapace oval, legs long and spindly, rostral spines acute, branchial region not armed with a stout spine.

Fig. 23 - Platymaia maoria Dell, 1963

Carapace oval, legs long and spindly, rostral spines blunt, branchial region armed with a stout spine.

Fig. 22 - Cyrtomaia lamellata Rathbun, 1906

26. Carapace broadly pyriform, rostrum consisting of a single acute spine, 3 median tubercles, 1 gastric, 1 cardiac and 1 intestinal.

Fig. 24 - Pyromaia tuberculata (Lockington, 1877)

Rostrum consisting of 2 prominent or blunt spines.

. 27

27. Legs very long and spindly, much longer than chelipeds, rostrum of 2 long spines (about one third of carapace length), orbit flanked by short acute spines.

Fig. 25 - Achaeopsis ramusculus (Baker, 1906)

Legs and chelipeds of similar length, chelipeds may be longer.

. 28

28. Rostrum of 2 very long, acute, widely divergent spines.

. 29

- Rostrum of 2 short spines which may be acute or blunt and divergent or sub-parallel.32
29. Carapace covered in small nodules, no marginal spines.
Fig. 29 - Leptomaia tuberculata Griffin & Tranter, 1986
- Carapace with well developed marginal spines.30
30. Chelipeds long and crested, carapace with a lamellate, marginal hepatic process.
Fig. 40 - Thacanophrys filholi (A. Milne Edwards, 1876)
- Chelipeds not crested, no lamellate, marginal hepatic process.31
31. Carapace margins with 2 spines, 1 hepatic and 1 (longest) branchial.
Fig. 27 - Rochinia riversandersoni (Alcock, 1895)
- Carapace margins with 6 or 7 spines increasing in length posteriorly.
Fig. 39 - Teratomaia richardsoni (Dell, 1960)
32. Walking legs with sub-chelate dactyls.
Fig. 30 - Trichoplatus huttoni A. Milne Edwards, 1876
- Walking legs normal, not sub-chelate.33
33. Carapace bearing flat-topped tubercles, flattened lobes and short conical spines.
Fig. 21 - Eurynome bituberculata Griffin, 1964
- Tubercles on carapace not flattened.34
34. Rostrum short, consisting of two blunt lobes, floor of orbit formed by expanded basal antennal article.
Fig. 41 - Jacquiniotia edwardsi (Jacquinot, 1853)
- Rostrum well developed, consisting of two well developed spines.35
35. Supra-orbital eave, intercalated spine and post-orbital spine widely separated from each other, post-orbital spine simple. Eyestalks short, slender, cornea small. Carpus of cheliped with 2 longitudinal ridges converging proximally.36
- Supra-orbital eave, intercalated spine and post-orbital lobe closely approximated, post-orbital lobe excavated anteriorly. Eyestalks stout, cornea very large. Carpus of cheliped lacking prominent ridges.38

36. Carapace with both spines and tubercles dorsally. Two hepatic spines. More than 3 marginal branchial spines extending on to dorsum of carapace posteriorly.

. 37

Carapace hairy and covered by tubercles only. Three hepatic spines. Merus of cheliped with dorsal row of laterally compressed spines, carpus with dorsal ridge serrate.

Fig. 33 - Notomithrax ursus (Herbst, 1788)

37. Protogastric regions smooth or only faintly tuberculate. Seven marginal branchial spines. Merus of cheliped smooth dorsally, carpus with dorsal ridge poorly developed, tuberculate, lateral ridge well developed.

Fig. 31 - Notomithrax minor (Filhol, 1885)

Entire surface of carapace covered by tubercles and spines, 5 marginal branchial spines. A pair of short spines at the posterior carapace margin. Merus of cheliped with a few spines and tubercles dorsally, carpus with dorsal and lateral ridges entire.

Fig. 32 - Notomithrax peronii (H. Milne Edwards, 1834)

38. Intercalated spine in orbit markedly shorter than antorbital, almost excluded from outer rim of supraorbital margin by distal approximation of antorbital spine and postorbital spine.

. 39

Intercalated spine as long as antorbital, reaching outer rim of supraorbital margin.

. 40

39. Antorbital spine separated from postorbital spine, two marginal hepatic spines.

Fig. 38 - Leptomithrax tuberculatus mortenseni Bennett, 1964

Antorbital and postorbital spines closely approximated, one marginal hepatic spine.

Fig. 39 - Leptomithrax longipes (Thomson, 1902)

40. Postorbital lobe with a prominent spinule or tubercle on upper anterior edge.

. 41

Postorbital lobe lacking a spinule on upper anterior edge.

Fig. 36 - Leptomithrax longimanus Miers, 1876

41. Carapace in both male and female covered by a few spines.

Fig. 35 - Leptomithrax garricki Griffin, 1966

Carapace in male densely covered by spines, in female by numerous tubercles.

Fig. 34 - Leptomithrax australis (Jacquinot, 1853)

42. Carapace with distinct gastrocervical groove and cervical grooves.

. 47

- Carapace without distinct gastrocadiac groove. 43
43. Eyestalks entirely visible dorsally, folded antennules similarly visible. Epistome absent. Dactyls of each walking leg devoid of teeth.
Fig. 84 - Hymenosoma depressum Jacquinot, 1853
- Cornea of eye, but not eyestalks visible dorsally, folded antennules completely hidden. Epistome large and rectangular. Dactylus of each walking leg sparsely dentate. 44
44. Distinct suture between carapace and rostrum. Rostrum without keel or ridge ventrally. Dactylus of each walking leg with a single large tooth adjacent to claw, lacking other dentation.
Fig. 83 - Halimena aoteoroa Melrose, 1975
- Rostrum and carapace completely fused, no suture between them. Rostrum with a keel ventrally. Dactylus of each walking leg with 2 large teeth adjacent to claw, lacking other dentation. 45
45. Rostrum narrow, produced, sub-rostral keel with strong spine extending from it. Carapace triangular. Legs with many sturdy teeth.
Fig. 73 - Elamena longirostris Filhol, 1885
- Rostrum broad, rounded, sub-rostral keel blunt. Carapace rounded, legs without teeth except for 1 on merus. 46
46. Length of rostrum at least half width. Keel deepest anteriorly, tapering behind. Prominent upwardly curved tooth on the distal end of merus of walking legs. Antero-lateral carapace margins angular.
Fig. 75 - Elamena producta Kirk, 1878
- Length of rostrum less than a third of width. Keel shallow, of equal depth throughout. Tooth on merus of each walking leg reduced, obtuse. Antero-lateral carapace margins without distinct angles.
Fig. 74 - Elamena momona Melrose 1975
47. Rostrum trilobate or tridentate, arising below level of carapace, carapace rim continuous above rostrum and concavities between lobules extending below this rim. 48
- Rostrum simple or, if trilobate, lobes arising from level of carapace, separated from it only by a suture. 50
48. Three rostral lobes arising well below carapace rim, carapace rim being continuous above rostrum, with lateral rostral lobes at same level as median one and not set at an angle to it. Antero-lateral border of carapace convex. Dactylus of each walking leg with a single row of teeth or tubercles.
Fig. 77 - Halicarcinus innominatus Richardson, 1949

Three rostral lobes arising just below rim of carapace, with lateral lobes set at an oblique angle to median lobe. Anterolateral border of carapace straight or concave. Dactylus of each walking leg with double row of teeth.

.49

49. Rostral lobes widely separated, median rostral tooth shortest, lateral lobes sloping downward and outward.

Fig. 79 - Halicarcinus planatus (Fabricius, 1775)

Rostral lobes close together, median lobe a little longer than laterals, all lobes projecting straight forward.

Fig. 78 - Halicarcinus ovatus Stimpson, 1858

50. Rostrum distinctly trilobate or tridentate, concavities between lobes reaching almost to suture between carapace and rostrum.

.51

Rostrum simple or, trilobate only distally, any concavities between lobes not reaching near suture between rostrum and carapace.

.52

51. Rostrum extending past eyes. Rostral lobes acute, subequal.

Fig. 80 - Halicarcinus tonqi Melrose, 1975

Rostrum not projecting past eyes. Rostral lobes rounded apically, median one slightly longer than laterals.

Fig. 76 - Halicarcinus cooki (Filhol, 1885)

52. Rostrum not projecting past eyes, and forming a flat almost horizontal platform.

Fig. 81 - Halicarcinus varius (Dana, 1851)

Rostrum projecting past eyes, and downwardly deflexed anteriorly.

.53

53. Rostrum distinctly trilobate on tip, projecting well past eyes. Dactylus of each walking leg with a single row of sharp recurved teeth.

Fig. 82 - Halicarcinus whitei (Miers, 1876)

Rostrum simple, just extending past eyes. Dactylus of each walking leg lacking teeth or sparsely dentate.

.54

54. Rostrum deflexed only a little downwardly, convex from side to side above, narrowing to a blunt point anteriorly. Dactylus of each walking leg curved, with a single blunt tooth adjacent to claw. Covered with long feathery hairs.

Fig. 85 - Neohymenicus pubescens (Dana, 1851)

68. The pair of median frontal teeth closely set and produced further forwards than anterior orbital; no supra-orbital tooth. Chelipeds relatively long, carpus armed with small acute teeth.

Fig. 46 - Ovalipes molleri (Ward, 1933)

The pair of median frontal teeth closely set but not produced much further forwards than anterior orbital teeth, prominent supra-orbital tooth present. Chelipeds relatively short, carpus with a long, robust, distal inner spine.

Fig. 45 - Ovalipes catharus (White, 1843)

69. Last anterolateral tooth very long and directed laterally, chelipeds very long (3 times CL).

Fig. 47 - Portunus pelagicus (Linnaeus, 1766)

All anterolateral teeth of similar size and shape, chelipeds massive.

Fig. 51 - Scylla serrata (Forsk., 1775)

70. Symbiotic crabs with reduced eyes and orbits. Body swollen and smooth; sometimes taken at night free-swimming and attracted to light.

.83

Free-living crabs with a more or less straight-sided body and well developed eyes.

.71

71. Carapace surface smooth and with a single, long laterally directed, acute spine or two smaller anterolaterally directed spines (the second larger than the first).

.82

Carapace surface smooth or tuberculated but without prominent, acute, lateral spines.

.72

72. Front broad, eyestalks relatively short, less than one-third of CW, dactyls of walking legs often compressed and spinous. A narrow gap between external maxillipeds.

.73

Front narrow, eyestalks relatively long, dactyls of walking legs styliform. External maxillipeds almost or fully closing across the mouth.

Fig. 71 - Macrophthalmus hirtipes (Heller, 1862)

73. Frontal margin of carapace bearing 10-14 broad spines.

.74

Frontal margin of carapace may be tuberculated but without spines.

.75

74. Dorsal carapace surface tuberculate, dorsal margins of meri of walking legs smooth except for a single distal spine.

Fig. 61 - Plagusia depressa tuberculata Lamarck, 1818

Dorsal carapace surface mostly smooth with blunt tubercle just behind each orbit, dorsal margins of meri of walking legs spinous.

Fig. 60 - Plagusia chabrus (Linnaeus, 1758)

75. Frontal margin tuberculated, 2 anterolateral teeth behind external orbital angle, branchial regions with 7-9 prominent, weakly curved transverse ridges.

Fig. 59 - Leptograpsus variegatus (Fabricius, 1793)

Frontal margin smooth.

.76

76. Meri of legs flattened and transverse striations on at least the anterior half of the carapace.

.81

Meri of legs not especially flattened, no striations on carapace.

.77

77. Anterolateral carapace margins with 2 small teeth behind the orbital corner.

.79

Anterolateral carapace margins without teeth.

.78

78. Orbits small but well incised, outer corner raised, median frontal groove prominent.

Fig. 66 - Cyclograpsus lavauxi H.Milne Edwards, 1853

Orbits very small and shallow, outer corner not raised, eyes very small, median frontal groove absent.

Fig. 65 - Cyclograpsus insularum Campbell & Griffin, 1966

79. Eyestalk length much less than one-fifth of CW.

.80

Eyestalk length approx. one-fifth of CW, lateral margins of carapace straight, sub-parallel.

Fig. 64 - Helice crassa Dana, 1851

80. A strong, broad frontal groove extending back from frontal margin and separating 2 protuberances. Fourth and fifth segments of male abdomen fused.

Fig. 62 - Hemigrapsus edwardsi (Hilgendorf, 1882)

A short, shallow groove extending back from frontal margin. Fourth and fifth segments of male abdomen faintly movable.

Fig. 63 - Hemigrapsus crenulatus (H.Milne Edwards, 1837)

81. Carapace varies from a little broader than long (ratio 0.86) to a little longer than broad (ratio 1.06). Legs relatively short (proportion of length of 3 distal segments of second leg to CL is 0.68 to 0.89).

Fig. 67 - Planes cyaneus Dana, 1852

Carapace distinctly wider than long (ratio 1.07 to 1.16).
 Legs relatively longer (proportion of length of 3 distal segments of second leg to CL is 0.77 to 0.99).
 Fig. 68 - Planes marinus Rathbun, 1914

82. Eyestalks very long, almost half CW, lateral carapace margin produced into a single long, acute spine against which the eyes can rest.

Fig. 58 - Neommatocarcinus huttoni (Filhol, 1886)

Eyestalks short, lateral carapace margin armed with 2 short acute spines.

Fig. 57 - Carcinoplax victoriensis Rathbun, 1923

83. Chela with a continuous dorsal row of setae on propodus, terminal segment of abdomen quadrate. In the female the legs are noticeably asymmetrical.

Fig. 69 - Pinnotheres atrinocola Page, 1983

Chela without a continuous dorsal row of setae on propodus, terminal segment of abdomen trapeziform. Legs of female not markedly asymmetrical.

Fig. 70 - Pinnotheres novaezealandiae Filhol, 1885

Lithodes murrayi Henderson, 1888
Southern Stone Crab

Synonymy

Lithodes murrayi Henderson, 1888; Bouvier, 1896; Thompson, 1900; Hale, 1941; Dell, 1963a; Yaldwyn, 1965; Yaldwyn & Dawson, 1970; Arnaud, 1971; Pseudolithodes pyriformis Birshtein & Vinogradov, 1972; Lithodes murrayi Webb, 1972; Campodonico & Guzman, 1972; Arnaud, Do-Chi & Rannou, 1976; Arnaud & Do-Chi, 1977; (not of Kensley, 1977; 1980; Melville-Smith, 1982; MacPherson, 1983; = L.tropicalis A. Milne Edwards, 1883); Lithodes murrayi Takeda & Hatanaka, 1984; Lithodes unicornis Macpherson, 1984; Lithodes murrayi Dawson & Yaldwyn, 1985.

Type Locality

Off Prince Edward Is, southern Indian Ocean, 570m.

Distribution

Southern Ocean, circumpolar: Possession Is. (Ross Sea), Prince Edward Island, Crozet Is., Macquarie Is, southern New Zealand, southern Chile and off the Falkland Is. Within New Zealand, Kaikoura Peninsula, Solander Is., Foveaux Strait and west coast of Stewart Is. Reports of L.murrayi off the Durban coast of South Africa have been corrected to L.tropicalis by Melville-Smith & Louw (1987).

Diagnosis (Fig. 1a-e).

Carapace is broadly pyriform ('pear-shaped') with length (including the rostrum) greatly exceeding width, regions are well defined and surface armed with long, acute spines. Degree of development of spines is variable. The rostrum is five-spined, directed slightly upward, the base broad, and terminating in two prominent diverging spines which are directed forwards and upwards, the distal portion shorter and more slender with its apex bifurcate. On the lower surface of the rostrum is a large spine directed downwards and forwards. The gastric area, behind the rostrum, is swollen, with a few small scattered tubercles but armed with four acute, conical spines arranged in two rows, the anterior pair of larger size. The cardiac area is well-defined, separated from the gastric area by a deep transverse sulcus and bearing two acute spines. In front of these are two conspicuous tubercles. The branchial areas are moderately convex and each is armed with a pair of conspicuous spines and a smaller submedial spine with scattered tubercles. The eyes are close together freely movable, cornea well developed and oblique. On a lower level are the antennules with the antennae nearby. The second joint of the antennal peduncle has a conical spine on its outer distal border and the flagellum is about equal in length to the carapace. There is a strong spine external to the ocular peduncle and the antero-lateral border is armed with about six prominent spines of varying size. Postero-lateral border broadly convex, armed with about nine spines the last is submedial and largest. Chelipeds small compared to the walking legs, the right somewhat stouter, all segments armed with conical, acute spines especially on the upper surface. Fingers long, excavated internally, right fingers have many minute teeth, both have numerous tufts of bristle-like setae scattered over the inner

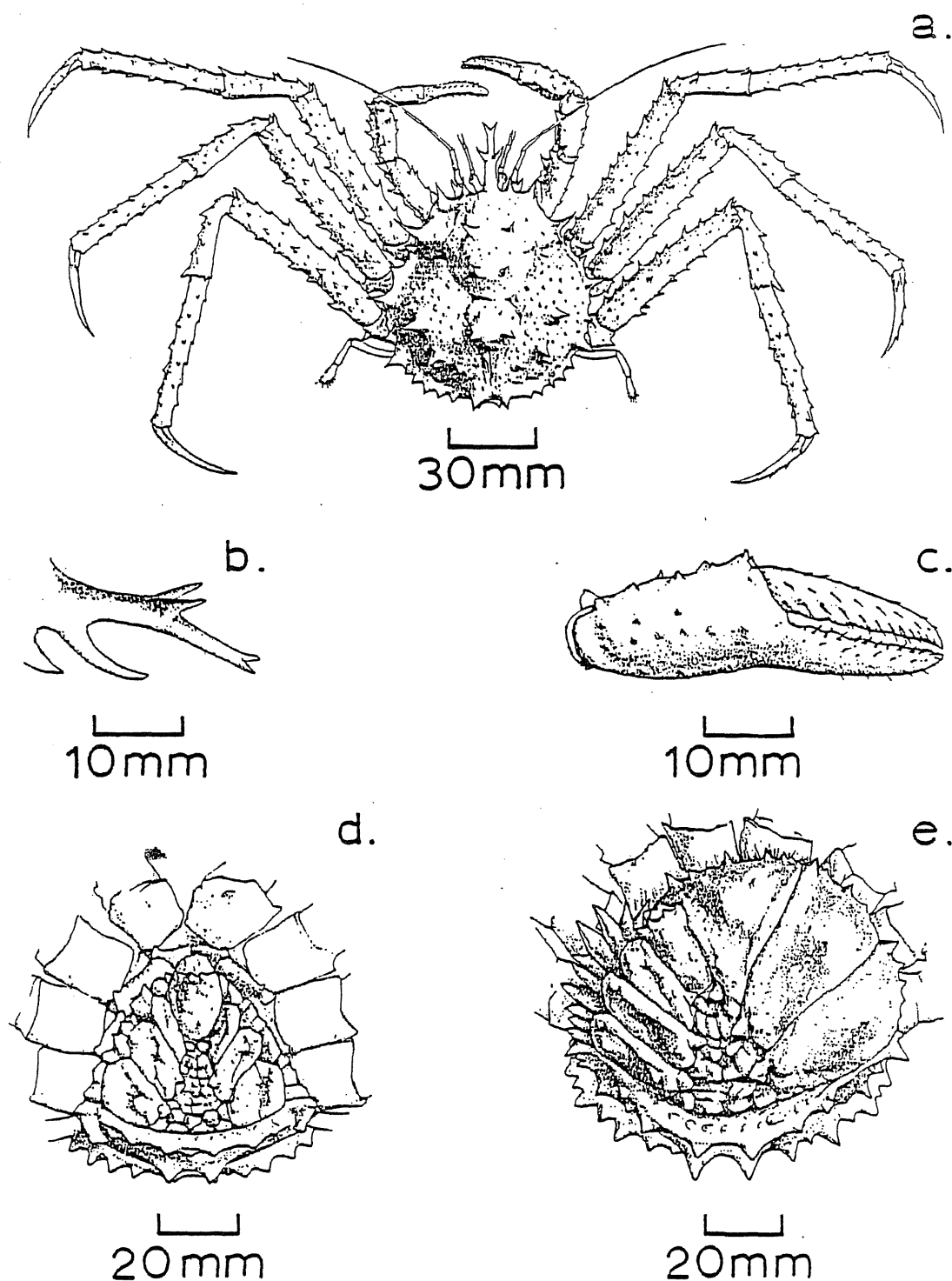


Fig. 1 - *Lithodes murrayi*: a - male, dorsal view; b - lateral view of rostrum; c - right chela, male, outer face; d - male abdomen, ventral view; e - female abdomen, ventral view (after Henderson, 1888).

surface. Walking legs very long, spinous with a prominent spine distally on the merus, and two spines at either end of the carpus. Dactyli long and armed, without spines on their inner margins. The reduced last pair of legs are smooth, flattened with the terminal portion densely pubescent and placed in gill chambers. Abdomen of six segments plus telson in both sexes, symmetrical in male, asymmetrical in female. First abdominal segment bears two small submedian spines, the second bears a large pair and has a raised posterior border, the penultimate segment has two small spines on its posterior border. Plates of third to fifth segments replaced by a median membranous portion which bears numerous sharp nodules. Uropods absent. Female has a pair of rudimentary pleopods on the first segment, and single pleopods on the left side of the next four segments. Right border of abdomen armed with a series of about 10 marginal plates in female, with plates on both sides in the male. Pleopods absent in male.

Colour

Dark purplish-red or brick-red with pale pinkish-white patches. Tips of dactyls of walking legs are black. Due to the attenuation of red light these crabs may be cryptically coloured.

Size

Male 172mm CW, 209mm CL (incl. rostrum). Female 138mm CL, female (ovigerous) 113mm CL. Smallest ovigerous female 71mm CW, 91mm CL. Distance between tips of second legs is approximately 110-120cm.

Habitat

Caught by potting and sometimes entangled in deep water set nets. Associated with suspension-feeding fauna e.g. sponges, gorgonians, polychaetes, brachiopods, bryozoans and ascidians.

Depth

120-700m.

Breeding

Ovigerous females of L. murrayi have been taken in December, February and April. Females collected in February by Webb had large numbers of unlaidd eggs in their ovaries, suggesting that ovigerous females could be expected in later months. Arnaud & Do-Chi (1977) found that clutch size increased non-linearly from about 1000 eggs for a 55mm CW female to 2300 for an 84mm CW female. Webb (1972) estimated brood size of a 140mm CW female at approx. 8000 eggs. The eggs are yellow when newly laid, red when mature, measuring 2.56mm diameter and weighing 0.01gm each. Arnaud & Do-Chi (1977) found that L. murrayi eggs increase from 2.31mm to 2.45mm during development. These are very large eggs, larger than eggs of Lithodes maja (2.0 x 1.8mm) (Pike & Williamson 1959). In this species eggs are laid in autumn and are carried through the winter months (September to November), hatching in April or May. Females moult soon afterwards. Stuardo & Solis (1963) found that Lithodes antarcticus from the Straits of Magellan (53°S) was also a seasonal spawner. It also has large eggs and after moulting, mating and spawning in shallow waters during the warm months (December-January) the incubating

females and adult males disperse to depths around 200m in February (summary from Sloan 1985). This pattern may also be true for L.murrayi.

Sloan (1985) has argued that there are two distinct reproductive strategies among lithodid crabs: aseasonal spawners with small numbers (<40,000) of large (>2.1mm) eggs (e.g. Lithodes spp.) and seasonal spawners with large numbers (300,000) of small (<1.2mm) eggs (e.g. Paralithodes spp.). However there seems to be considerable variation in reproductive strategy among the Lithodes spp. While Sloan (1985) found L. aequispina in a British Columbia fjord was aseasonal, studies in Japan and Russia suggest that there it is seasonal (see Hiramoto & Sato 1970). While L. cousei is aseasonal in the Gulf of Alaska (Somerton 1981a), L. longispina from Japan is a seasonal spawner. Finally, L. antarcticus, L. maja and L. murrayi would be expected, on the basis of their large eggs, to be aseasonal but in fact they appear to be seasonal spawners. Therefore the hypothesis that large egg size is associated with aseasonal spawning may well be incorrect. The suggested mechanism behind this strategy - that seasonal spawners produce small eggs hatching larvae whose abundance is cued to pulses of suitable food produced in the plankton while aseasonal spawners produce large eggs which hatch well-provisioned larvae whose survival is less dependent on seasonally available food - needs further study.

The relationship between clutch size and CL in L. murrayi is non-linear (Arnaud & Do-Chi 1977) but a linear relationship is found in L. aequispina (Hiramoto and Sato 1970, also Jewett, Sloan & Somerton 1985) and L. antarctica (Guzman and Campodonico 1972). But in P. camtschatica (Haynes 1968, but see Somerton & MacIntosh 1985), P. platypus (Sasakawa 1975 also Somerton & MacIntosh 1985) and L. couesi (Somerton 1981) fecundity initially increases and then remains fairly constant giving a curvilinear relationship. Thus lithodid crabs exhibit a wide variety of fecundity/size relationships and in all species clutch size variability is high. As noted earlier there is an order of magnitude difference in clutch size between Lithodes spp. and Paralithodes spp. which have many small eggs. It is probable that lithodid females produce a maximum of only one clutch of eggs per year (maybe less) because of slow development at low temperatures. The pattern seems to be that eggs are laid soon after mating which follows every adult moult (Jewett, Sloan & Somerton 1985).

Comparison of regression line intercepts for fecundity data suggests that 8-13% of eggs are lost during incubation to the eyed stage in Lithodes aequispina (Jewett, Sloan & Somerton 1985). There are no comparative data for other lithodids.

In a detailed comparison of the reproductive strategies of two lithodid species Somerton & MacIntosh (1985) revealed some interesting differences between Paralithodes camtschatica and P. platypus. P. camtschatica produce smaller eggs (1.0mm long) and spawn annually while P. platypus produces larger eggs (1.2mm long) but spawn biennially. There is a two-year ovarian cycle and a development period of 14-15 months. These crabs expend more energy per spawning, produce larger larvae and have a longer (17yr) adult life-span than P. camtschatica (10yr). They point out that P. platypus conforms to the low frequency reproduction

model (LFR) proposed by Bull & Shine (1979) i.e. a species in which populations reproduce annually but individuals reproduce biennially or less often. Greater expenditure of energy per spawning and longer life may be a consequence of moulting less often, thereby avoiding an energetically expensive and hazardous event. The management implication of these results is that percentage of adult females carrying embryos cannot be used for LFR species to determine whether or not a sufficient number of males remain in the population.

In an interesting study of the small, shallow water lithodid, Cryptolithodes typicus from British Columbia, Hart (1965) found that eggs (about 1.0mm diam.) were laid in summer (May onwards), carried over winter (with little development until December) and hatched in March-April. Eggs did not hatch simultaneously but larvae emerged over a three-week period. This may be an offspring-investment strategy which enhances larval survival and may also occur in other lithodids.

In northern British Columbia 41% of male and female golden king crabs, Lithodes aequispina, were parasitized by the rhizocephalan barnacle Briarosaccus callosus and were therefore sterile. Parasitized crabs behave like unparasitized brooding females which migrate to deeper water to spawn. Parasitism did not inhibit moulting in host crabs or influence body size in females but male body size and right cheliped allometry were decreased. This high level of infection is probably the result of confinement of host and parasite to an area with restricted exchange with the surrounding sea (Sloan 1984). Infection levels in other crabs range from 1.0-15.0% (Hawkes et al. 1986). Arnaud & Do-Chi (1977) found 3.5% of L. murrayi from exposed islets in the southwestern Indian Ocean were parasitized by B. callosus. Lower levels have been reported for L. antarcticus from southern Chile (Stuardo & Solis 1963). B. callosus infects seven other lithodid species. Rhizocephalan parasites of anomurans do not inhibit moulting but similar parasites of brachyuran crabs suppress moulting after the externa is formed (Bower & Sloan 1985). The rather limited data of Hawkes et al. (1987) suggest that moult increments of parasitized Alaskan blue king crabs (Paralithodes platypus) are reduced compared to non-parasitized crabs. B. callosus effects on king crab haemolymph include inhibition of ion regulation, decrease in pH and increase in total protein, hemocyanin and glucose concentrations (Shirley, Shirley & Meyers 1986).

Development and Growth

Larval stages of Lithodes murrayi are unknown. The range of variation in lithodid larval development has been tabulated by Konishi (1986). Larvae of L. maja, L. aequispina and L. antarctica and their megalopae have been described by MacDonald et al. (1957), Hayes (1982) and Campodonico (1971) respectively. These species tend to have abbreviated development, 2-4 zoeal stages followed by the megalopa, which has many spines on the carapace like the adult crabs. Larval development may take 3-4 months depending upon water temperature.

Arnaud & Do-Chi (1977) have studied relative growth in L. murrayi from the Crozet Islands. Carapace width increases isometrically with carapace length in both sexes as do most female dimensions except for merus length (of first leg) which is negatively allometric and left cheliped height which is positively allometric. In males height and length of both cheliped propodi as well as merus length (of first leg) are all positively allometric with respect to carapace length. The smallest L. murrayi female carrying eggs was 60mm CL (excl. rostrum) and most females produce eggs by the time they reach 80mm CL.

Relative growth has also been studied in Lithodes antarcticus from southern Chile. For both males and females carapace length grows isometrically with carapace width. In males the length of the merus of the first legs and the length and height of the right cheliped propodus all grow positively allometrically. In females these show negative allometry (Stuardo & Solis 1963). Males reach sexual maturity between 90-102mm CL (not including spines) and females at about 75mm. In northern British Columbia 50% of female L. aegispina mature at 105.5mm CL while chela allometry suggests that males mature at 114mm (Jewett, Sloan & Somerton 1985). There is a trend of increasing size of maturity with decreasing latitude. In L. couesi males cheliped height can be used to detect maturity as there is a marked increase in cheliped size at a pubertal moult which can occur anywhere in the range 80-120mm CL. Estimated sizes of 50% maturity are 91.4mm CL for males and 80.2mm for females (determined by presence of eggs) (Somerton 1981). Weber (1967) has estimated that the red king crab, Paralithodes camtschatica from Alaska takes about 5 years to reach sexual maturity at a comparable size but there is considerable variation in growth rates between different areas of the North Pacific. Similarly, the blue king crab, P. platypus shows different sizes of 50% maturity in different areas of Alaska (Somerton & MacIntosh 1983).

Mature king-crabs may moult annually but large crabs may only moult every 2-3 years. Growth increments of both male and female immature P. camtschatica (10-50mm CL) from Alaska range from 23-27%, but larger crabs have smaller percentage growth of about 20% at 80mm. Analysis of size-frequency modes suggests that crabs over 60mm have nearly constant absolute increments of about 16mm (Weber 1967) which means that percentage increments would decline even further. Large male Lithodes aegispina also show average increments per moult of 16.2mm, moulting annually up to 145mm CL and gradually becoming biennial or less frequent thereafter (Jewett, Sloan and Somerton 1985).

Regeneration of lost limbs by P. camtschatica from the Bering Sea has been investigated by Edwards (1972). Almost 30% of juveniles and 15% adults had lost at least one limb. Limb loss increased in frequency from anterior to posterior limbs. It is suggested that full regeneration of a limb may require 4-5 moults. The right chela is normally larger but when it is lost dominance is transferred to the left chela. With lower moult frequency adult crabs have limited ability to regenerate lost limbs.

Behaviour

Nothing known about L.murrayi but it may share the aggregation behaviour peculiar to king crabs (e.g. Paralithodes camtschatica). Juveniles of Paralithodes form large 'pods' resembling hay stacks containing several thousand small crabs and this may confer some protection against fish predators (Powell & Nickerson 1965). In addition adult crabs may form 'pods' when migrating to shallow water for breeding and moulting. These aggregations may protect newly-moulted soft crabs. Lithodes aequispina seem to have a migratory pattern which consists of 1) juvenile recruitment in the shallows (50-100m); 2) moulting, mating and egg extrusion by adults slightly deeper; 3) downward migration by incubating females while males tend to remain in shallows; 4) hatching and larval release at depth (>200m); 5) post-spawning recovery in deep water; 6) upward migration by females for moulting and mating (Sloan 1985). If this crab is an aseasonal spawner, as Sloan (1985) suggests, then different parts of the population would be at different stages of the migratory cycle at any one time. The duration of this cycle is probably longer than a year. L.antarcticus from southern Chile behaves somewhat differently: males precede females into the shallows (<10m) to moult; then females arrive in the warm season (Nov.-Dec.), moult, copulate, extrude eggs and then disperse with males offshore to deeper water to incubate the eggs and release larvae. Juvenile L.antarcticus recruit and spend the first few years of life in very shallow (2-3m) water (Stuardo & Solis 1963). Some anecdotal observations suggest that L.murrayi may follow a similar pattern (Arnaud 1971, Arnaud et al. 1976, Arnaud & Do-Chi 1977).

Lithodid crabs may be caught using baited pots in deep water or alternatively by a coarse mesh set net with a weighted foot rope and floating head rope set across the migratory pathway of the crabs (Makarov 1938).

Mating behaviour of Paralithodes camtschatica, observed in captivity, consists of males using their chelipeds to grasp the female cheliped meri in a pre-copulatory face to face embrace that lasts for 3-7 days through the pre-moult and moult stages. This 'handshake', which is not essential for the submissive female to moult, may well last much longer in the wild. Males will retain a firm hold on their partners even when removed from the water. The size of grasping partners is not correlated (Makarov 1938, Powell & Nickerson 1965) but Powell et al. (1974) suggest that small males may not produce enough sperm to fertilize a full clutch of eggs. The male assists the female to moult and protects her while she is soft and swelling. Casting of the old exoskeleton requires about 9-10 min (Weber 1967). After the female has moulted the male reclassps her by the chelipeds and inverts her beneath his body, bringing their abdomens close together. The female begins to lay her eggs from the genital apertures at the base of the second legs and the male spreads bands of spermatophores, from the base of the reduced last pair of legs, over the eggs which become attached to the pleopod setae. Spreading of the spermatophores over the eggs is accomplished by vigorous movements of the last pair of legs. Female king crabs have no seminal receptacle and therefore require the presence of a male during ovulation. The soft female attains her full size about 2 hours after shedding of the old

exoskeleton by which time fertilization is complete, and the male departs. Females which moult alone are still attractive to males up to 9 days after moulting and can produce a full clutch of fertilized eggs. After this time their success declines and by 13 days none were successful since males were repelled by female aggression (McMullen 1969). In captivity a male is polygamous and is capable of fertilizing about 5 females over a period of 10 days but the number of successful matings in the wild could well be somewhat lower because males must compete for females arriving on the spawning ground. In Alaska breeding P. camtschatica occupy the subtidal peripheries of kelp-covered reefs at 3-8m depth. It is interesting to note that although mating in this crab involves the male grasping the female by her chelipeds this does not seem to result in high levels of limb loss (Edwards 1972). This may be contrasted with the majid Jacquiniotia edwardsi where many limbs are lost, especially by females, as a result of tug-of-wars between males contesting over females.

Ecology

Lithodid crabs seem to be omnivorous although animal food predominates. Adult guts contain remains of polychaetes, echinuroids, small molluscs, starfish, sea urchins, holothuroids, and fish (Markarov 1938). Post-larval Paralithodes camtschatica from Alaska feed on diatoms, foraminifera, sponges as well as polychaetes and small crustacea (harpacticoids, ostracods) found living in sediment (Feder, McCumby & Paul 1980). Adult P. camtschatica from Alaska eat mainly molluscs (bivalves, Nucula, Nuculana, Macoma), Crustacea (mainly barnacles) and fish but the dominant food can vary between areas (Jewett & Feder 1982). Guts of L. murrayi from the Crozet Islands contain sessile (algae, foraminifera, hydrozoans, bryozoa, sponges and polychaetes), sedentary (gastropods, bivalves, echinoids and pycnogonids) and mobile organisms (other Lithodes, isopods, amphipods, cephalopods and fish debris) indicating an omnivorous diet of wide diversity (Arnaud & Do-Chi 1977).

Besides humans, the principal predators of lithodid crabs are fish (Markarov 1938, Gray 1964). Recently moulted, soft crabs are especially vulnerable. Large adult male crabs may well gain refuge from predators by virtue of their size. Nemertean worms of the genus Carcinonemertes are found on Paralithodes camtschatica from Alaska. Planktonic larvae settle on crab hosts and remain on the exoskeleton as juvenile worms. Those which infest ovigerous hosts invade the egg mass where they feed on host eggs, grow and reproduce sexually. Worms lay their own eggs in the host brood and worm larvae hatch near the time the host eggs hatch. In some populations and seasons, nemertean density was high enough to cause mortality of nearly all of the host eggs. There may well be several nemertean species involved (Wickham 1986, Wickham & Kuris 1988).

An extensive king-crab fishery based on males only has developed in the north Pacific since about 1900 involving Japan, Korea, Russia and the United States. Historically the fishery has been based mainly on the red king crab, P. camtschatica. Production peaked in 1980 at about 200 million pounds but despite a minimum legal size which allows for three years of reproduction by males this has since crashed as a result of severe over-exploitation and the blue king crab, P. platypus is now the

primary component of the catch. King-crabs are a gourmet sea food and very high prices (NZ \$125.00 per kilogram) are paid for them. Attention is now shifting to other lithodid species such as Lithodes aequispina, L. couesi, L. tropicalis, L. antarcticus and L. murrayi to meet the demand. An extensive fishery based on L. antarcticus and Paralomis granulosa has developed in Chile in the last decade (Campodonico 1981). The discovery of significant stocks of king crabs associated with orange roughy in deep water off the Wairarapa Coast (see DSIR Annual Report to Parliament 1985) has aroused interest among New Zealand fishermen. Much more biological information is needed before exploitation of these stocks should be allowed to proceed. Special consideration needs to be given to setting a minimum legal size which allows sufficient reproductive contribution. Lithodes species are much less fecund and may be much longer lived than the Paralithodes species. Another significant factor that must be taken into account is the effect of rhizocephalan parasites, such as Briarosaccus callosus, which sterilize crabs and could severely depress recruitment to the population.

Lithodes aequispina in northern British Columbia can be heavily infested with cocoons of a sanguivorous piscicolid leech, Notostomum cyclostoma. Larger crabs, which moult less frequently, have higher numbers of cocoons, especially on the carapace but also on the limbs, but the leeches do not feed on the crab host, obtaining their blood meals from fish (Sloan, Bower & Robinson 1984). Parasitism of lithodids by rhizocephalans is discussed above under 'Breeding'.

An interesting commensal association between several lithodid crabs and liparid fish (Careproctus spp.) has been reported. The female fish has a long ovipositor which she uses to lay her large (approx. 4-5mm diam.) eggs in the gill chamber of the crab. North Pacific Careproctus sinensis lay their eggs in the king crab, Paralithodes camtschatica (Rass 1950, Vinogradov 1950, Hunter 1969), off California and British Columbia C. melanurus use the box crab, Lopholithodes foraminatus (Parrish 1972, Peden & Corbett 1973), off Namibia C. griseleidea use the stone crab Lithodes tropicalis (Melville-Smith & Louw 1987), and off Chile C. falklandica uses L. antarctica while Careproctus sp. uses Paralomis granulosa (Balbontin, Campodonico & Guzman 1979). In the crab's branchial cavity the fish eggs have ideal conditions for aeration and protection during their development. The association seems likely to be beneficial to only one party because the ability of half the crab's gills to carry out gaseous exchange would be impaired. The fish lay from 200-1500 eggs in only one gill chamber and these must displace and compress the gills. In the cases of P. camtschatica and L. tropicalis only large males carry the fish eggs. However, an L. forminatus female 120mm CW had over 400 eggs in its right gill chamber (Peden & Corbett 1973). It may be that the fish select large crabs and these are all males. Melville & Louw (1987) found that about 10% of male L. tropicalis CL>110mm carried fish eggs. There are no reports of fish eggs in Lithodes murrayi but this may simply be because no one has looked for them. A liparid, Careproctus kermadecensis Nielsen 1964 has been described from 6660-6770m in the Kermadec trench and the family is probably widespread in the New Zealand region (Chris Paulin pers. comm.).

References

Arnaud (1971), Arnaud & Do-Chi (1977), Arnaud, Do-Chi & Rannou (1976), Bower & Sloan (1985), Haynes (1968), Pike & Williamson (1965), Powell (1965), Powell & Nickerson (1965), Makarov (1938), McMullen (1969), Sloan (1985), Somerton (1981a), Stuardo & Solis (1963), Webb (1972), Weber (1967), Yaldwyn & Dawson (1969).

Lithodes longispina Sakai, 1971Synonymy

Lithodes longispina Sakai, 1971a; Takeda, 1974; Dawson & Yaldwyn, 1985.

Type Locality

Off Matsushima, Japan, 600m.

Distribution

Japan, Guam, New Caledonia, south-east Australia, New Zealand. Within N.Z., off Wairarapa coast.

Diagnosis (Fig. 2a-e)

Carapace broadly pyriform ('pear-shaped') length (including rostrum) greatly exceeding width, regions well defined and armed with long acute spines. Rostrum five-spined, directed strongly upward in its proximal half but distal half is horizontal. At the junction of these two halves there is a pair of long accessory spines, the rostral tip is divided into two long, sharp, spines with an angle of about 30° and the sub-rostral spine is long and stout. Carapace spines are very long and sharp and eight in number. Four gastric spines, two long followed by two short, two cardiac spines, very long, and each branchial region has one extremely long sub-medial spine and one or two smaller posterior ones. The eyes are close together, freely movable, cornea well developed. On a lower level are the antennules with the antennae nearby. Second joint of antennal peduncle has a spine on its outer border, antennal flagellum long. There is a strong spine external to the ocular peduncle and the antero-lateral border is armed with 3 spines (second longest). Postero-lateral border broadly convex, armed with about 6 spines, the last is sub-medial and longest. Chelipeds, unequal, small compared to walking legs, merus armed with longitudinal series of short spines, terminal spine of anterior border prominent, carpus and propodus armed with 10-12 spinules on upper surface, fingers long, excavated internally. Walking legs, long, very thin, merus armed with 12-13 spines on anterior border, carpus has two very long spines, one proximal and the other distal, propodus markedly long and thin, armed with numerous spinules, dactyl has several spinules. Last pair of legs reduced and tucked into the gill chambers. Abdomen of six segments plus telson in both sexes, symmetrical in males asymmetrical in females. Second segment consists of three plates, third to fifth segments are replaced by a median membranous portion which is marked with 37-38 tubercles arranged in transverse lines. Female abdomen has about ten marginal plates on the right side while the male has about ten marginal plates on both sides. Uropods absent. Rudimentary pleopods on the first abdominal segment and single pleopods on the left side of the next four segments in females, but pleopods absent in males.

Colour

Deep red.

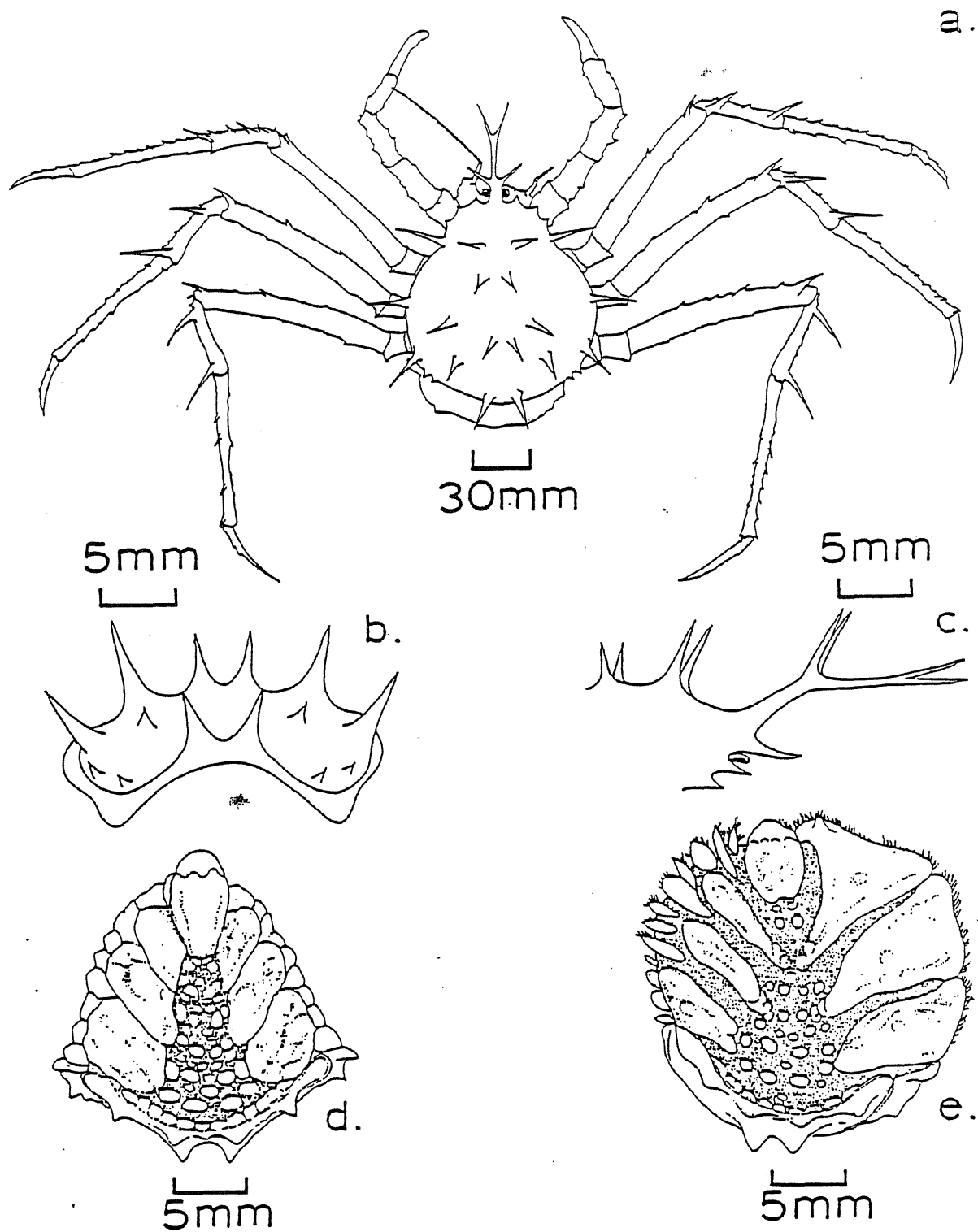


Fig. 2 - *Lithodes longispina*: a - female, dorsal view (by J. Black, based on a photo from Sakai, 1971); b - profile of carapace, posterior view; c - lateral view of rostrum; d - male abdomen, ventral view; e - female abdomen, ventral view (after Sakai, 1971).

Size

Male 98mm CW, 169mm CL (incl. rostrum).

Habitat

Deep water soft bottoms.

Depth

600-865m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown. Refer to L.murrayi where these aspects of lithodid biology are discussed.

References

Dawson & Yaldwyn (1985), Sakai (1971a), Takeda (1974).

ANOMURA

LITHODIDAE

Neolithodes brodiei Dawson & Yaldwyn, 1970Synonymy

Neolithodes brodiei Dawson & Yaldwyn, 1970; Webb, 1972; Dawson & Yaldwyn, 1985.

Type Locality

Campbell Plateau, 50°58'S, 173°57'E, 832m.

Distribution

South-eastern Australia, New Zealand. Within N.Z., off Wairarapa coast, south of Solander Island, Campbell Plateau.

Diagnosis (Fig.3)

Carapace broadly pyriform ('pear shaped'), much longer (including rostrum) than wide, regions well defined and armed with many small spines. Rostrum simple, directed upward with a pair of small spines at its base immediately behind and to the side of the pair of strong, obliquely-projecting basal spines. Major spines on the carapace are four gastric, two cardiac and about ten branchial spines. The eyes are close together, freely movable, cornea ventral. On a lower level are the antennules with the long antennae nearby. Spine (i.e. acicle) on outer border of second joint of antennal peduncle is rudimentary. There is a strong spine external to the ocular peduncle and the antero-lateral border is armed with three spines. Postero-lateral border broadly convex, armed with about 15 marginal spines. Chelipeds unequal, small compared to walking legs, armed with numerous spines, fingers long, curved inward, excavated internally. Differences in dentition indicate that the chelipeds are clearly differentiated into a 'crusher' and 'cutter'. The larger right cheliped has three interlocking, stout, conical proximal teeth with scissor-like margins for the distal third. The left cheliped has minute proximal teeth but most of the margins form a scissor-like edge. Walking legs long, flattened and with numerous small spines on the dorsal surface. Dactyls without teeth on the ventral margin, long, narrowing and thorn-like with acute tips. Last pair of legs reduced and located in gill chambers. Abdomen of six segments plus telson in both sexes, symmetrical in males, asymmetrical in females. Covered with many small, strongly pointed, closely packed spines. First segment with a calcareous spinous plate, remaining segments defined but without calcareous plates. Second segment composed of five pieces separated by sutures. Third to fifth segments with calcified nodules and no membranous area. In female, lateral plates on left side enlarged. A pair of rudimentary pleopods on the first segment and single pleopods on the left side of the next four segments in females but pleopods absent in males. Uropods absent in both sexes.

Colour

Red.

Size

Female (ovigerous) 112mm CW, 131mm CL (incl. spines).

a.

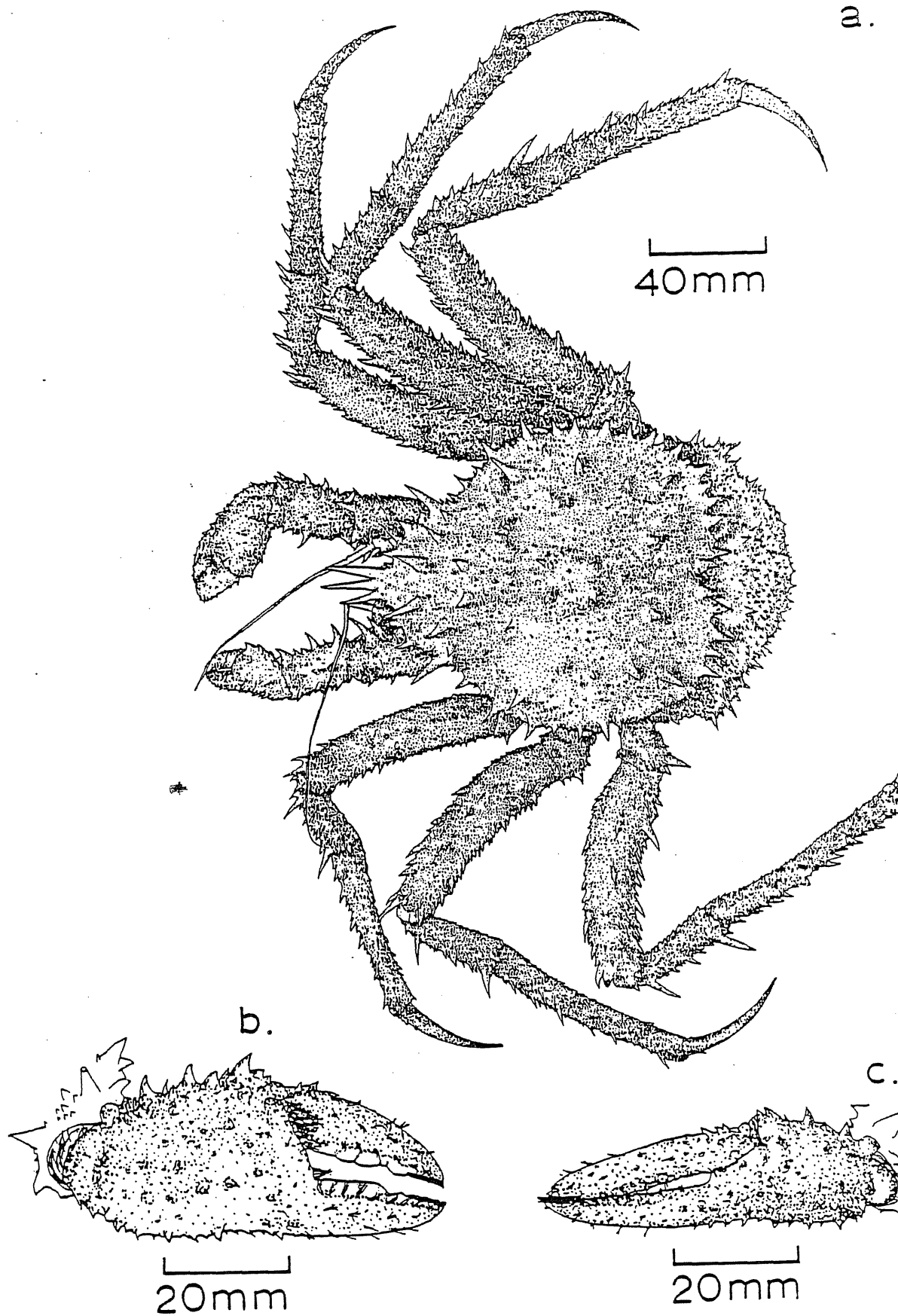


Fig. 3. - *Neolithodes brodiei*: a - dorsal view, female; b - outer face right cheliped, female; c - outer face left cheliped, female (by J. Black).

Habitat

Globigerina ooze, grey mud.

Depth

798-1120m.

Breeding

Webb (1972) collected an ovigerous female in February south of Solander Island but did not report any details except that the eggs were black. The ovigerous female reported by Dawson & Yaldwyn (1970) was collected in January from the Campbell Plateau. A female (CW = 107mm) collected from Hawke Bay in June was carrying a clutch of 4-5000 eggs with larval eye spots evident and the eggs had a diameter of 3.7mm. This would suggest that Neolithodes brodiei has large eggs and low fecundity to an even higher degree than Lithodes murrayi.

Development and Growth

According to Konishi (1986) larval development has not been studied in any Neolithodes spp. The large egg size reported above may indicate that N.brodiei has abbreviated development.

Behaviour, Ecology

Unknown. N.brodiei is the commonest lithodid found around New Zealand and may have considerable commercial possibilities (E. Dawson pers. comm.). Refer to Lithodes murrayi where lithodid behaviour and ecology is discussed.

References

Dawson & Yaldwyn (1970, 1985), Webb (1972).

Paralomis zelandica Dawson & Yaldwyn, 1971SynonymyParalomis zelandica Dawson & Yaldwyn, 1971; 1985.Type Locality

Chatham Rise, 44°18'S, 174°31'E, 640m.

Distribution

South and central eastern New Zealand.

Lithodid crabs are extraordinarily variable from place to place and adults often look very different from juveniles. I think that P. zelandica may well prove to be simply an adult P. hystrix but a full range of sizes of each supposed species needs to be examined.

Diagnosis (Fig. 4a)

Carapace broadly pyriform ('pear-shaped') width greatly exceeding length, numerous, subequal, conical, bluntly-pointed, short spines. Rostrum simple, acute, with two pairs of dorsolateral spines and an unpaired dorsal median spine at its base; ventral edge with a distinct swollen median lobe bearing several small flat tubercles laterally. The eyes are close together, freely movable, cornea ventral. On a lower level are the antennules with the antennae nearby. Outer border of second joint of antennal peduncle has an acicle which consists of two long lateral spines, a single, shorter, terminal spine and two still shorter median spines. External orbital spine strong, acute and larger than any other spine on hepatic margin. Postero-lateral border broadly rounded and armed with about 15 small marginal spines. Chelipeds unequal, similar in size to walking legs, armed with numerous spines, especially on inner margins of merus and carpus. Fingers short, stout and covered with numerous bunches of short setae. Walking legs stout, strongly-spined. Last pair of legs reduced and located in the gill chambers. Abdomen of six segments plus telson in both sexes, symmetrical in males, asymmetrical in females. Covered with many small, strongly pointed spines. Second segment entire, unpaired median plate and paired lateral and marginal plates fused together. Median plate of segments 3-5 entire, lateral plates distinct. Marginal plates present on right side only in females and on both sides in males. Females have a pair of rudimentary pleopods on the first segment and single pleopods on the left side of the next four segments. Pleopods absent in males, uropods absent in both sexes.

Colour

Creamy-white with pink spines.

Size

Male 127mm CW (incl. spines), 111mm CL (incl. rostrum).

Habitat

Fine sandy mud.

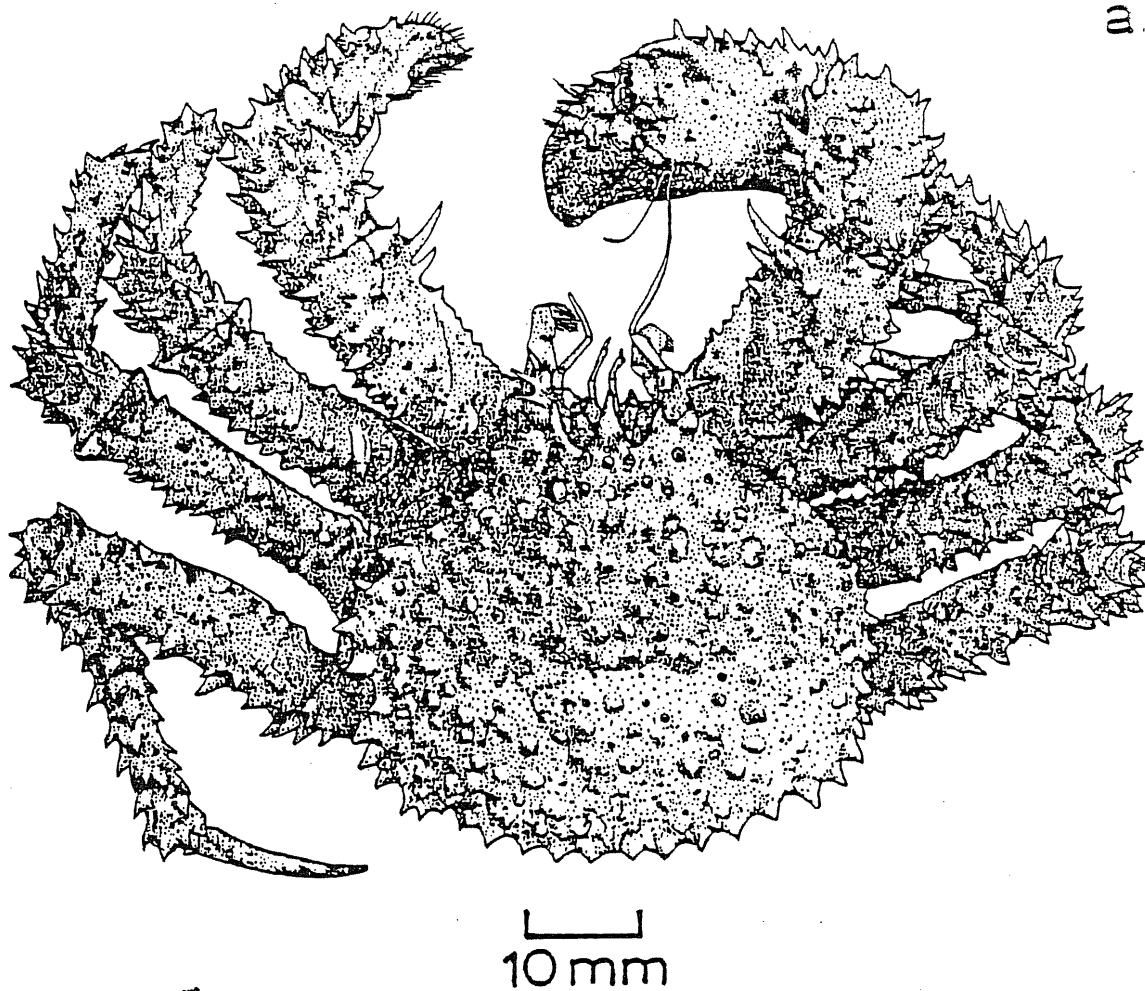


Fig. 4 - Paralomis zelandica: a - male, dorsal view (by J. Black, based on a photo from Dawson & Yalwyn, 1971).

Depth

640m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown. See Lithodes murrayi for discussion of these aspects of lithodid crabs.

References

Dawson & Yaldwyn (1971), Haig (1974), Sakai (1971a), Takeda (1974).

Note

A further undescribed species of Paralomis has been collected off East Cape (E. Dawson pers. comm.).

Paralomis hystrix (De Haan, 1849)Synonymy

Lithodes hystrix De Haan, 1849; Acantholithus hystrix Stimpson, 1858; Paralomis hystrix Ortmann, 1892a; Acantholithus hystrix Bouvier, 1894; 1896; Doflein, 1902; 1906; Balss, 1913; Yokoya, 1933; Miyake, 1965; Paralomis hystrix Sakai, 1971a; Acantholithus hystrix Dawson & Yaldwyn, 1985.

Type Locality

Japan

Distribution

Japan and (?) New Zealand.

Diagnosis (Fig. 5a)

Carapace broadly pyriform ('pear shaped'), length slightly greater than width, covered with numerous long, sharply pointed spines. Rostrum simple, acute, curving upwards, two pairs of dorsolateral spines and an unpaired dorsal median spine at its base; ventral edge bearing a few spinules. The eyes are close together, freely movable, cornea ventral. On a lower level are the antennules with the antennae nearby. Acicle of antenna (on second joint of peduncle) composed of four very long spines and one or two tiny spinules. Eye stalks armed with a few tiny spinules and a terminal spine. External orbital spine long, acute, hepatic margin bearing 6-7 acute spines of varying size. Postero-lateral border broadly rounded and armed with about 22-24 long, sharp spines. Chelipeds unequal, similar in size to walking legs, armed with numerous sharp spines, those on inner margins of merus and carpus are especially long. Fingers short, stout and covered with numerous bunches of short setae. Chelipeds clearly differentiated into a 'crusher' and 'cutter'. The larger right cheliped has three conical, interlocking proximal teeth and scissor-like cutting tips for one-fifth of length. Left cheliped has cutting edges. Walking legs, stout, bearing long, acute spines, last pair of legs reduced and tucked into the gill chambers. Dactyls of walking legs have a row of 7-8 tiny spines along the ventral margin. Abdomen of six segments plus telson in both sexes, symmetrical in males, asymmetrical females. Densely covered with many long, acute spines. First abdominal segment calcareous, rest soft. Second segment entire, plates fused. Median plate of segments 3-5 entire, lateral plates distinct. Marginal plates present on right side only in females and on both sides in males. Females have a pair of rudimentary pleopods on the first segment and single pleopods on the left side of the next four segments. Pleopods absent in males, uropods absent in both sexes.

Colour

Deep red-orange.

Size

Male 114mm CW, 126mm CL (incl. spines).

Habitat

Continental shelf.

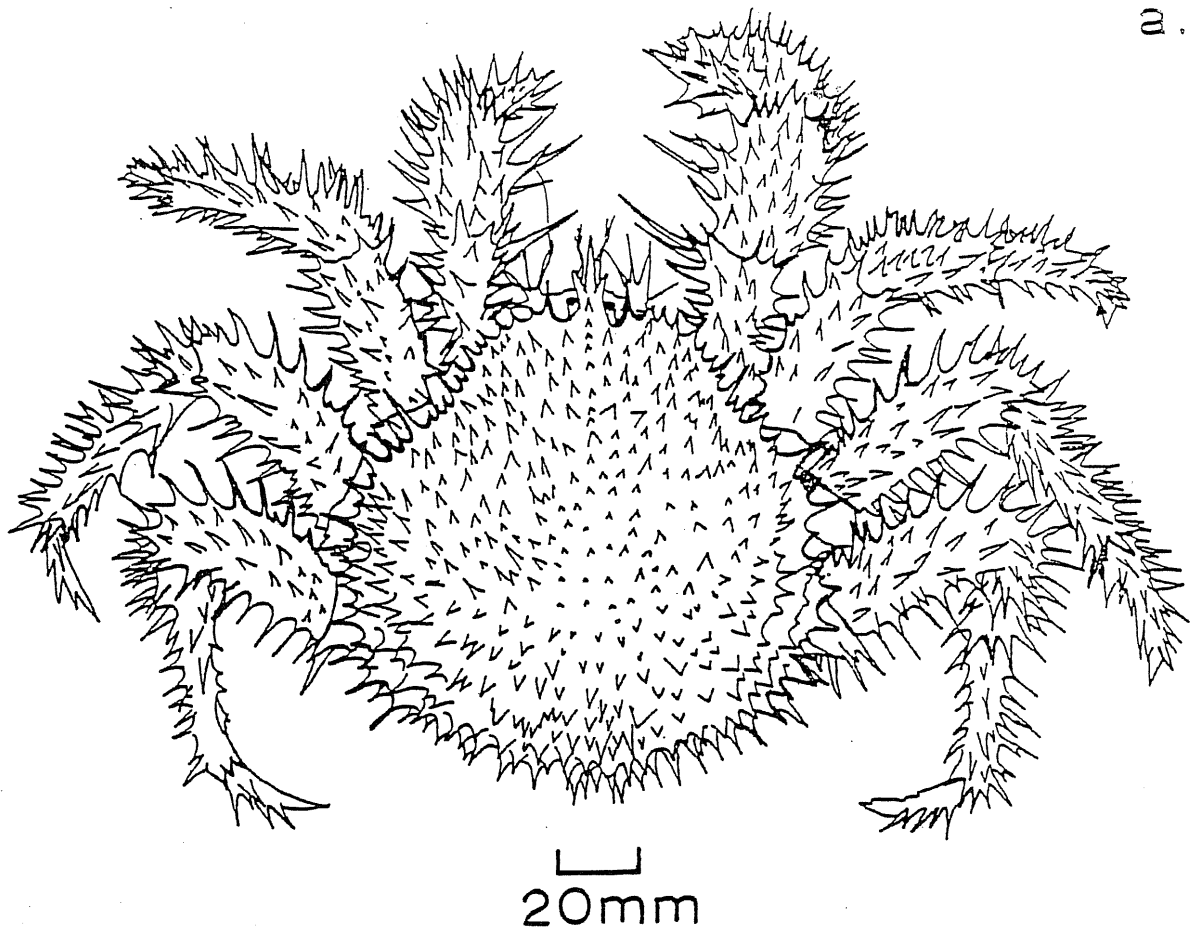


Fig. 5 - Paralomis hystrix: a - male, dorsal view (by C. Duffy, based on a photo from Sakai, 1971).

Depth

150-600m.

Breeding

Unknown. Ovigerous Paralomis granulosa from southern Chile have been collected in November, when the eggs also began to hatch (Campodonico & Guzman 1981).

Development and Growth

Unknown. Development of Paralomis granulosa is very abbreviated both in number of stages (two zoea plus megalopa) as well as duration (about 10-12 days at 11°C) (Campodonico & Guzman, 1981). Lithodes maja is the only other lithodid known to have only two zoeal stages (MacDonald et al. 1957). Campodonico & Guzman (1981) reared larvae of P. granulosa with and without Artemia as food and while larvae in both groups produced megalopae, survival was seriously reduced in the absence of food. The presence of yolk reserves in all larvae and its gradual decrease as development proceeds, indicates that both zoeae and megalopae are to some extent lecithotrophic but additional food is probably normally required.

Behaviour, Ecology

Unknown. Refer to Lithodes murrayi for discussion of the aspects of lithodid biology.

References

Campodonico (1977, 1980), Campodonico & Guzman (1981), Dawson & Yaldwyn (1985), Sakai (1971a).

Porcellanopagurus edwardsi Filhol, 1885Synonymy

Porcellanopagurus edwardsi Filhol, 1885; Thomson, 1898; Alcock, 1905; Chilton, 1909; Stephensen, 1927; Thompson, 1930; Balss, 1930; Bennett, 1932; Forest, 1951; Roberts, 1972a; 1972b; Yaldwyn, 1975; Fenwick, 1978; Takeda, 1981; Wear, 1985.

Type Locality

Campbell Island.

Distribution

Kaikoura Peninsula, Stewart Island, Campbell Island, Auckland Island, Snares Island.

Diagnosis (Fig. 6a-d)

Carapace finely granulated produced anteriorly as a blunt rostrum wide at its base and slightly convex on the sides. Antennules about twice as long as eyestalks, antennae are very long and slender. Upper margin of orbit is smooth and the eyestalks extend a little beyond the tip of the rostrum. The eyestalks are of uniform width along their length and the cornea is not bulbous. Four antero-lateral teeth, including the post-orbital. A strong post-orbital tooth at the outer angle of the orbit, followed by two equidistant, blunt, antero-laterally directed teeth and a blunt, postero-laterally directed tooth at the posterior corner, marking the greatest width of the carapace. In addition there may be secondary teeth in front and behind the second antero-lateral tooth. In juveniles the secondary teeth are absent. Chelipeds well developed with the right one much larger than the left. Merus triangular, widening distally, carpus about as broad as long, marked on the upper surface with transverse lines of setae arranged in short curves, propodus flattened, about as long as the carapace is wide, considerably wider than carpus, margins spinose. Whole surface of propodus bears scattered tufts of short setae which also occur on the dactyl. Fingers of right cheliped with well developed blunt teeth, with tufts of setae between the bases of them. Propodus of left cheliped much smaller, narrower than carpus, fingers slender, inner margins straight and fitting close together without teeth. The right cheliped appears to be a "crusher" while the left is a "handler" of food. First two pairs of legs well developed, finely granulose, margins spinose, with well-developed dactyls ending in a hooked claw. Last two pairs of legs reduced, propodus of the sub-chelate third leg has a narrow band of pegs on its posterior margin. Fourth leg smaller, propodus has a broad band of pegs on its anterior border, extending on to the dactyl. The last two pairs of legs are probably used to support and manipulate the bivalve shell carried by the crab. Abdomen is straight, very short, soft and with well developed uropods which grasp the bivalve shell under its hinge-line. The uropods are symmetrical, flattened and bear well-developed rasps on the dorsal surface. The rasps consist of distally-directed, broad, over-lapping plate-like pegs. The telson is soft, rounded and with a small notch in the posterior margin. Female pleopods are sub-dorsal in position rather than lateral as in other hermit crabs.

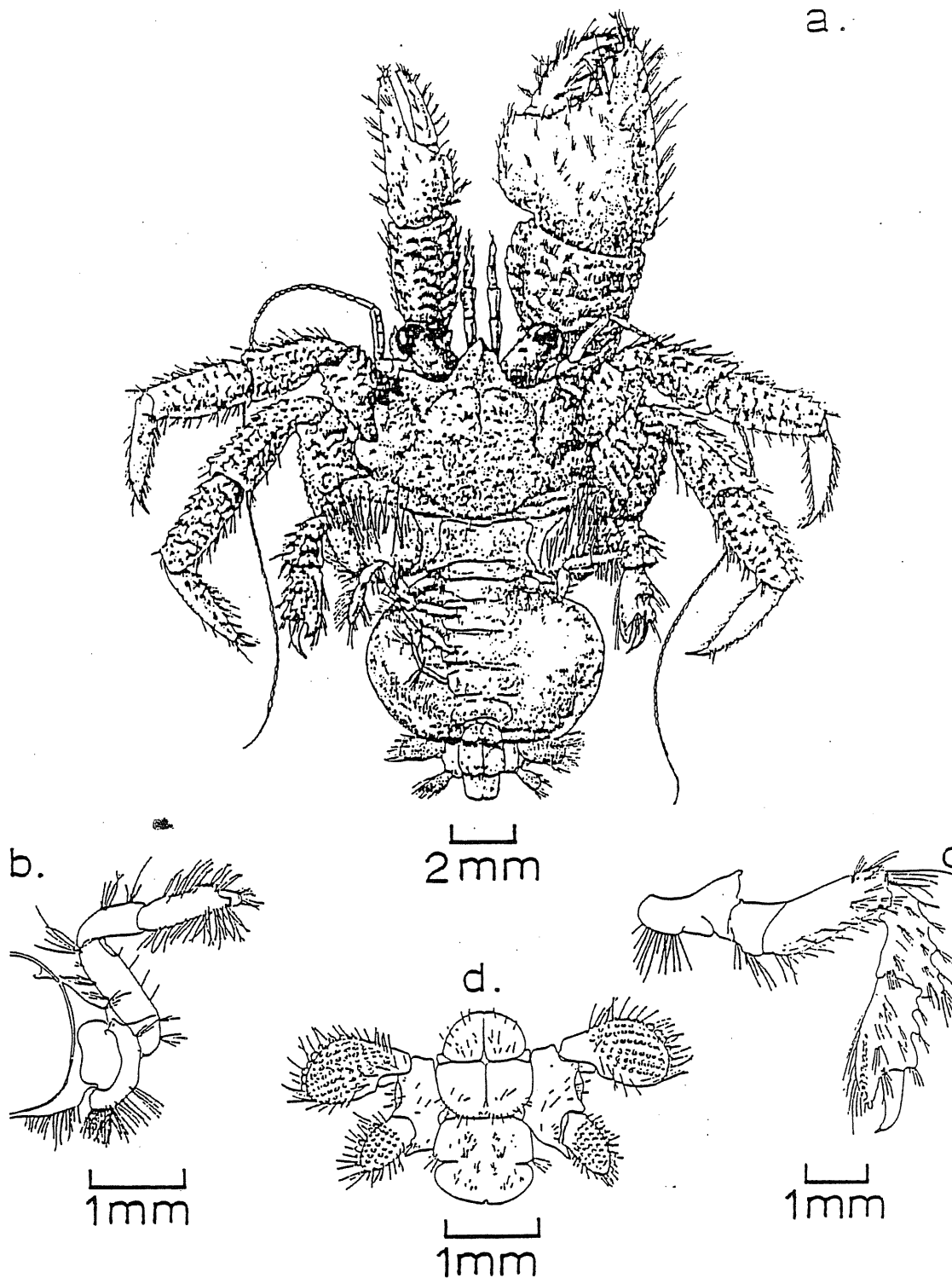


Fig. 6 - *Porcellanopagurus edwardsi*: a - male, dorsal view; b - right 4th leg, dorsal view; c - right 3rd leg, dorsal view; d - posterior region of abdomen, dorsal view (modified after Forest, 1951).

Colour

Body and limbs orange, cornea of eye green, antennules light purple, antennae barred orange and white. Distal half of propodal segments on first two pairs of legs white, proximal half orange.

Size

Male 24.8mm CW. Female 18.6mm CW.

Habitat

On sand and rocks, among algae and shells.

Depth

Shallow subtidal (in subantarctic waters) to 150m.

Breeding

Ovigerous females have been collected at Campbell Is. in March, April, May, July and October. Zoea larvae have been collected from plankton in October, November and February (Roberts 1972b). Roberts reared larvae from the female collected in April which had eggs ready to hatch so presumably larvae could be expected in the plankton much later than February. The female (16.8mm CW) collected in May had (?) 2000 new eggs 0.75mm diameter. To have produced larvae in the summer months the crabs must have carried eggs through the winter and since the female collected in April had mature eggs it seems likely that ovigerous females probably occur in summer as well. It is likely that females may carry a brood of eggs for long periods because embryonic development would be slow in these cold waters. Therefore females may only produce a single large brood per year.

Development and Growth

Roberts (1972a) has thoroughly described the four zoeal stages of P.edwardsi but he did not indicate how long each stage of development required. Small numbers of larvae occurred in the plankton in October, November (peak) and February at Campbell Island.

Behaviour

P.edwardsi is unusual among hermit crabs in using single bivalve shells or shells of univalve gastropods for protection. These shells hardly protect the crab from predators because they usually only cover the rear half. When the female is carrying a brood of eggs these are concealed because the pleopods to which the eggs are attached are sub-dorsally positioned. However, males also carry shells and it is difficult to imagine what value the shell is apart from its obvious camouflage function. Bivalve shells such as Leptomya aucklandica, Genaximus otagoensis, Chlamys delicatula, Venerupis largillierti and Kidderia campbellica, are grasped by the rasp-like uropods which are inserted under the hinge-line and the third pair of legs are probably used to grasp the shell margin and prevent loss of the shell. Some gastropod shells such as Sigapatella novaezelandiae, Haliotis virginea and Margarella antipoda are also used.

Nothing is known about the behaviour of this hermit crab but it seems unlikely that shell-exchange behaviours common in gastropod-shell users would be well developed. Bivalve shells

are unlikely to be in short supply and besides P.edwardsi often uses damaged shells. The only requirement seems to be that the hinge-line should be intact.

Ecology

Nothing is known about feeding behaviour but the dimorphic chelipeds suggest that P.edwardsi may well be a predator of hard-shelled prey with the right cheliped used to break them open.

References

Bennett (1932), Chilton (1909), Forest (1951), Roberts (1972a, 1972b).

Petrolisthes elongatus (H. Milne Edwards, 1837)
Blue False Crab

Synonymy

Porcellana elongata H. Milne Edwards, 1837; White, 1843;
Petrolisthes (Petrolisthes) elongatus Miers 1874; 1876b;
Porcellana rupicola Kirk, 1878; Petrolisthes elongatus Thomson,
 1898; Oliver, 1923; Young, 1929; Bennett 1930; 1932; Trevarthen &
 Kulka, 1950; Trevarthen, 1951; Batham, 1956; 1958; Dell, 1963a;
 Bennett, 1964; Wear, 1964b; 1965b; Batham, 1965; Greenwood, 1965;
 Hayward, 1974; Jones M.B., 1976; 1977; Knox, Bolton & Hackwell,
 1977; Marsden & Fenwick, 1978; Knox & Bolton, 1978; Knox &
 Fenwick, 1978a; Marsden, 1981; Jones, 1983; Knox, 1983b.

Type Locality

New Zealand

Distribution

Tasmania and New Zealand. Found very widely around the
 coasts of North, South and Stewart Island also Auckland Islands.
P. elongatus may have been introduced by man to Tasmania in among
 oysters (see Halicarcinus inominatus).

Diagnosis (Fig. 7a-c)

Carapace flattened, smooth, oval-shaped, truncated
 posteriorly, longer than wide (ratio approx. 1.1). Margins
 without teeth, regions not well defined. Posterior margin
 concave. Antennae longer than CL, rostrum short but extending
 beyond eyes, blunt, broad, deflexed, dorsal surface concave. Eyes
 large and prominent, cannot be withdrawn into orbits.
 Post-orbital corner a clear-cut right angle. Third maxillipeds
 very large, covering the whole buccal area and extending forward
 to the tip of rostrum. Maxilliped palps well developed and
 bearing long setae which are used for filter feeding. Outer
 margin of carpal segment not denticulate. Chelipeds very large,
 flattened, especially carpus and propodus. There are three small,
 sharp, distal spines on the outer margin of the carpus and a
 single, small proximal spine on the inner margin. Propodus
 broadest at the base of dactyl (movable finger), fingers
 tapering, without teeth but minutely granulate and occluding
 along their entire length. Tips of fingers strongly curved,
 blunt, crossing. Legs much shorter than chelipeds, only three
 pairs visible, meri laterally flattened, remaining segments
 setose, propodus with three or four short spines ventrally,
 dactyl short and strongly curved. Last pair of legs setose but
 without spines, reduced, folded and partially concealed under the
 abdominal flap. Abdomen of six segments, broadly developed, two
 or three segments visible dorsally, telson divided into seven
 plates and surrounded laterally by large uropods. Both telson and
 uropods setose. Spines on the chelipeds and legs are variable in
 development and position. They may be easily broken off by wear
 and tear.

Colour

Variable colouration from black, blue, greyish, greenish or
 even pinkish. Antennules dark brown proximally, bright red-orange
 tips, antennae dark brown. Dorsal surface of chelipeds and legs

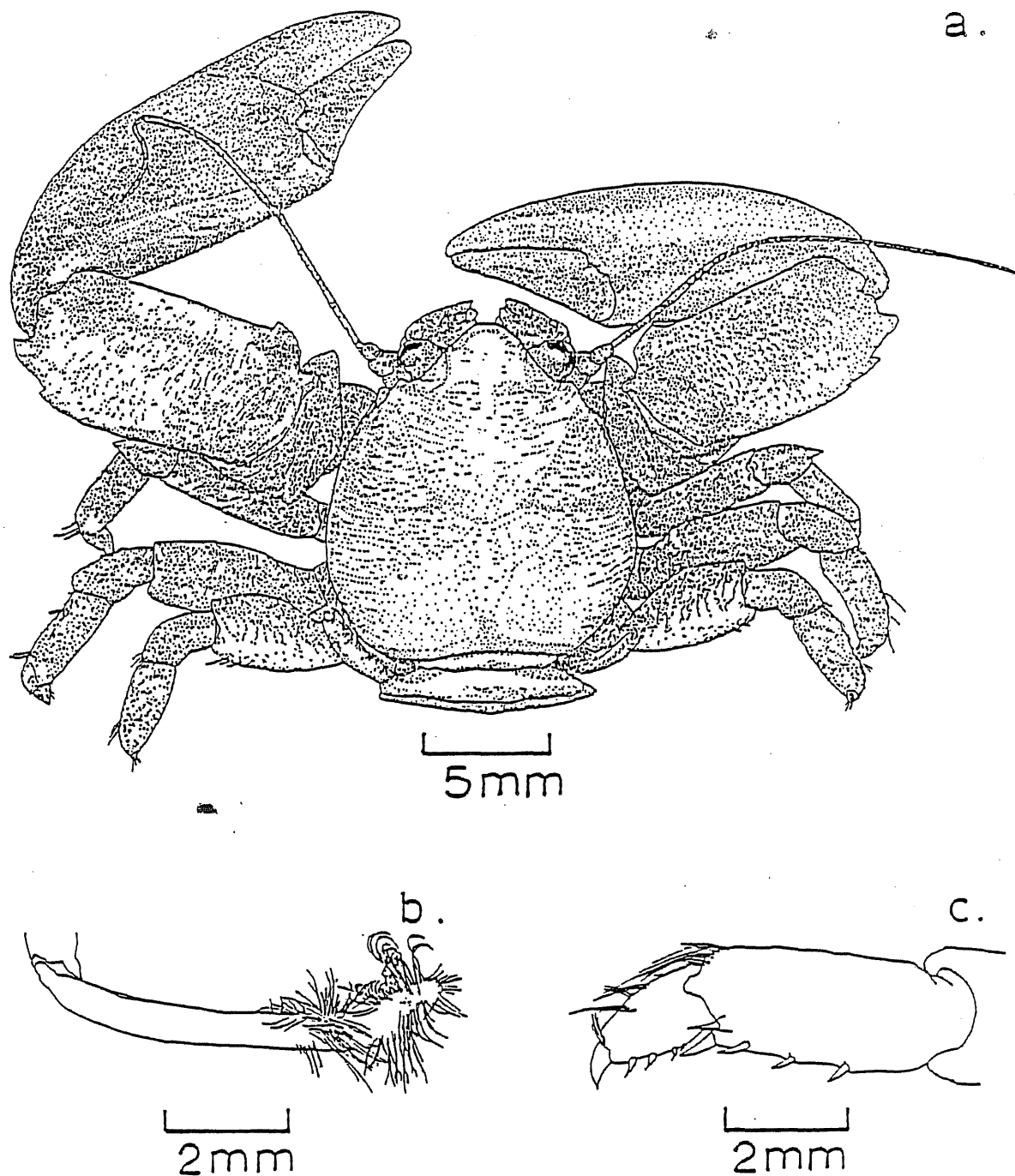


Fig. 7 - *Petrolisthes elongatus*: a - male, dorsal view;
 b - distal region, left 4th leg; c - distal segments
 left 2nd walking leg (by J. Black).

same as carapace, ventral surfaces lighter (white, yellow, blue-green).

Size

Female CL 16mm, male CL 16.5mm.

Habitat

An extremely gregarious crab found beneath boulders in the intertidal region, sheltering in beds of large mussels on rocky coasts and on wharf piles, and extending into estuaries.

Depth

Upper littoral down to just below low tide.

Breeding

Studies at Auckland, Wellington, Kaikoura and Christchurch suggest that the breeding biology of P. elongatus varies from north to south (Greenwood 1965, Wear 1965b, Jones 1977, Scott 1958).

At Auckland Greenwood (1965) found that ovigerous females were present throughout the year (2.3-17% of females) with the greatest proportion ovigerous in October. Planktonic zoeae are also found in all months. Females mature at 8.1mm CL and probably produce more than one brood per year although this has not been verified. Eggs are initially dark rust-red in colour, but fade during development as yolk is used. Later eggs are light brown with green and gold patches and measure 0.65 x 0.3mm. Egg numbers increase logarithmically with CL.

At Wellington Wear (1965b) found that the sex ratio is biased in favour of females in most months. Females are sexually mature at 8.5 mm CL when they carry approx. 200 eggs. The relationship between number of eggs and female CL is logarithmic and at 16 mm CL females carry from 1500-1750 eggs. Egg laying begins in July and by September about 90% of females are ovigerous. New eggs are reddish-purple and measure 0.65 x 0.4mm but close to hatching they are reddish, semi-transparent and measure 1.0 x .75mm. By February and March few females are ovigerous and all these have eye-pigmented eggs. In late September a few first-stage larvae appear in the plankton indicating that incubation is from 6-8 weeks. Females with late stage eggs have their ovaries gravid with the next batch of eggs and at least 2 broods are laid annually by each female. Larvae are most abundant in the plankton during January and February and are not found after March.

At Kaikoura Jones (1977) found that the sex ratio fluctuated widely with no seasonal pattern but females generally outnumbered males. Ovigerous females were first found in October (although Morgans 1967 recorded some in August), increasing until January (68%). At the start of breeding females were predominantly large (8-10mm CL) with smaller females breeding in December and January. Ovigerous females were absent after March. Indirect evidence of male sexual maturity (presence of spermatophore ribbons extending from the male genital opening near the base of the last walking leg) showed that 4.9mm - 16.5mm CL males extruded spermatophores in most months except June and July. Females with stage 1 eggs were found from October to January but

females with stage 4 eggs did not appear until January suggesting that P.elongatus at Kaikoura has only 1 brood per year. Each female may have 2 or perhaps 3 broods over her lifespan. Brood size increased logarithmically with female CL, at 5.5mm they carried about 70 eggs and at 14mm, 930 eggs. Therefore each female may produce from 500 eggs (2 broods) to 1000 eggs (3 broods). During incubation there was a 15.2% mortality probably due to egg loss, failure to develop and disease.

At Christchurch Scott (1958) recorded ovigerous females at the end of August but some females have eggs developing in the ovaries as early as May. In August ovaries contain both mature eggs ready to be laid as well as immature eggs for the second brood. Egg-laying continued until mid-December and 1 female laid a second brood 3 weeks after the first brood hatched without an intervening moult. Other females moulted as soon as the first brood hatched. Newly laid eggs measured 0.6mm and were dark red. Ovigerous females were most frequent in November (41%) and were collected until February. Regular exposure to air during each low tide and higher air temperatures may be important in ensuring egg development since ovigerous females kept in aquaria do not successfully produce larvae. Egg hatching began about mid-November and continued until February. During March-August 1982, zoea of P.elongatus were rarely found in plankton from the Avon Heathcote Estuary (Roper, Simons and Jones 1983).

Further south at Stewart Island ovigerous females have been collected in November and December but no systematic sampling has been undertaken to define the breeding season (Jones 1977).

In summary the breeding season of P.elongatus decreases from 12 months at Auckland to 9 months at Wellington and 6 months at Kaikoura. Females seem to mature at a smaller size at Kaikoura than at Wellington or Auckland and larger (>12mm CL) females seem to have smaller numbers of eggs per brood. But small females are the reverse and have larger brood sizes. Egg size does not appear to be correlated with latitude but whereas incubation at Wellington was 6-8 weeks, at Kaikoura incubation was of the order of 3 months. It would appear that temperature differences from north to south are probably responsible for differences in life history between localities. However it is necessary to conduct a thorough experimental study of the effects of temperature on adult growth rates, gonad maturation, incubation and time of larval development to test this hypothesis.

Development and Growth

Porcellanid zoeae are elongate, characterized by very long, tapering rostral and posterior carapace spines. The telson is triangular with a convex posterior margin bearing several processes. There are 5 free abdominal somites and no uropods. Only first and second maxillipeds functional, pereopods small, non-functional, 3 or 4 pairs of pleopods in later stages (Greenwood 1965).

Five zoeal stages are possible in P.elongatus but only 3 and occasionally 4 zoeal stages are passed through in reaching the megalopa stage. Wear (1964b, 1965b) and Greenwood (1965) have described the pre-zoea and larval development in this species. During the day zoeae are not found in surface plankton. The

megalopae can survive for long periods but are probably only planktonic until suitable benthic habitat is found. Kingsford & Choat (1985) found large numbers of megalopae, attributed to the genus "Petrolisthes", associated with clumps of drifting algae off the coast of Leigh in December. The occurrence of floating algae and its pattern of movement will clearly have an effect on recruitment to shore populations.

Behaviour

P.elongatus has two distinct kinds of feeding mechanism, macrophagy and filter feeding. Scott (1958) found that pieces of Pomatoceros worms were conveyed to the mouth where they were shredded by the second maxilliped and sliced in a scissor-like fashion by the mandibles. However most food consists of fine organic particles filtered from the water by the long setae on the third maxillipeds. Right and left maxillipeds sweep alternately and as they approach the mouth the exhalent respiratory current aids in rejection of unwanted mud particles and sand grains. As the third maxilliped begins to unfold for the next stroke the terminal setae of the second maxillipeds are passed through them, combing out the particles which are passed on to the maxillae. The maxillae move from side to side in sympathy with movements of the scaphognathites. This results in food being passed back towards the mandibles. Water is drawn towards the crab and the antennules (chemoreceptive or tactile in function) are extended into the water current and flicked about. The third maxillipeds may also occasionally sweep the substrate and pick up pieces of algae and utilize bottom deposits.

Agonistic interactions of P.elongatus have not been studied but work by Molenock (1976) on 4 species of Californian Petrolisthes which also live in dense aggregations suggest some things to look for. In these species the long antennae and enlarged chelae are used extensively in agonistic (and also sexual) interactions which preserve individual space and serve a social bonding and exploratory function. Interactions of Petrolisthes involve little forceful physical contact and none of the agonistic acts seemed to be derived from filter feeding activities (cf. sexual behaviour, below).

When attempting to escape P.elongatus will readily autotomize their chelae and limbs. Scott (1958) found that the percentage of the population at Christchurch regenerating one or more limbs (chelae or legs) varied from 10% (sheltered sites) to 40% (exposed sites), mean 26%. Most of the limb losses involved chelipeds (48%) with first (15%), second (16%) and third (21%) walking leg losses being less frequent. Loss of limbs seems to have little effect upon locomotory efficiency. Escape is also aided by the use of the large abdominal flap which allows the crab to swim backwards (like a crayfish). The flattened body and legs allow P.elongatus to escape into crevices between rocks.

Mating behaviour of P.elongatus has not been observed but involves transfer of spermatophores from the male to the female. The female aerates her eggs by flexing the abdomen and thrusts the reduced last pair of legs into the egg mass to remove debris.

The study of 4 Californian species of Petrolisthes, (P.manimaculis, P.eriomerus, P.cinctipes, P.cabrilloi) by Molenock (1975) gives some clues about the nature of courtship and mating of New Zealand Petrolisthes. In the laboratory P.manimaculis defended a small territory (7cm diam.) within which the female moved freely, but protected by the male. The female frequently rested just in front of the male, making short excursions, during which she stretched her appendages and performed grooming movements, apparently in preparation for the moult. Courtship often lasted several hours and during this time the male often oscillated his bright blue third maxillipeds. This was not a part of feeding because they were not drawn into the mouth. About 30min. after moulting the soft female was tapped and manoeuvred by the male using his legs so that their sterna were juxtaposed with the male underneath. But copulations also occurred with the male on top or with the pair perpendicular. The male was usually larger than the female. Copulation was usually completed within 60sec. The females deposited eggs on their pleopods within a few hours of copulation. P.manimaculis males also copulated with hard females, without prior courtship, but these females did not deposit eggs. Courtship and copulation of P.eriomerus were extremely similar to that of P.manimaculis, but the remaining 2 species were quite different. P.cinctipes males only copulated with hard females and within the territory defended 1-4 female crabs. Territories were held for 2-21 days but sometimes small males were able to sneak in and mate with the females. Courtship interactions were brief. There were no maxilliped oscillations by males but approaches were made with chelae hunches, rocks and nudges. Females moved back and forth, turning and grooming in the vicinity of the male, resembling the pre-moult movements of P.manimaculis and P.eriomerus females even though no moult occurred before copulation. About an hour after copulation the female deposited her eggs. Courtship and mating by P.cabrilloi was similar to P.cinctipes but males copulated with both hard and soft females with little or no preliminary exchanges. Considering the need for reproductive isolation there is a surprising degree of similarity in the behavioural acts of some of these species. A comparison of the behaviour of the New Zealand species would be interesting because they are spatially separated.

Ecology

At Kaikoura juvenile (<4mm CL) P.elongatus were present in every month (Jones 1977), small juveniles (<2mm CL) began to appear in March (onset of recruitment) and from May to December juveniles were the dominant size class. Numbers of juveniles decreased from October to March as they continued to grow and become either males or females. Large males (>14mm CL) and females (>12mm CL) present from October to March disappeared during April to June probably as a result of mortality. The maximum life span ranged from 12-18 months depending upon season of recruitment. Therefore P. elongatus is comparatively short-lived producing only 2 or 3 broods of eggs.

At Leigh P.elongatus is preyed upon by the black-fingered crab, Ozius truncatus, suckerfish (Diplocrepis puniceus) and rockfish (Acanthoclinus quadridactylus). It is probably eaten by red- and black-billed gulls (Larus novaehollandiae, L.bulleri) and also kingfishers (Halcyon sanctus). Scott (1958) found the

remains of a young P. elongatus in the sea anemone Isocradactis magna, and the wandering sea anemone (Phlyctenactis tuberculosa), the cephalopods Robsonella australis and Octopus maorum will readily attack and eat this crab in the laboratory. Habib (1977) found that the pufferfish (Contusus richiei) in Lyttelton Harbour also eats this crab. Webb (1966, 1973a, 1973b) found that sand flounder (Rhombosolea plebeia), common sole (Peltoramphus novaezealandiae), spotty (Pseudolabrus celidotus), pufferfish, and short finned eels (Anquilla australis) in the Avon Heathcote Estuary ate varying amounts of P. elongatus. Zoeae of this crab are eaten by horse mackerel (Trachurus novaezealandiae), 0.7% of gut volume (Godfriaux 1970a) and also by kahawai (Arripis trutta) in Wellington harbour (Baker 1971). Graham (1939) found that 9 species of fish in Otago Harbour consumed small numbers of Petrolisthes spp. but unfortunately he did not distinguish P. elongatus from P. novaezealandiae.

In the Avon-Heathcote Estuary Jones (1976) found that Petrolisthes elongatus only occurred under silt-free stones and was concentrated in areas with channels of free-flowing sea water. It made up 9.3% of the 6 species collected. Laboratory experiments showed that P. elongatus were photonegative (in both air and water) and preferred stones over both sand and mud. They survived 7 day exposure to 50% sea water, although activity was reduced, but died at 10% and 0%. This species is relatively stenohaline between 18.7-37.4 ppt. Hoskins (1966) found that this crab is an osmo-conformer and does not regulate its haemolymph sodium concentration as the external medium changes. In this estuary P. elongatus is absent from some areas (chiefly at higher levels) where suitable substrates occur. Jones and Greenwood (1982) found that the occurrence of small (mean dry body weight 0.12g) crabs may be controlled by intolerance to desiccation but larger crabs have a significantly slower rate of water loss and should be able to tolerate conditions at these higher shore levels. Absence from stony habitats at high-tidal levels may be related to the requirement of a minimum time of water coverage to feed. One factor that has not been considered is the possible impact of avian predators at these sites.

The relationship between volume and surface area for P. elongatus is given by Pellegrino (1984) who estimated that 70% of crab mass is contained in the pereopods and only 30% in the body. Shanks (1982) compared the effects of aerial exposure on P. elongatus and Cyclograpsus lavauxi and found that P. elongatus has a much faster rate of water loss and a much lower lethal water loss level (25-31%). Time to reach the lethal percentage was 16.8 hours for small crabs and 30.7 hours for large crabs. In the field these crabs live well within these limits because they have only 6-8 hours exposure. Jones (1977) found large crabs higher up the shore than small crabs and Pellegrino (1984) suggested that retreat from higher shore levels in warmer months was due to desiccation stress. Shanks (1982) found that the osmotic concentration of fully hydrated crabs in 100% seawater was higher than the medium but chloride ion concentration was lower than the medium. During desiccation water was lost preferentially from the extracellular compartment. With increasing loss of body water during aerial exposure, the osmotic concentration of the haemolymph increased but changes in the individual ionic components were not the same. Sodium

concentration increased in 2 stages: below 12% body water loss, sodium levels were significantly elevated but above 12% they were as expected, given the amount of water lost. But changes in magnesium ions showed the opposite pattern, suggesting that these changes may be linked to corresponding changes in sodium concentration. Potassium concentration was lower than expected and chloride concentration was higher than expected. Thus P. elongatus is capable of some degree of osmoregulation under aerial conditions. Water content seems to be related to habitat: Pellegrino (1984) estimated 67.6% in crabs from Island Bay, Wellington. Crabs collected from Governor's Bay (a marine site) had a total body water content of 64.3-66% but Jones and Greenwood (1982) found only 60.3% in crabs from the nearby Avon-Heathcote Estuary. However comparably sized crabs from both populations had a similar desiccation resistance.

References

- Bennett (1932), Dell (1963a), Graham (1939), Greenwood (1965), Habib (1977), Hoskins (1966), Jones (1976, 1977, 1983), Jones & Greenwood (1982), Molenock (1975, 1976), Pellegrino (1984), Roper, Simons and Jones (1983), Scott (1958), Shanks (1982), Thomson (1898), Wear (1964b, 1965b), Webb (1966, 1973a, 1973b).

Petrolisthes novaezelandiae Filhol, 1886
Red False Crab

Synonymy

Petrolisthes novaezelandiae Filhol, 1886; Petrolisthes stewarti Filhol, 1886; Petrolisthes novaezelandiae Thomson, 1898; Chilton, 1906a; Bennett 1930; 1932; ?Petrolisthes elongatus Powell, 1937; Petrolisthes novaezelandiae Wear 1964a; 1965c; Fenwick, 1978; Marsden & Fenwick, 1978; Probert et al., 1979.

Type Locality

New Zealand

Distribution

Endemic to New Zealand. From Bay of Islands south to Stewart Island and Auckland Islands.

Diagnosis (Fig. 8a-b)

Carapace flattened, slightly wider than long, covered in fine, short hairs, surface uneven. Antennae much longer than CL. Rostrum, broad based, blunt, projecting well past eyes and with short, stout hairs on the margins. Dorsal surface of rostrum is concave and this depression extends back as a broad frontal groove separating a pair of protuberences on the carapace. These protuberences bear bunches of setae and extending obliquely towards the lateral carapace margin on each side are a further three raised areas, each bearing setae. Third maxillipeds large, with well developed setiferous palps, extending as far forward as the rostrum. Outer margin of carpal segment is denticulate. Eyes short, fat unable to be withdrawn into orbits and with the post-orbital corner produced as a short tooth. Anterolateral margins convex but interrupted by two oblique depressions or notches in the hepatic and branchial regions. Posterior carapace margin concave. Chelae small in female, larger in male, carpus flattened with a central ridge on the outer surface, inner margin with two spines (one proximal, the other midway), outer margin with four approximately equidistant spines, each bearing bunches of long hairs. Chela propodus also flattened, broadest at base of dactyl, strong central ridge, lower margin bearing numerous small spines and fringed with long hairs. Outer surface of fingers each with a central ridge, movable finger with a carinate dorsal border, inner margins of both fingers without teeth, movable finger fitting in behind fixed finger. Fingers variable in length, more slender and elongated than in P. elongatus and may have a narrow gape. Only three pairs of legs visible dorsally, meri laterally compressed. Other segments fringed with bunches of long hairs, dactyli curved and sharp. Fourth pair of legs shortest, sub-dorsal and folded against the posterolateral corner of the carapace and tips inserted under the broad abdominal flap. Telson divided into seven plates, setose and surrounded by well developed uropods.

Colour

Males reddish, females greyish with red spots. Preserved material has white carapace and legs and pale orange chelipeds.

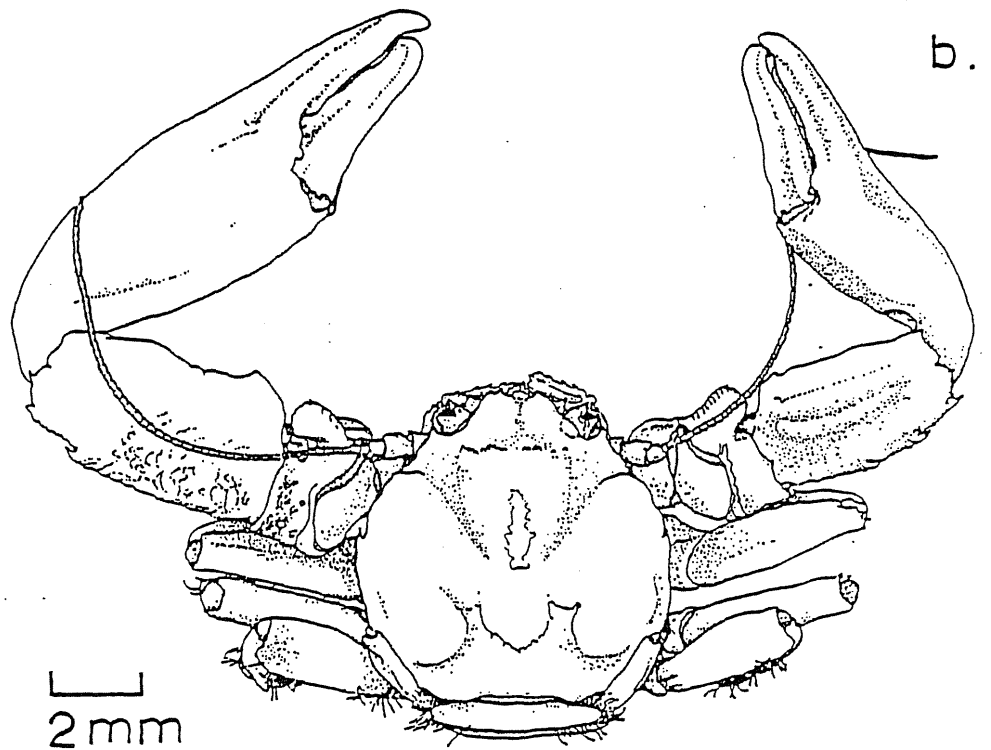
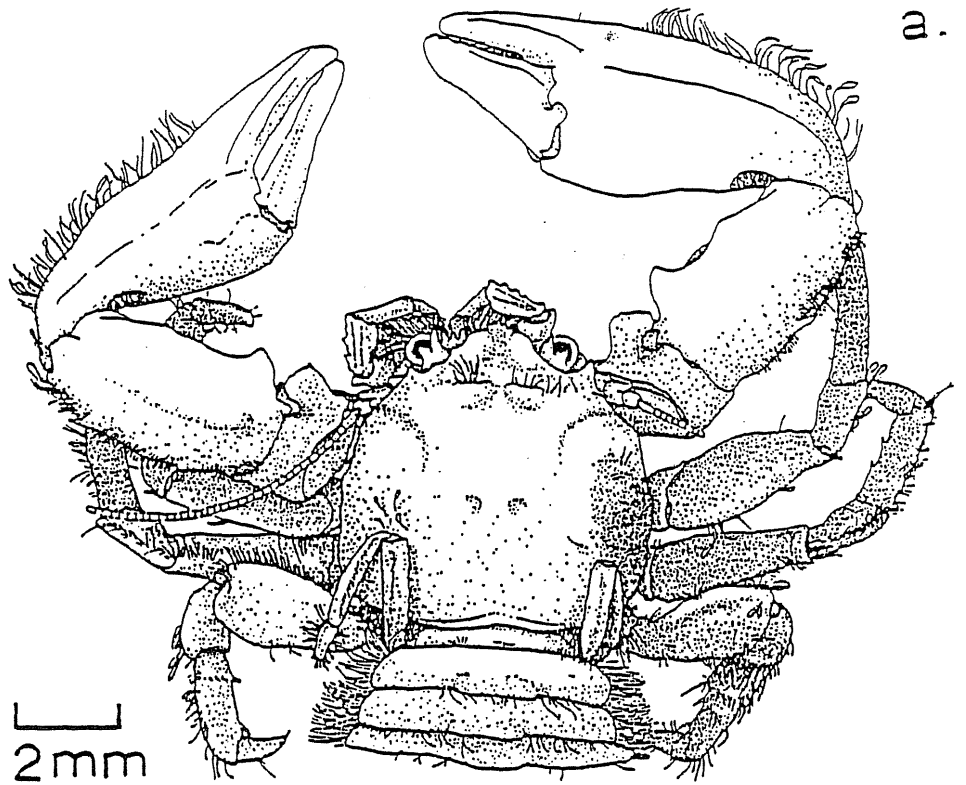


Fig. 8 - *Petrolisthes novaezelandiae*: a - female, dorsal view;
b - male, dorsal view (by C. Duffy).

Size

Female 12mm CW, 12.5mm CL. Male size unknown.

Habitat

Intertidal (rarely), beneath boulders, Macrocystis holdfasts, among shell debris.

Depth

Intertidal (rarely), 3-75m.

Breeding

Ovigerous females have been collected in September, February and March. Eggs freshly laid are brick-red in colour and measure 0.6 x 0.4mm. When ready to hatch they are transparent with a pair of conspicuous black larval eyespots and measure 1.0 x 0.65mm. The smallest ovigerous female (3.2mm CW) carried 50-60 eggs and the largest females (12mm CW) carried about 300 eggs (Wear 1965c).

Development and Growth

Larval development of P.novaezealandiae has been described by Greenwood (1965) and Wear (1964a) who found that this species was the most abundant of the 3 types of porcellanid larvae found in the Wellington plankton especially during spring and summer. The pre-zoea stage which lasts only 3-4 hours has been described by Wear (1965c). Planktonic zoea larvae of this family are characterised by an enormously long rostrum and posterior carapace spines. Zoeae of P.novaezealandiae are found in the Wellington Harbour plankton throughout the year but are most abundant from November to January. During March-August 1982, zoeae of P.novaezealandiae were rarely found in plankton from the Avon-Heathcote Estuary (Roper, Simons and Jones 1983). Larvae may pass through a maximum of 5 stages but only 2 stages are essential for development.

Kingsford & Choat (1985) recorded large numbers of megalopae, attributed to the genus "Petrolisthes", beneath clumps of drifting algae off the coast of Leigh in December. The occurrence of floating algae and its pattern of movement will clearly have an effect on recruitment to local populations.

Behaviour

See P.elongatus for discussion of courtship and mating of related species.

Ecology

Snapper (Chrysophrys auratus) and trevally (Caranx lutescens) from Hauraki Gulf and NW Bay of Plenty eat P.novaezealandiae occasionally, 0.2-0.3% of gut volume (Godfriaux 1969, 1970a) and red gurnard (Chelidonichthys kumu) eat it very rarely (Godfriaux 1970a). Zoeae larvae of P.novaezealandiae are eaten by kahawai (Arripis trutta) in Wellington harbour (Baker 1971).

References

Bennett (1930, 1932), Greenwood (1965), Roper, Simons and Jones (1983), Thomson (1898), Wear (1964a, 1965c).

ANOMURA

PORCELLANIDAE

Petrocheles spinosus Miers, 1876
Spiny False Crab

Synonymy

Petrolisthes (Petrocheles) spinosus Miers, 1876a;
Petrocheles spinosus Thomson, 1898; Chilton, 1911a; Bennett,
 1930; 1932; Batham, 1956; Bennett, 1964; Wear, 1965a; 1966;
 Hayward, 1974; Fenwick, 1978; Marsden & Fenwick, 1978; Probert et
 al., 1979.

Type Locality

New Zealand

Distribution

Endemic to New Zealand. Hauraki Gulf, Bay of Plenty, Lyall Bay and southern half of the South Island. Also recorded from Kawerua, between Hokianga and Kaipara Harbours. Larvae have been collected from Spirits Bay, Northland.

Diagnosis (Fig. 9a-b)

Carapace flattened, as wide as long, densely covered with short hairs, lateral margins convex, posterior margin concave. Antero-lateral margins armed with two series of sharp spines curving upwards and forwards. First series of 4-5 small spines (including post-orbital corner) and after slight gap 6-7 more spines, with a larger, dorsally situated spine opposite the first of this second series. Antennae much longer than CL, rostrum strongly deflexed and extending well past eyes which are large and bulbous. Sides of rostrum fringed with about six short, sharp spines directed forwards and upwards, rostral tip narrowly rounded and bearing tiny spinules. Orbital margin first granular and then smooth. Post-orbital corner right-angled. Third maxillipeds large, well developed, setiferous palps and extending as far forward as rostrum. Exposed surfaces finely tomentose, outer margin of carpus with a distal spine. Chelipeds large, carpus, propodus and dactyl flattened and covered with small tubercles. Inner margin of carpus bearing four stout, equidistant spines, upper surface with sharply and irregular granular ridge, outer margin has eight spines. Propodus elongate, lower margin minutely spinulose to tip of fixed finger, outer surface with two rows of granules and another row of granules along upper margin and on to the movable finger. Fingers tapering, inner margins finely granulate, pilose within. First three pairs of legs much shorter than chelipeds, meri flattened; all segments covered with long, dense hairs. Meri with a close row of spines on the upper margin, carpi have four small spines on the upper margin, dactyli with four spines below. Fourth pair of legs shortest and folded against posterolateral corner of carapace and tips inserted under broad abdominal flap. Telson divided into five plates, margins setose.

Colour

Grey with bluish tinge, finger tips reddish, spines ochreous.

Size

Male 9mm CW, 9.5mm CL. Female 12mm CW, 11.5mm CL.

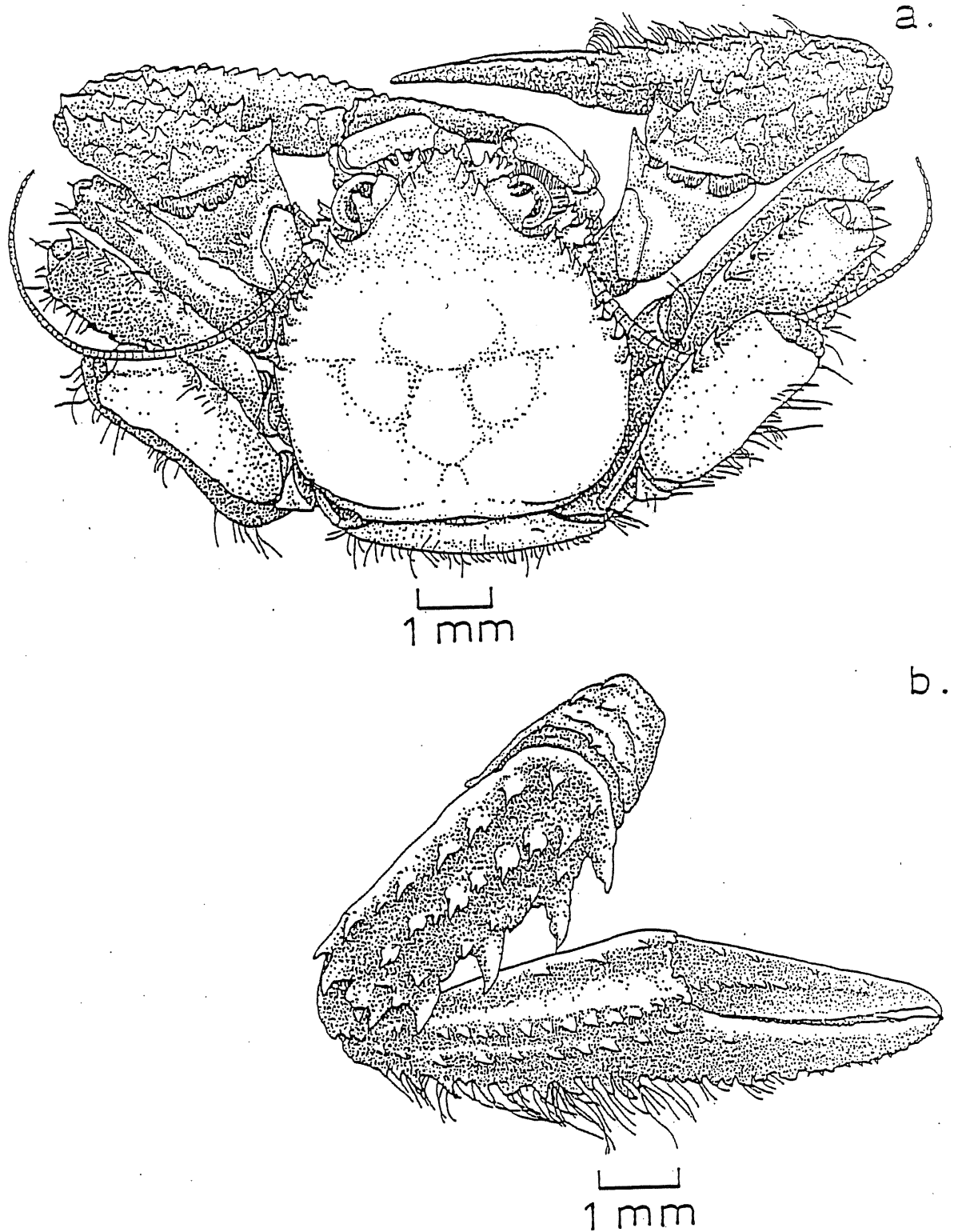


Fig. 9 - *Petrocheles spinosus*: a - female, dorsal view; b - right chela, female, outer face (by C. Duffy).

Habitat

Sub-littoral on mud, shingle or rock substrate also Lessonia holdfasts. The southern distribution and absence of littoral records from the North Island suggests that P.spinosus is a cold-temperate species restricted to colder water in the north.

Depth

Intertidal-100m.

Breeding

A single ovigerous female has been collected from Halfmoon Bay, Stewart Island in October. This crab (CW 12mm) carried 683 eggs near to hatching when they measured 0.69 x 0.56mm, coloured bright orange. Eggs about to hatch measure 0.78 x 0.63mm. After larval release the ovaries were gravid with immature eggs measuring 0.5 x 0.45mm. This suggests that females produce at least 2 batches of eggs per year. Early stage larva appear in Wellington plankton in late July and by September all 5 stages are present. Larvae persist in the plankton until January but are rare at all times (Wear 1965a).

Development and Growth

Larvae of P.spinosus pass through a prezoa and 5 planktonic stages which have been described by Wear (1965a,1966). The pre-zoeal stage only lasts 30-45 minutes at 16deg C. The zoeal larvae of P.spinosus suggest a close relationship between the Porcellanidae and Galatheidae. The possession of 5 zoeal stages is a galatheid feature and suggests that P.spinosus is closer to the ancestral stock than either of the two Petrolisthes species in New Zealand.

Behaviour

See P.elongatus for discussion of courtship and mating of related species.

Ecology

This crab has been recorded from blue cod (Parapercis colias) stomachs.

References

Bennett (1930,1932,1964), Miers (1876a), Thomson (1898), Wear (1965a,1966).

Petalomera wilsoni (Fulton & Grant, 1902)
Sponge Crab

Synonymy

Cryptodromia lateralis Heller, 1868; Miers, 1876b; Thomson, 1898; Cryptodromia wilsoni Fulton & Grant, 1902; Cryptodromia lateralis Chilton, 1911a; Dromia pseudogibbosa Ihle, 1913; Parisi, 1915; Balss, 1922; Petalomera wilsoni Rathbun, 1923; Hale, 1927; Dromia pseudogibbosa Yokoya, 1933; Petalomera wilsoni Sakai, 1935; 1936b; Barnard, 1946; Petalomera lateralis Richardson, 1949b; Petalomera wilsoni Barnard, 1950; Guiler, 1952; Dell, 1963a; Bennett, 1964; Sakai, 1965; Suzuki & Kurata, 1967; Dell, 1968a; Wear, 1970c; Kim, 1970; Griffin, 1972; Kim, 1973; Sakai, 1976; Wear, 1977; Kensley, 1978; 1981; Kim & Kim, 1982; Wear & Fielder, 1985.

Type Locality

Port Phillip Heads, Victoria, Australia.

Distribution

St. Helena (south Atlantic), South Africa, Australia, New Zealand and Japan. P.wilsoni has one of the widest distributions of any of the dromiid sponge crabs. Within Australia, southern Western Australia, South Australia, Victoria, New South Wales and Tasmania. Within New Zealand from Cape Kari Kari to Kaikoura, Wanganui to Tasman Bay.

Diagnosis (Fig. 10a-f)

Carapace much wider than long (ratio 1.3-1.4), moderately convex, thickly covered with soft, long, areolate pubescence. Rostral area projecting slightly in front of eyes, anterolateral margins rounded, posterolateral margins convergent, posterior margin concave. Median rostral tooth small, acute and projecting as far as lateral rostral teeth. Frontal groove extends backwards separating two protuberances. Lateral rostral teeth continuous with supra-orbital margin which has a strong tooth, external orbital angle not produced and a strong infraorbital tooth present beneath the eye. Three strong anterolateral teeth, last two upwardly directed, and a large posterolateral tooth behind the branchial groove. Chelipeds large, especially in male, merus triangular in cross section, all three borders have small rounded tubercles. Upper border of propodus with three rounded nodules (more evident in male), fingers armed with seven teeth. First pair of legs longer than second, carpi and propodi have nodules at distal end of anterior borders. Inner margins of dactyls have 4-5 small spines. Last two pairs of legs much reduced, fourth pair sub-dorsal. A single propodal spine opposes the dactyl on each of the legs. Telson wider than long, uropod plates visible externally. Female sternal grooves end wide apart between bases of first and second legs.

Colour

A shaggy covering of dark khaki hairs over the entire animal, although these are usually concealed under a piece of sponge or compound ascidian which may be brightly coloured.

Size

CW 70mm.

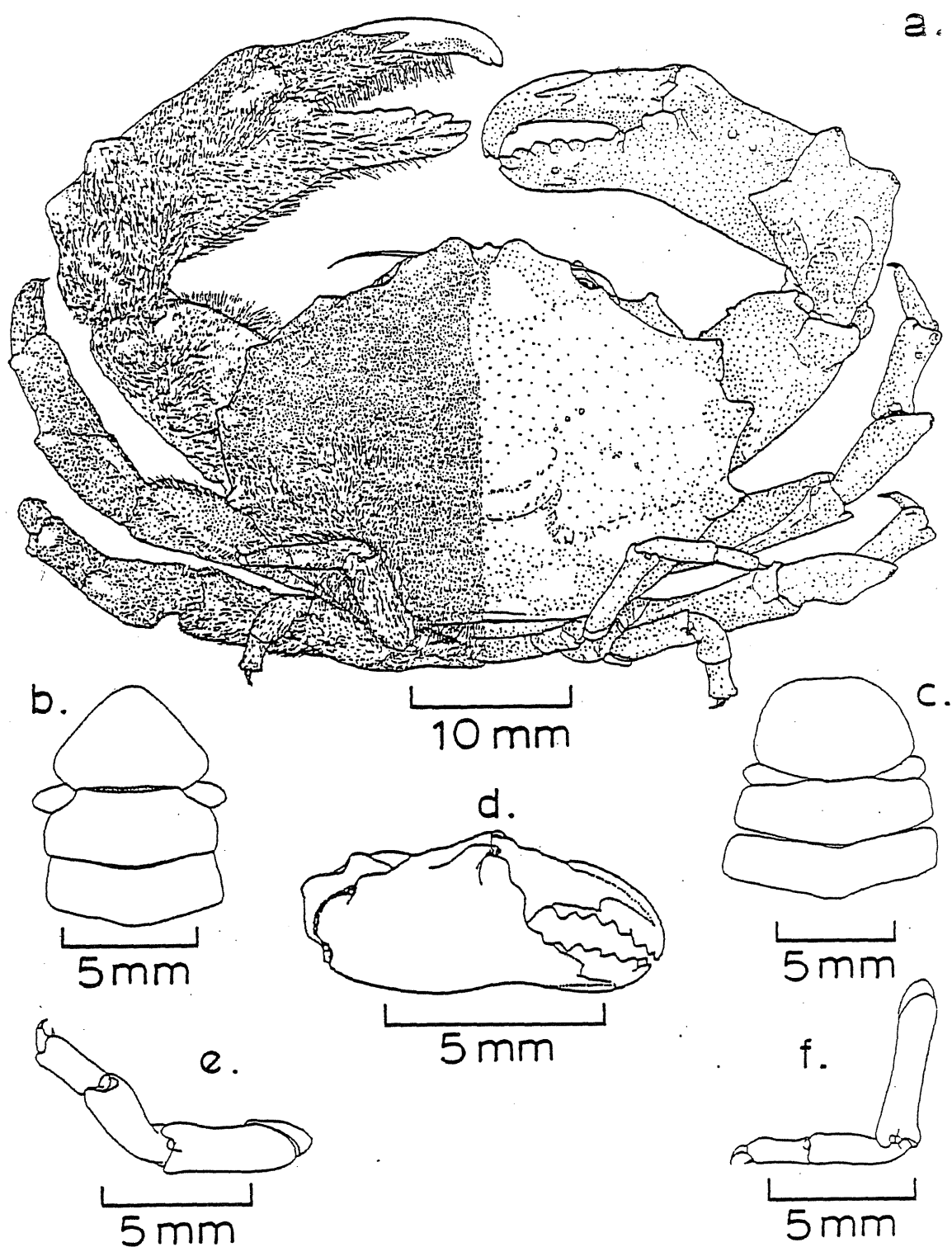


Fig. 10 - *Petalomera wilsoni*: a - male, dorsal view; b - distal segments of male abdomen, ventral view; c - distal segments of female abdomen, ventral view; d - right chela, male, outer face; e - 3rd walking leg; f - 4th walking leg (by J. Black).

Habitat

Low intertidal rock pools, under boulders but more commonly sub-tidal usually associated with sponges and ascidians encrusting hard substrates.

Depth

Intertidal and continental shelf, 0-190m.

Breeding

Ovigerous females have been collected in December to June although larvae occur in Wellington plankton throughout the year. New eggs measure 0.75mm diameter and are deep red in colour, while eggs ready to hatch measure 1.0mm diameter and are light orange.

Dromiid crabs tend to have large eggs but show a wide size range with large-egged species having direct development. Hines (1986) has reviewed the importance of egg size in brachyuran life histories.

Development and Growth

Larvae hatch as a prezoa, followed by 3 or possibly 4 zoeal stages before moulting to the megalopa (Wear 1970c, 1977). First zoea hatched from eggs in the laboratory, zoea 2 and megalopa from plankton (Wear & Fielder 1985). Megalopae have been found in Macrocystis holdfasts.

Behaviour

P.wilsoni, like most other dromiid crabs, is a slow-moving, secretive species. It is called a sponge crab because it camouflages itself with a piece of sponge or ascidian, which is carried above the crab by the last 2 pairs of legs. The dactyls of these legs are modified into long spines which grip the sponge or ascidian and 'stretch' it over the carapace. Because the crab lives in close association with these encrusting animals it is well camouflaged. The masking behaviour of P.wilsoni has not been studied but is probably similar to the behaviour of Cryptodromia hilgendorfi (see McLay 1982, 1983). This sponge crab is masked throughout its life (some larger P.wilsoni do not carry a mask) and uses its chelae to cut out the piece of sponge or ascidian, crawls underneath discarding the old cap and then walks off with its new camouflage. A wide variety of sponges and ascidians are used and these are constantly changed as the crab grows and moves from one 'host' to another. Camouflage changes are always made during the intermoult period and sometimes the same cap is used after moulting. The camouflage prevents visual detection by predators and may also protect the crab because some sponges and ascidians are distasteful to fish predators.

Wicksten (1986) has reviewed carrying behaviour of brachyuran crabs from different families: the Homolidae, Latreillidae, Tymolidae and Dorippidae as well as the Dromiidae all show this behaviour. A variety of objects are carried: shells, pieces of sponge, tunicates, algae, branches of gorgonians or antipatharians, or chips of rock. Except for the Dorippidae all the other families have been classified in the section Podotremata which contains the 'primitive' brachyurans. Wicksten suggests that carrying may well be a conservative behaviour pattern.

Ecology

Snapper (Chrysophrys auratus) from the Hauraki Gulf eat small numbers of P.wilsoni (Godfriaux 1969).

References

Bennett (1964), Dell (1963a,1968a), McLay (1982,1983), Wear (1970c,1977), Wear & Fielder (1985), Wicksten (1986).

PODOTREMATA

HOMOLIDAE

Homola orientalis Henderson, 1888Synonymy

Homola orientalis Henderson, 1888; Homola andamanica Alcock, 1899; Alcock & Anderson, 1899; Homola orientalis Whitelegge, 1900; Homola andamanica Alcock, 1901; Homola orientalis Doflein, 1902; Homola barbata orientalis Doflein, 1904; Balss, 1922; Homola orientalis Rathbun, 1923; Thelxiope orientalis Barnard, 1926; Homola orientalis Sakai, 1936b; Thelxiope orientalis Barnard, 1950; Gordon, 1950; Sakai, 1965; Homola orientalis Campbell, 1971; Serene & Lohavanijaya, 1973; Yaldwyn & Dawson, 1976; Sakai, 1976; Thelxiope orientalis Crosnier, 1976; Homola orientalis Sakai, 1979; Guinot & Richer de Forges, 1981; Wear & Fielder, 1985.

Type Locality

Philippines.

Distribution

Wide-spread Indo-west Pacific : off south-east Africa, Gulf of Aden, Andaman Sea, Indonesia, Philippines, Japan, Australia (southern Queensland to Victoria) and off north-east New Zealand (Bay of Plenty, 37°25.5'S, 176°28.5'E, south-east of Mayor Is.).

Diagnosis (Fig. 11a-d)

Carapace quadrangular, longer than broad, convex with a short bifid rostrum without lateral accessory spines. The eyes are on long stalks and the proximal segment is slender and visible dorsally. Eyes and antennules are not retractile, antennal flagellum is longer than the carapace. The carapace has high, upright lateral walls, anterolateral spines are distinct and at some distance behind the level of the supraorbital spines. Supraorbital spine is short and simple and there is an intermediate spine between rostral and each supraorbital spine. Mouthframe more or less quadrate in shape and there are no obliquely longitudinal grooves on the female sternum. Chelipeds small and pubescent. First three pairs of legs longer, posterior margins of meri armed with spines. Last pair of legs prehensile and subdorsal in position. The dactyl is about half the length of the propodus and is turned back against a series of spines on the propodus.

Colour

Unknown.

Size

A male of 15mm CW, 19mm CL, and female of 21mm CW, 27mm CL have been reported by Serene & Lohavanijaya (1973) but the specimen of Yaldwyn & Dawson (1976) was a female (ovigerous) 27.6mm CW, 35mm CL.

Habitat

The Bay of Plenty specimen was collected in a crayfish pot. Usually found on muddy bottoms.

Depth

Continental shelf and slope, 38-548m.

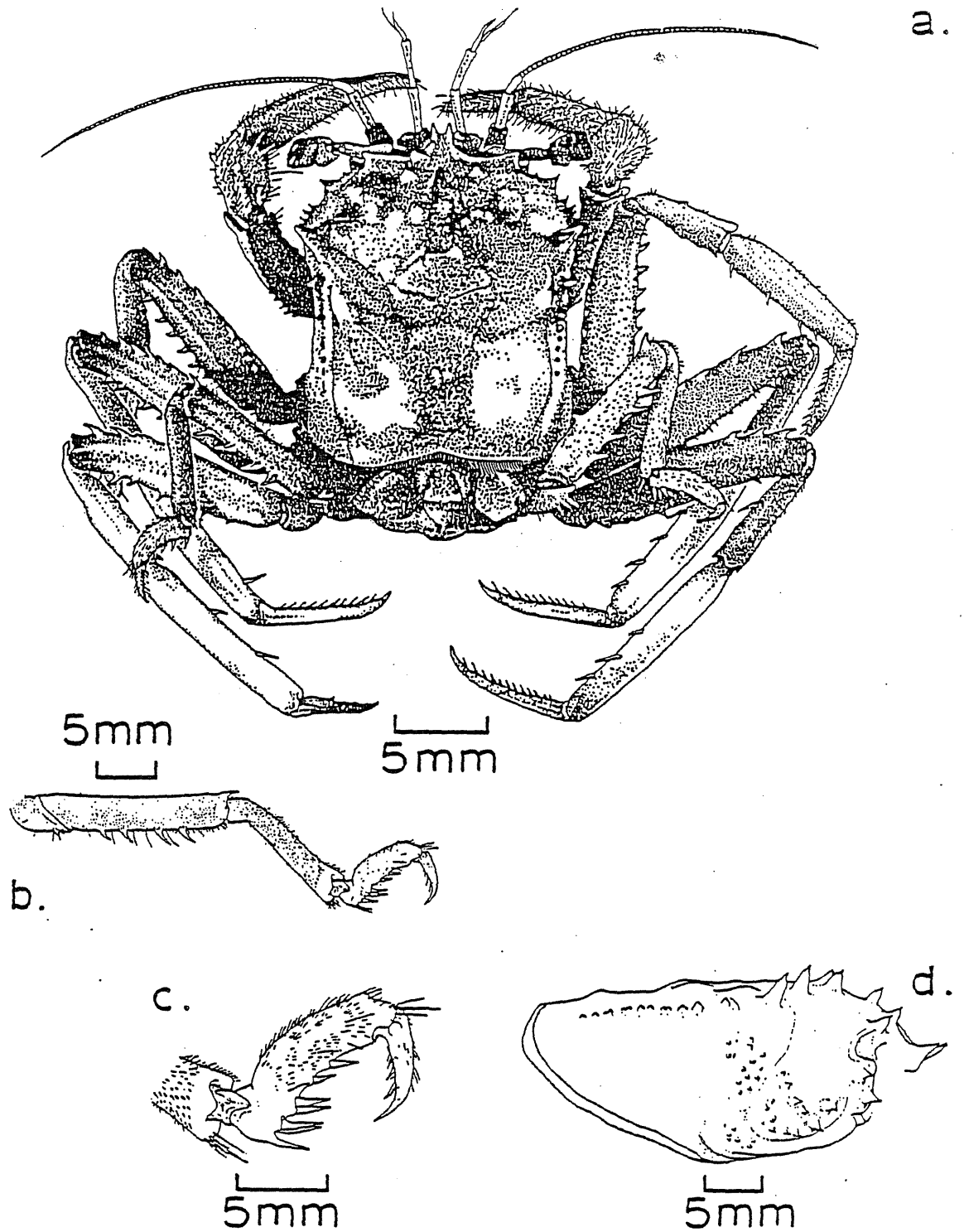


Fig. 11 - *Homola orientalis*: a - female, dorsal view (by C. Duffy, based on a photo from Yaldwyn & Dawson, 1976); b - right, 4th leg; c - distal segments, right 4th leg; d - male carapace, lateral view (after Guinot & Richer de Forges, 1981).

Breeding

Ovigerous female collected in September. Egg size and numbers not recorded.

Development and Growth

Probably 5 or more zoeal stages, only fourth zoea known from plankton (Wear & Fielder 1985).

Behaviour, Ecology

Unknown.

References

Guinot & Richer de Forges (1981), Serene & Lohavanijaya (1973), Wear & Fielder (1985), Yaldwyn & Dawson (1976).

PODOTREMATA

HOMOLIDAE

Latreillia australiensis Henderson, 1888Synonymy

Latreillia australiensis Henderson, 1888; Whitelegge, 1900; Rathbun, 1923; Dell, 1963a; Williamson, 1965; 1967; Dell, 1968a; Campbell, 1971; Serene & Lohavanijaya, 1973; Wear & Fielder, 1985.

Type Locality

Southeastern Australia.

Distribution

Bass Strait to southeast Queensland and northern New Zealand (SE of Poor Knights Islands, off Doubtless Bay, NE of Arid Island, Bay of Plenty).

Diagnosis (Fig. 12a-c)

Carapace much longer than wide, margins converging and strongly produced anteriorly beyond cheliped bases. Rostrum consists of a short, simple spine with very long supraorbital spines on either side. These spines are almost as long as the eyestalks which carry very bulbous eyes. Chelipeds long (2.5 - 3.5 times CL), propodus expanded, fingers long, narrow, distal half occluding. Male movable finger has a small proximal tooth. First three pairs of legs very long, last pair of legs sub-dorsal. Seven abdominal segments in both sexes. Spines on abdominal terga, three or four abdominal segments visible dorsally.

Colour

White or purplish with red markings.

Size

Male 15.3mm CL. Female 19mm CL.

Habitat

Soft mud and sand.

Depth

Outer continental shelf and continental slope, 54-330m.

Breeding

Off New Zealand ovigerous females have been collected in November but off Australia they have been collected in all months. Newly laid eggs are white, 0.3mm diam. and when nearly ready to hatch eggs are transperant, 0.4mm diam. (Wear & Fielder 1985).

Development and Growth

Wear & Fielder (1985) have described the first zoea from laboratory hatched eggs while Williamson (1967) has described a megalopa from Australia which he attributed to L. australiensis.

Behaviour, Ecology

Unknown.

References

Dell (1963a), Rathbun (1923), Serene & Lohavanijaya (1973), Wear & Fielder (1985).

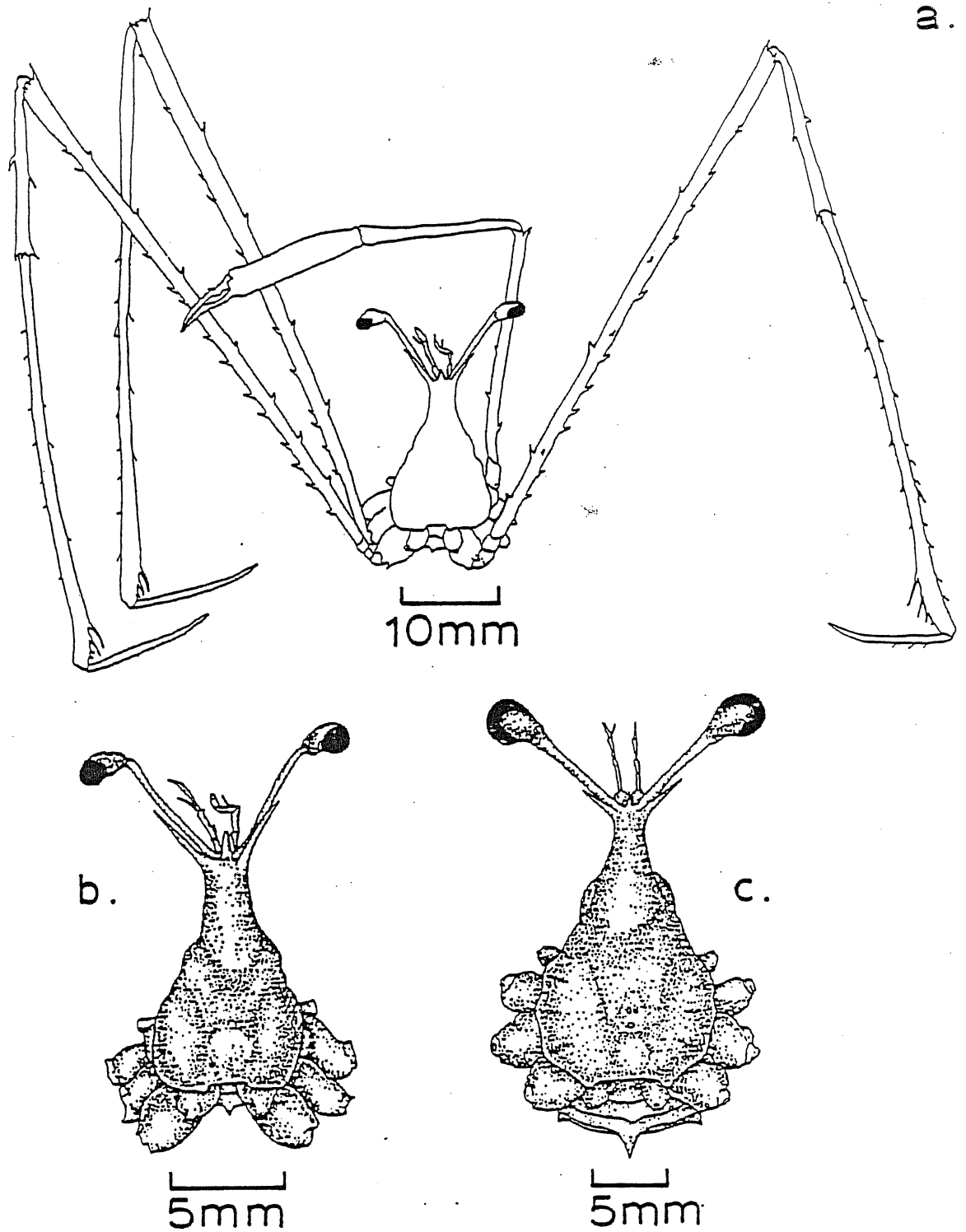


Fig. 12 - *Latrellia australiensis*: a - male, dorsal view;
b - carapace of male; c - carapace of female (after
Dell, 1963a).

PODOTREMATA

HOMOLIDAE

Paromola petterdi (Grant, 1905)
Antlered Crab

Synonymy

Latreillopsis petterdi Grant, 1905; McCullough, 1907; Rathbun, 1923; Hale, 1927; Dell, 1955; 1963a; 1963b; Griffin, 1965; Paromola petterdi Williamson, 1965; Latreillopsis petterdi Webb, 1972; Paromola petterdi Serene & Lohavanijaya, 1973; Latreillopsis petterdi Griffin & Brown, 1975; Paromola petterdi Wear & Fielder, 1985.

Type Locality

About 45km east of Sydney Harbour Heads.

Distribution

Southern and southeastern Australia, New Zealand (Cavalli Islands to Banks Peninsula, Fiordland and also the Snares Islands).

Diagnosis (Fig. 13a)

Carapace longer than wide (length 1.2 times width), armed with tubercles and spines, produced in front to form a simple rostrum. There is a prominent antler-like supraorbital spine above each eye, this peculiar structure being branched. They are probably easily broken off in life and may be different in different specimens. Young specimens have numerous sharp spines on the carapace but in other specimens there may be only rounded tubercles. Eyestalks are short and eyes are bulbous and prominent. Behind the eyes is a series of 4-5 short acute spines on the carapace margin. Chelipeds long, merus spinous, propodus generally enlarged in older males, fingers long, pointed and curved inwardly. First three pairs of legs much longer than chelipeds (4 times CW), meri spinous. Last pair of legs sub-dorsal in position and dactyls are sub-chelate. Several segments of the abdomen visible in dorsal view. Median spine or tubercle on segments 1-4 and 6; segments 3, 4 and 6 also bear a spine on each side. Uropods absent from base of telson.

Colour

Greyish white with black eyes, cheliped fingers also black, and deep orange around joints on limbs and on dactyls.

Size

Male 69mm CW, 85mm CL. Female 73mm CW 90mm CL.

Habitat

Soft grey mud. Sometimes caught in deepwater crayfish pots.

Depth

Continental slope, 188-517m.

Breeding

Unknown.

Development and Growth

Williamson (1965) described a megalopa, dredged off Port Hacking NSW, which he attributed to P.petterdi. Zoea unknown (Wear & Fielder 1985).

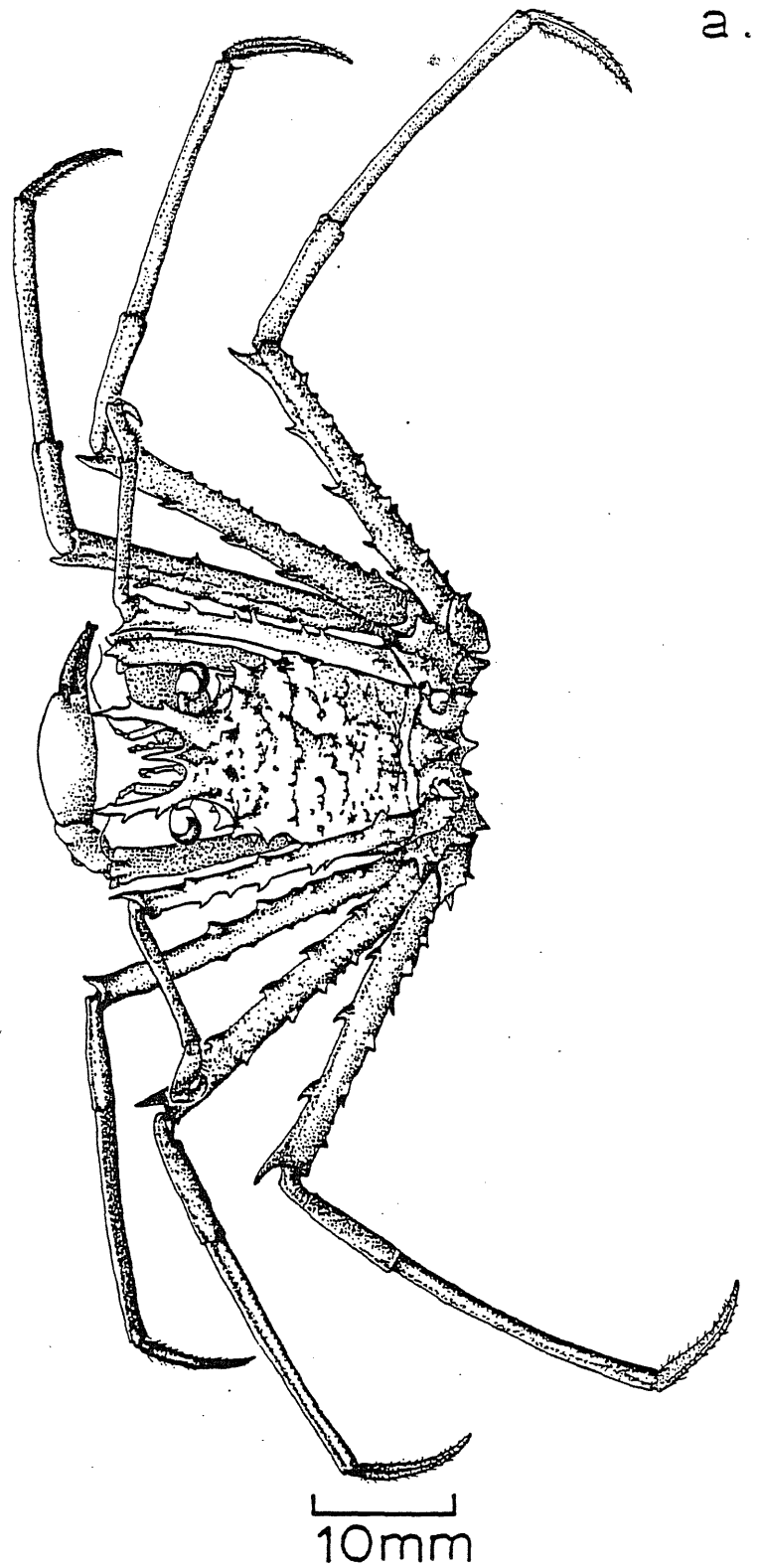


Fig. 13 - Paramola petterdi: a - male, dorsal view (by C. Duffy).

Behaviour

Using its long legs P. petterdi probably holds itself above the soft mud on which it lives.

Using film footage from a submersible Wicksten (1985) has reported that P. japonica off the Hawaiian Is. use the sub-chelate last pair of legs to carry pieces of sponges, antipatharians or gorgonians over the carapace but value of this behaviour remains obscure. It could be anti-predatory or perhaps food-carrying. (See also Wicksten 1986 for discussion of brachyuran carrying behaviour.)

Ecology

Habib (1975) found that red cod (Pseudophycis bacchus) from Banks Peninsula ate small quantities of P. petterdi, March (0.5% of gut volume), May (1.1%) and October (0.8%).

References

Bennett (1964), Dell (1955, 1963a, 1963b), Griffin & Brown (1975), Hale (1927), Serene & Lohavanijaya (1973), Wear & Fielder (1985), Webb (1972), Wicksten (1986).

PODOTREMATA

HOMOLIDAE

Paromola spinimana Griffin 1965Synonymy

Paromola spinimana Griffin, 1965; Dell, 1968a; Serene & Lohavanijaya, 1973; Wear & Fielder, 1985(list).

Type Locality

Off North East Island, Three Kings, 92m.

Distribution

Known only from the type locality.

Diagnosis (Fig. 14a-c)

Carapace urn-shaped, convex, longer than wide, anterior and lateral surfaces armed with coarse, conical, sharply pointed spines, largest anteriorly. Medial rostral spine sharp, simple, dorsally weakly concave with a longitudinal groove basally. Supraorbital, infraorbital and anterolateral spines as long as medial spine. Eye-stalks relatively short, not obvious in dorsal view. Chelipeds very long (almost four times carapace length), moderately stout, coarsely spinose, fingers carinate on inner edges, inwardly curved and ending in a sharp 'hook'. Legs also very long, compressed, dactyls of first three pairs long and weakly tapering with spinules along ventral edge. Fourth pair of legs shorter, dactyl sub-chelate. Abdomen of seven segments.

Colour

Carapace and legs uniform bright orange, fingers black.

Size

Male 41mm CW (excluding spines), 53mm CL.

Habitat

Continental shelf.

Depth

Continental shelf, 92m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown.

References

Griffin (1965), Serene & Lohavanijaya (1973).

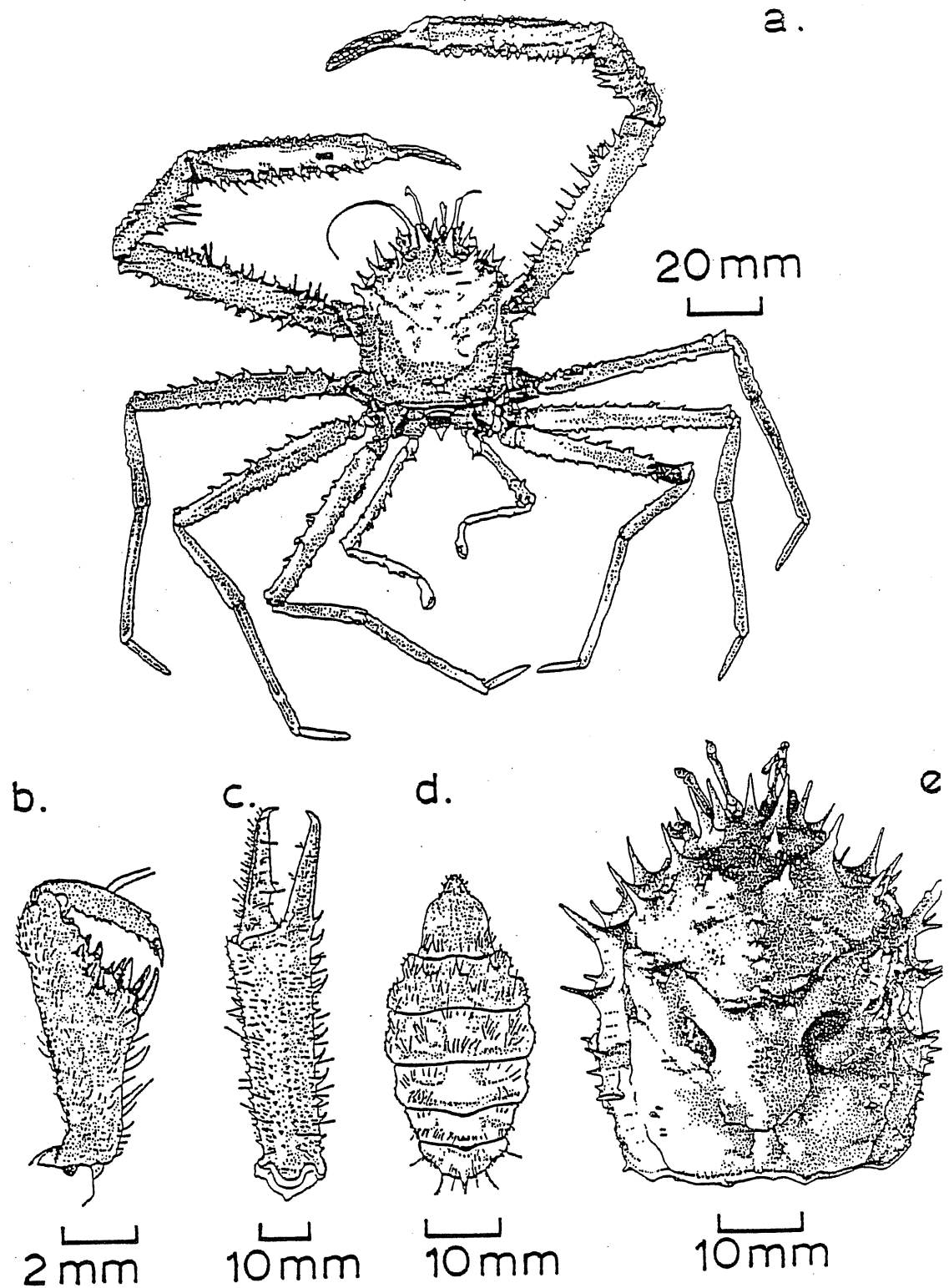


Fig. 14 - *Paramola spinimana*: a - male, dorsal view (by C. Duffy, based on a photo from Griffin, 1965); b - distal segments of right 4th leg; c - right chela, male, outer face; d - male abdomen, ventral view (after Griffin, 1965); e - detail of male carapace, dorsal view (by C. Duffy, based on a photo from Griffin, 1965).

Lyreidus tridentatus De Haan, 1841
Harp Crab

Synonymy

Lyreidus tridentatus De Haan, 1841; Lyreidus elongatus Miers, 1879b; Lyreidus tridentatus Haswell, 1882a; Wood-Mason, 1887; Henderson, 1888; Ortmann, 1892; Whitelegge, 1900; Doflein, 1902; Chilton, 1906a; Parisi, 1914; Balss, 1922; Yokoya, 1933; Lyreidus australiensis Ward, 1933; Lyreidus tridentatus Sakai, 1934; 1936b; Miyake, 1936; Sakai, 1937; Lyreidus australiensis Richardson & Krefft, 1949; Lyreidus tridentatus Powell, 1949; McNeill, 1953; Dell, 1955; Utinomi, 1958; Dell, 1963a; 1963b; Lyreidus fossor Bennett, 1964; Lyreidus tridentatus Tinker, 1965; Williamson, 1965; Dell, 1968a; Griffin, 1970; Hartnoll, 1979; Wear & Fielder, 1985; Feldmann, 1986.

Type Locality

Japan.

Distribution

Western Pacific : southeastern and western Japan, South China Sea near Hong Kong, central and southeastern coast of Australia, Fiji, New Caledonia, northern New Zealand. Central Pacific Ocean : Hawaii. Eastern Indian Ocean : southwestern coast of Australia. New Zealand distribution is whole of North Island and Cape Campbell at the northern tip of the South Island. Habib (1975) recorded L. tridentatus from stomachs of red cod (Pseudophycis bacchus) captured off Banks Peninsula.

Griffin (1970) has provided a key to the five recent species of Lyreidus.

Diagnosis (Fig. 15a-e)

Carapace much longer than wide, anterolateral margins gradually convergent, frontal width one-third of CW or more. Strongly convex from side to side and weakly convex from front to back, surface smooth and polished, regions undefined. Rostrum is a subacute spine, external orbital spine strong, divergent, no longer than rostrum. Single lateral carapace spine short to moderately long, straight or weakly curved. Chelipeds short, spinous, fingers almost at right angles to palm, minutely dentate, gaping and tips crossed. First two pairs of legs shorter than chelipeds, dactyls long and narrowly triangular. Third legs shorter, dactyls expanded close to base. Fourth pair of legs also short, sub-dorsal, dactyls expanded and triangular. Abdomen of six segments plus telson in both sexes. First four abdominal segments visible dorsally, third and fourth segments bearing spines. Penultimate segment winged and locking with processes on the bases of the first legs. Last segment rounded and very small.

Colour

Not recorded.

Size

Male 29.8mm CW, 49.5mm CL. Female 28.7mm CW, 47.9mm CL.

Habitat

Mud, muddy sand, mud and shell.

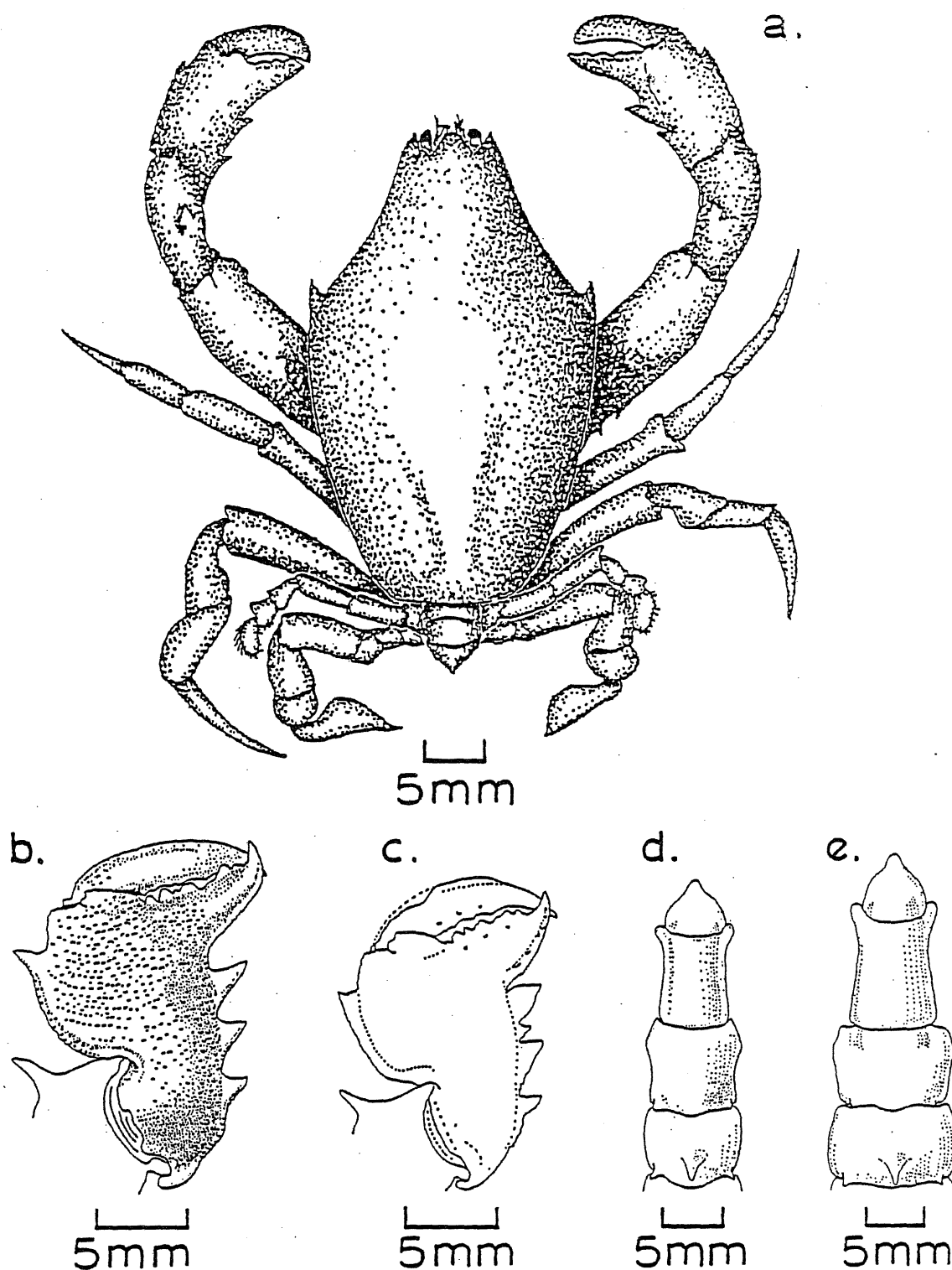


Fig. 15 - *Lyreidus tridentatus*: a - male, dorsal view (after Dell, 1963); b - right chela, male, outer face; c - right chela, female, outer face; d - distal segments of abdomen, male; e - distal segments of abdomen, female (after Griffin, 1970).

Depth

Continental shelf and slope, 27-382m.

Breeding

An ovigerous female of unspecified CW, collected in December with approx. 1000 eggs (diameter 0.5mm) was recorded by Bennett (1964). Newly laid eggs are bright orange to red 0.47-0.5mm diam., ready to hatch, red, 0.6-0.65mm.

The Brachyura consist of both primitive and advanced forms and the morphology of the female reproductive system is an important criterion in separating these forms. In the primitive Brachyura the oviducts open on the coxa of the second walking leg and the spermathecae are separate integumental pouches which have no internal connection with the oviducts. In the advanced Brachyura oviducts open on the sternum and spermathecae are enlargements of these oviducts. Hartnoll (1979) showed that L.tridentatus females have paired rather than single spermathecae close to the coxal oviduct openings confirming the Raninidae as the most advanced of the primitive Brachyura. In these crabs there is no possibility of trans-moult sperm retention and re-mating must follow female moulting to ensure egg fertilization.

Development and Growth

Probably 6 zoeal stages, zoea 1 (Wear & Fielder 1985), zoeae 2-6 (Williamson 1965) and megalopa (Wear & Fielder 1985). Chace & Barnish (1976) and Kidd & Rice (1986) have recorded swarms of Atlantic raninid megalopae in the eastern Caribbean but similar swarms have not yet been recorded off New Zealand.

Some aspects of relative growth have been investigated by Griffin (1970) but nothing in his investigation is useful for detecting changes in relative growth during adult maturation.

Behaviour

L.tridentatus lives on soft bottoms and escapes predators by burrowing, with only the rostral area showing. The legs and carapace are well adapted for burrowing and it is probable that this species has a reversed respiratory current.

Ecology

This crab is preyed upon by sharks (Mustelus sp.). Snapper (Chrysophrys auratus) from the Hauraki Gulf eat small numbers of L.tridentatus (Godfriaux 1969), but in the Western Bay of Plenty this crab makes up 2.1% of snapper gut volume (Godfriaux 1974b). Also tarakihi (Cheilodactylus macropterus) from this area eat (0.5%) this crab. Habib (1975) found L.tridentatus in stomachs of Banks Peninsula red cod (Pseudophycis bacchus) in March (0.4%).

Two fossil species have been described from the South Island: L.waitakiensis from middle to late Eocene rocks and another undescribed species from the late Eocene (Glaessner 1980), and L.elegans (Glaessner 1960). L.elegans may have been the ancestor of L.tridentatus.

References

Bennett (1964), Bourne (1922), Dell (1963a), Griffin (1970), Powell (1949), Wear & Fielder (1985).

PODOTREMATA

TYMOLIDAE

Cymonomus bathamae Dell, 1971Synonymy

Cymonomus bathamae Dell, 1971; Wear & Batham, 1975; Chapman, 1977; Probert et al., 1979; Wear & Fielder, 1985.

Type Locality

Off Otago Peninsula, Papanui Canyon, 45°51'S, 170°02'E, 732m.

Distribution

Off Otago coast, Chatham Rise.

Diagnosis (Fig. 16a-d)

Carapace quadrate, as wide as long, slightly swollen posteriorly (more so in female). Surface finely granular, regions not distinct except for deep furrows marking lateral borders of cardiac area. Rostrum well developed, shorter than eyestalks, narrowly triangular, sides ornamented by granules or scales. Front straight and produced into prominent post-orbital teeth. Eyestalks narrowly tapering, armed with strong, blunt spines, no visible cornea although cornea area is smooth and polished. Eyestalks solidly fixed in position, from two to three times the length of the rostrum. Antennae and antennules long and prominent. Basal joint of antenna stout, shorter than eyestalks. Second segment of antennules extending well beyond the eyes. Antero-lateral border of carapace begins behind post-orbital tooth and forms almost a right-angle, margin granular. No antero-lateral teeth, borders slightly divergent, posterior carapace border distinctly concave. Chelipeds well developed, granulate, propodus deep in male, much narrower in female, fingers relatively short in male, more elongate in female. First two pairs of legs longer than chelipeds, granulate, dactyls especially long and slightly curved. Last two pairs of legs reduced, sub-dorsal, similar in length, directed forwards. Abdomen consists of only five segments, ovate in both sexes, narrower in male. Female abdomen projects posteriorly, telson triangular. No uropods and only three pairs of pleopods in female.

Colour

Unknown.

Size

Male 3.8mm CW, 4mm CL. Female 5.0mm, 4.9mm.

Habitat

Fine, grey mud, over edge of continental shelf, in association with sponges, molluscs and echinoderms.

Depth

200-800m.

Breeding

Ovigerous females have been collected in November, January and May. Dell (1971) recorded females of CW 4.0-5.0mm with 12, 14, 17, 19, 21 & 23 eggs up to 1.4mm diameter. In May Wear &

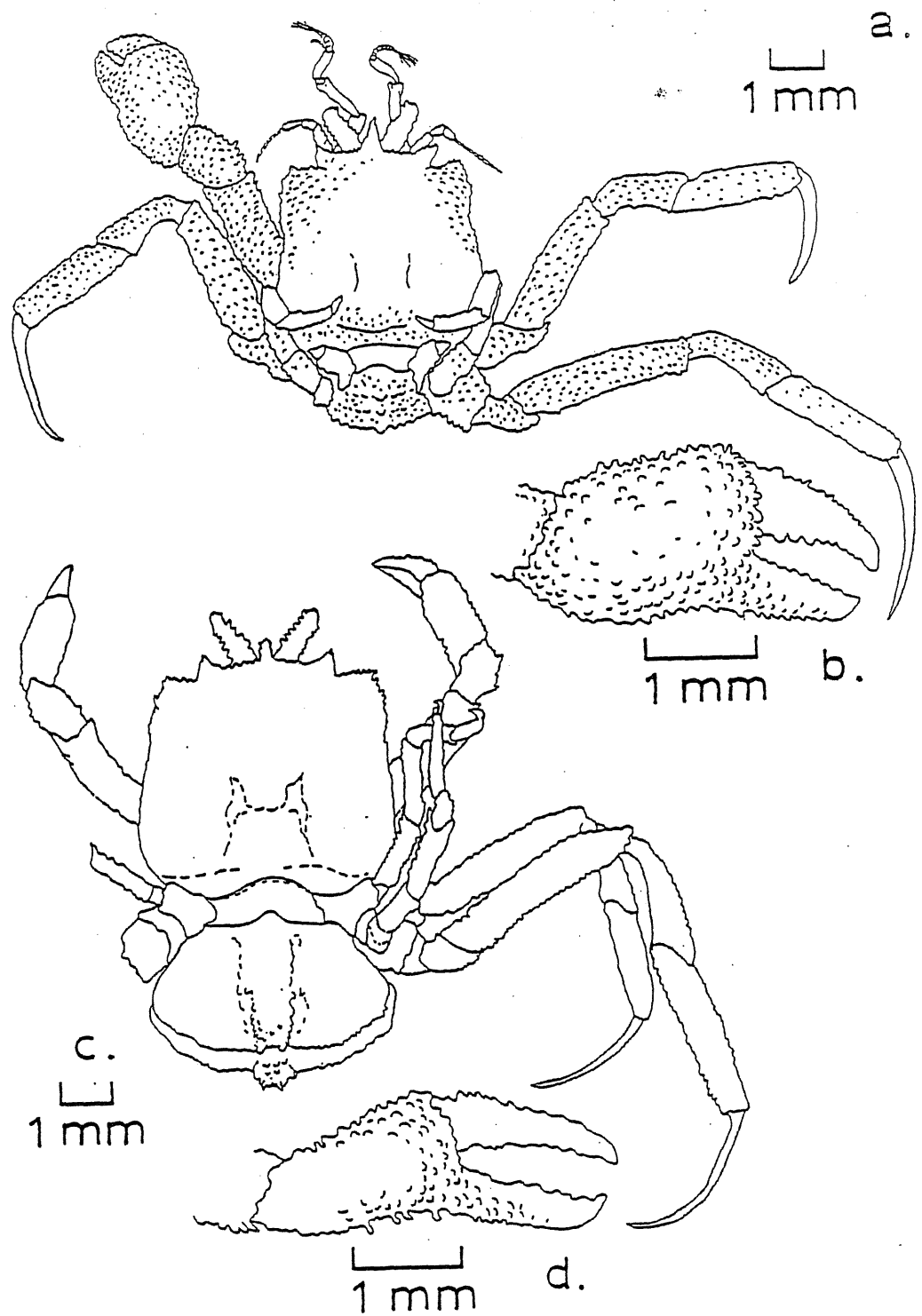


Fig. 16 - *Cymonomus bathamae*: a - male, dorsal view; b - right chela, male, outer face; c - female, dorsal view; d - right chela, female, outer face (modified after Dell, 1971).

Batham (1975) recorded one female, CL 5.0mm, carrying 17 eggs close to hatching. The maximum number of eggs carried was 26 by a female 5.1mm CL. Eggs, freshly laid, measure 1.2 x 1.0mm, with orange yolk and when ready to hatch they measure 1.4mm diameter.

Development and Growth

At least one and possibly two zoeal stages, which are weak swimmers, followed by the megalopa. Development abbreviated, larvae possess primitive characters (especially the telson) which suggest close relationship to the Raninidae and Homolidae (Rice, 1980).

Behaviour

Chapman (1977) has examined the structure of the sessile eyes of C.bathamae. Although the eyes lack corneal facets the corneal region is only relatively slightly smaller than corneas of shore-dwelling crabs. There are no crystalline cones and the rhabdomes vary in size and are irregular in shape and number of constituent rhabdomeres. Rhabdomes are arranged parallel to the eyestalk axis so that illumination from above passes through the sides of the rhabdomes instead of passing lengthwise as is usual with compound eyes. The eyes lack any lens system or tapetum and only have photoreceptors. Thus image formation is impossible. The exact role of the eyes in C.bathamae has not been established because experiments have not been performed on live crabs.

It is not clear whether the reduced and modified last two pairs of legs are used for carrying camouflage material.

Ecology

Unknown.

References

Dell (1971), Gordon (1963), Rice (1980), Wear & Batham (1975).

PODOTREMATA

TYMOLIDAE

Cymonomus aequilonius Dell, 1971Synonymy

Cymonomus aequilonius Dell, 1971; Wear & Fielder, 1985 (list).

Type Locality

N.E. of Mayor Island, Bay of Plenty, 37°10'S, 176°23.5'E, 731m.

Distribution

Known only from the type locality.

Diagnosis (Fig. 17a-d)

Carapace quadrate, as wide as long, wider posteriorly, surface with fine rounded granules, some fine hairs especially near the margins. Regions not distinctly marked except for cardiac. Rostrum well developed, longer than eyestalks, narrowly triangular, sides ornamented with granules. Front straight and becoming small, post-orbital teeth. Eyestalks tapering, armed with spines and scales especially along inner margins, no marked cornea. Eyestalks solidly fixed, a little more than two-thirds the length of the rostrum. Antennae and antennules well developed, basal joint of antennae almost as long as eyestalks, second segment of antennule extending beyond the eyestalks. Antero-lateral margins of carapace begins behind post-orbital tooth and forms almost a right-angle, margin granular. No antero-lateral teeth, margins slightly convex, posterior carapace border concave. Chelipeds well developed, granulate, fingers of female especially elongate. First two pairs of legs longer than chelipeds, granulate, dactyls especially long and slightly curved. Last two pairs of legs, reduced, sub-dorsal, similar in length, directed forwards. Abdomen consists of only five segments, no uropods and only three pairs of pleopods in female. Female abdomen projects posteriorly, telson triangular.

Colour

Unknown.

Size

Female 7.0mm CW, 7.0mm CL (including rostrum).

Habitat

Muddy bottoms over edge of continental shelf.

Depth

731m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown.

References

Dell (1971).

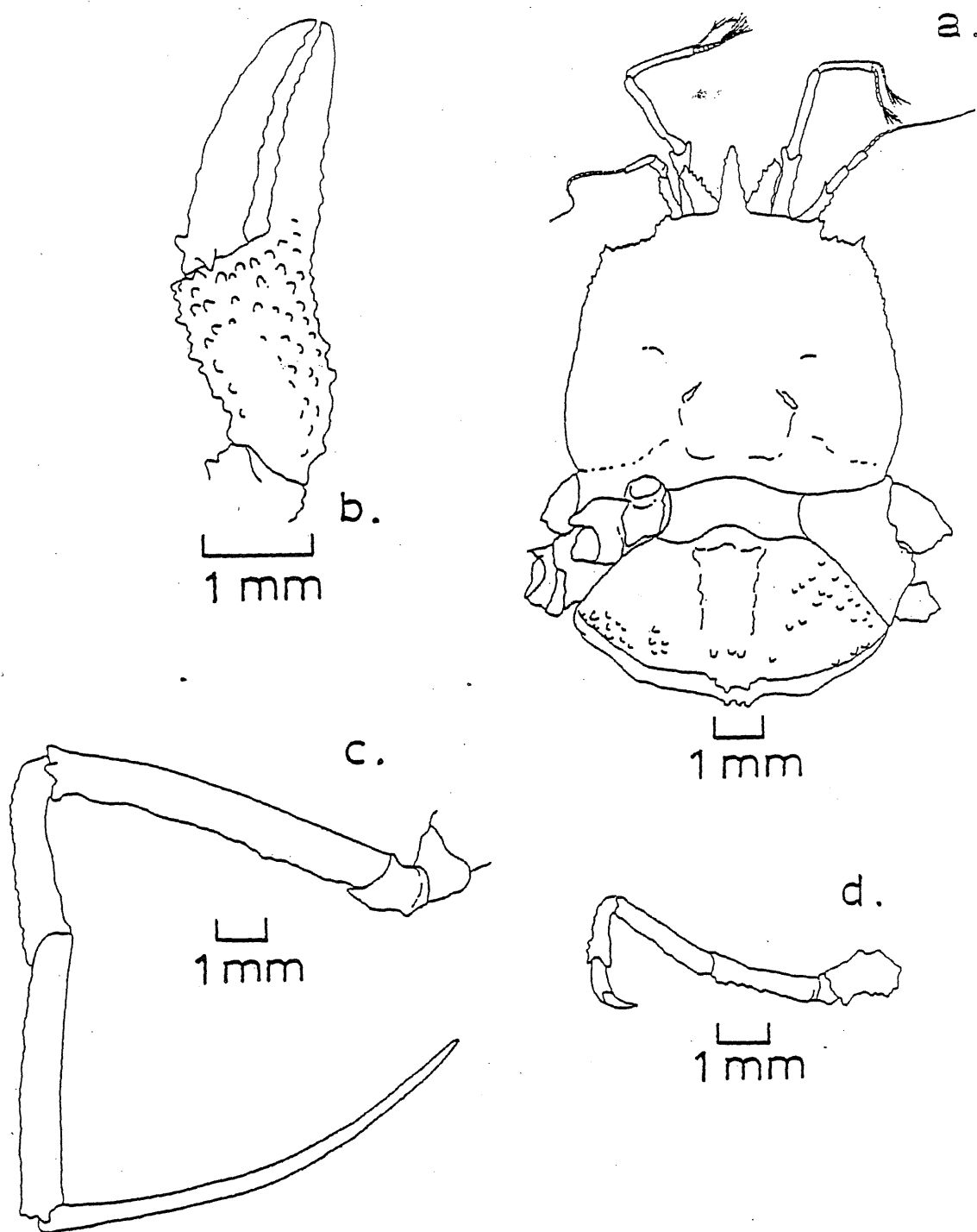


Fig. 17 - *Cymonomus aequilonius*: a - body, female, dorsal view; b - right chela, female, outer face; c - left, 2nd walking leg; d - left, 3rd walking leg (modified after Dell, 1971).

HETEROTREMATA

LEUCOSIIDAE

Ebalia laevis (Bell, 1855)
Nut Crab

Synonymy

Phlyxia laevis Bell, 1855; Miers, 1876b; Phlyxia tumefacta Kirk, 1878; Phlyxia laevis Filhol, 1886; Phlyxia cheesemani Filhol, 1886; Ebalia laevis Miers, 1886; Chilton, 1906a; 1911a; Young, 1929; Richardson, 1949b; Ebalia tumefacta Richardson, 1949b; Ebalia cheesemani Richardson, 1949b; Dell, 1960; Ebalia laevis Dell, 1963a; Bennett, 1964; Dell, 1968a; Takeda & Miyake, 1969; Wear & Fielder, 1985.

Type Locality

New Zealand.

Distribution

Endemic to New Zealand. Little Barrier Is. to Stewart Is., Wanganui to Dusky Sound and also Chatham Islands.

Diagnosis (Fig. 18a-c)

Carapace as wide as long, granulated regions well marked, less prominently swollen in female than in male. Branchial region much swollen, separated from cardiac and posterior gastric regions by a broad depression. Front concave in dorsal view with a median linear groove, orbit minute, circular, with two sutures above. Anterolateral margin with two concavities, a single lateral, conical tooth. Posterolateral margins sharply convergent and posterior margin with three projections : these are highly variable and more prominent in males but usually consist of a median cardiac projection which is longest and a marginal pair. Chelipeds very long, granular all over, fingers long, fixed finger inclined, small sharp denticles on both fingers, gape narrow, nearly half length of fingers. Chelipeds of female shorter, fingers without gape. Legs also granular, decreasing in length from first to last pair, dactylus straight and smooth. Tip of male abdomen acutely rounded, female abdomen broader and with three fused distal sutures.

Colour

Uniformly whitish-grey with pink or orange tinges. Cheliped fingers, carpi and distal ends of meri of legs pale orange.

Size

Male and female 20mm CW.

Habitat

Sand, shell, Bryozoa and sand.

Depth

Continental shelf and slope, 18-373m.

Breeding

Ovigerous females have been collected December-January also May and August. Newly laid eggs are light orange, 0.38mm diam. Schembri (1982) found that in Ebalia tuberosa, off Scotland, females attain sexual maturity at 11-12mm CL and mate in November, both sexes being hard-shelled and eggs are laid soon

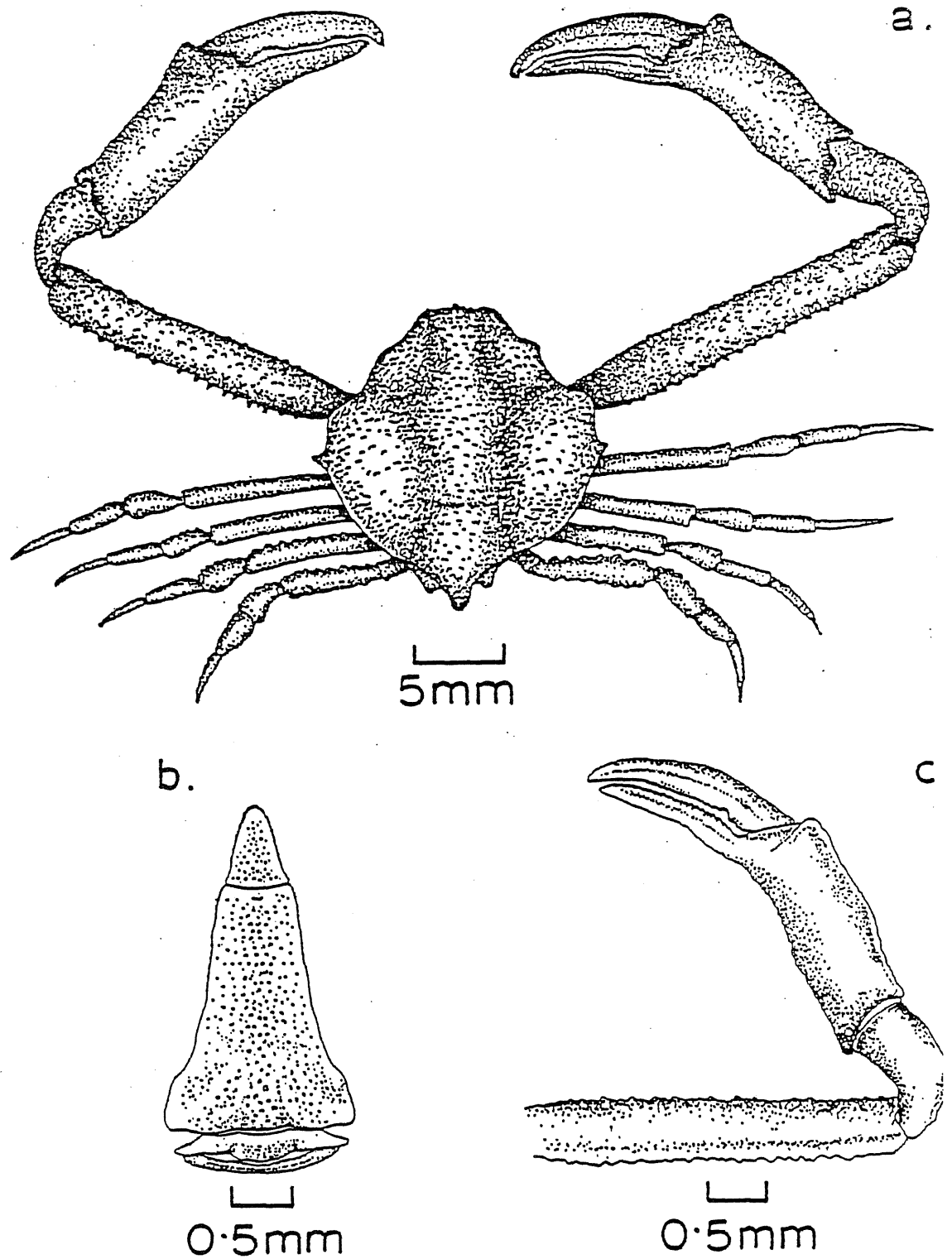


Fig. 18 - *Ebalia laevis*: a - male, dorsal view (after Dell, 1963); b - male abdomen, ventral view (after Takeda & Miyake, 1969); c - left chela, male, outer face (by J. Black).

afterwards and incubated for 7-8 months over winter. In June hatching begins and larvae appear in the plankton. A 12mm CL female carries about 1000 eggs and a 16mm female about 3000 eggs. This pattern may also be true for E.laevis. Egg size is approx. the same as E.laevis and females only produce a single brood each year.

Development and Growth

Four zoeal stages (Wear & Fielder 1985), megalopa unknown. Zoeae often found in inshore plankton samples at or near the bottom. Quintana (1986) has described megalopae of some Japanese leucosiids.

Schembri (1982) observed that moulting in E.tuberosa was restricted to late July-early September i.e. warmer months. Males above 9.5mm CL and females above 11.0mm did not moult and probably have terminal anecdyosis. These crabs survive for at least two years. Females grow to a larger size than males and while small crabs (7mm CL) have moult increments of around 30%, large females grow about 20% but males only grow about 10%. The population structure did not show any seasonal progression of modes and appeared static. However, the combined size-frequency data suggest a population dominated by large, old individuals and the presence of three or possibly four classes. The sex ratio, 1.14 females:1 male was significantly different from 1:1.

Behaviour

E.laevis burrows in sandy substrates. Crabs back into the sand using the legs till about half buried and then alternately use each long cheliped to pull scoops of sand over the rest of the carapace till only the cheliped tips are visible. A 15mm CW crab buried in about 60sec. This burying behaviour is similar to that of E.tuberosa reported by Schembri (1981a) which remains in one spot for long periods (Schembri, 1981b). E.laevis is extremely sluggish in its movements and easily handled.

With E.tuberosa the male is the active partner in courtship and mating which occurs when both sexes are hard-shelled. The copulating pair may partly bury themselves in sediment or remain on the surface. They may remain in copula for up to 9 hours (Schembri, 1983).

Ecology

Sometimes recorded in large numbers in dredge samples and frequently preyed upon by fish. Young (1929) found E.laevis in blue cod (Parapercis colias) stomachs from the Chatham Islands. Snapper (Chrysophrys auratus) from the Hauraki Gulf and Bay Of Plenty eat E.laevis, 1.5-6.2% of gut volume (Godfriaux 1969), trevally (Caranx lutescens), 0.3%, red gurnard (Chelidonichthys kumu), 2.2%, eagle ray (Holorhinus tenuicaudatus), 0.9% (Godfriaux 1970a) and tarakihi (C.macropterus), 2.1% (Godfriaux 1974a). Red cod (Pseudophycis bacchus) from Banks Peninsula in October also ate (0.5%) this crab (Habib 1975).

References

Bennett (1964), Dell (1963a), Schembri (1979a, 1979b, 1981a, 1981b, 1982, 1983), Wear & Fielder (1985).

HETEROTREMATA

LEUCOSIIDAE

Merocryptus lambriformis A. Milne Edwards, 1873
Rough Nut Crab

Synonymy

Merocryptus lambriformis A. Milne Edwards, 1873; Miers, 1886; Whitelegge, 1900; Balss, 1922; Rathbun, 1923; Hale, 1927; Ebalia rugulosa Yokoya, 1933; Merocryptus lambriformis Sakai, 1935; 1937; Serene, 1955; Bennett, 1964; Sakai, 1965; Dell, 1968a; Campbell, 1971; Wear & Fielder, 1985 (list).

Type Locality

Upolu Is., Samoa.

Distribution

Japan to Samoa, Australia and New Zealand. Within Australia from the Great Australian Bight, Bass Strait, Port Hacking, Crowdy Head and Queensland. Within New Zealand Little Barrier Is., off Patea, South Taranaki.

Diagnosis (Fig. 19a-c)

Carapace somewhat rhomboidal, wider than long (ratio 1.25), covered in bead-like granules, very convex and uneven behind the bilobed rostrum. Two conical, forwardly directed gastric tubercles, and a large cardiac tubercle. Two small spines on margins behind hepatic region. Branchial region has a stout, laterally directed process. Posterior margins bearing two projections which are most prominent in young males. Chelipeds well developed, densely tuberculated, propodus short and inflated, finger s long slender and curved inward. Legs shorter than chelipeds, covered in bead-like granules, some granules are sagittate in shape.

Colour

Not recorded.

Size

Male 14.3mm CW, 10.8mm CL. Female 19.3mm CW, 14.8mm CL.

Habitat

Rough bottom with sand and shell.

Depth

40-219m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown.

References

Bennett (1964), Campbell (1971), Dell (1968a), Hale (1927), Rathbun (1923).

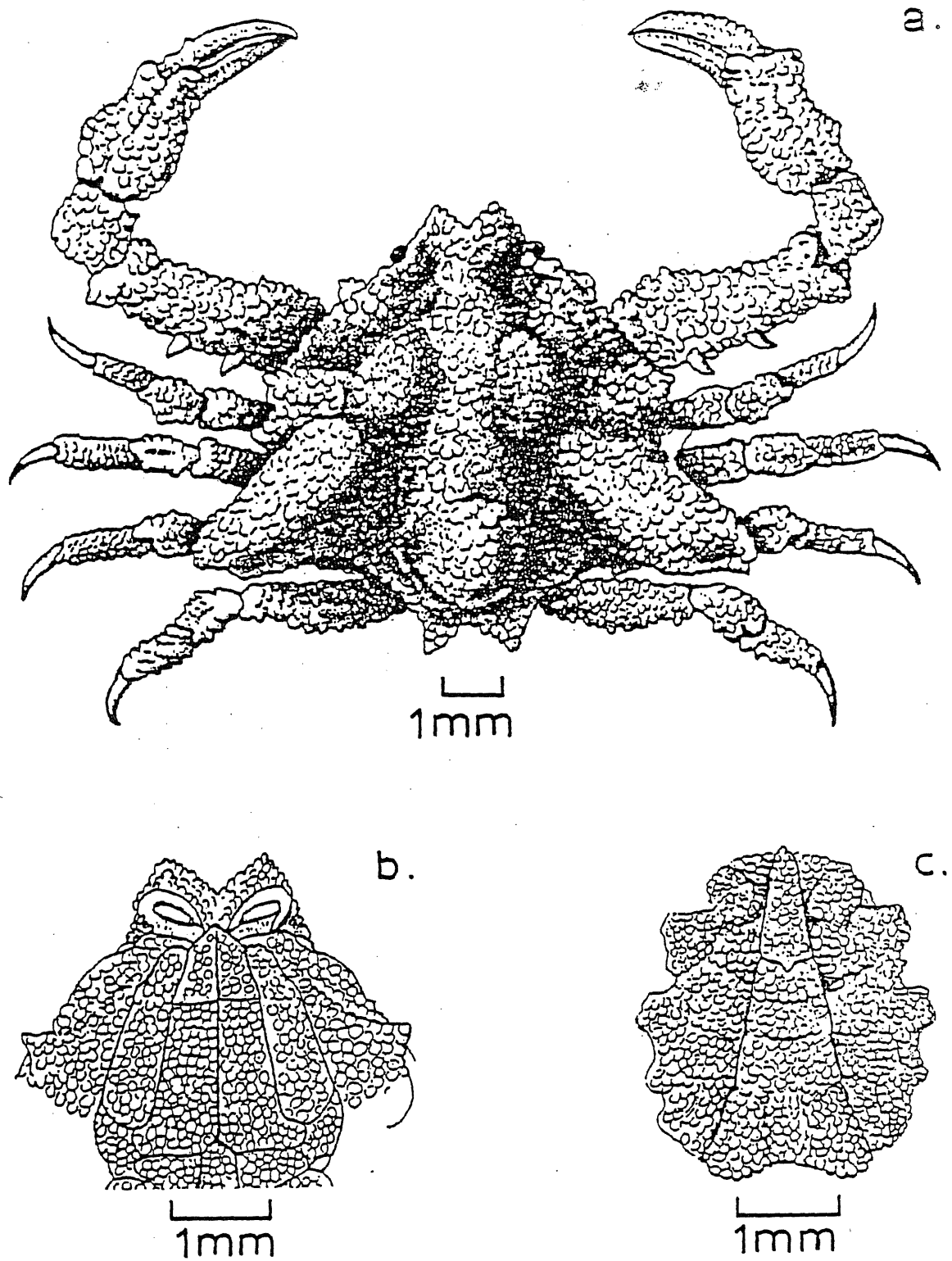


Fig. 19 - *Merocryptus lambriformis*: a - male, dorsal view; b - anterior end, ventral view; c - male abdomen, ventral view (after Milne Edwards, 1873).

HETEROTREMATA

LEUCOSIIDAE

Randallia pustulosa Wood-Mason, 1891
Purse Crab

Synonymy

Randallia pustulosa Wood-Mason, 1891; 1892; Alcock, 1896; 1899; Doflein, 1904; Ihle, 1918; Yaldwyn & Dawson, 1976; Wear & Fielder, 1985 (list).

Type Locality

Indian waters.

Distribution

Indo-west Pacific, off East Africa, Arabian Sea (Laccadive Sea), Bay of Bengal (Andaman Sea), Indonesia (Strait of Macassar) and northern New Zealand.

Diagnosis (Fig. 20a)

Carapace globular, strongly convex, circular in outline, granulate, regions defined by grooves. Mouth-frame anteriorly prolonged and orbits dorsally emarginate with two clefts. Lateral margins of carapace with three or four pronounced tubercles and the posterior margin has a pair of lobes on either side of a conspicuous intestinal spine. Chelipeds very long (about twice CL) and slender, evenly and finely tuberculate. Propodus not inflated, fingers long and curved and not gaping. Legs short and slender, finely tuberculate, dactyls pubescent with a dense brush of setae laterally.

Colour

White when preserved.

Size

Male 42mm CL, female 43mm CL.

Habitat

Deep water mud and sand.

Depth

Deep water on the continental slope 402-977m.

Breeding

One ovigerous female has been collected in December.

Development and Growth

Unknown.

Behaviour

Unknown for this species but other species in this family commonly bury themselves with only the eyes exposed above the substrate. Some species feign death when disturbed.

Ecology

Unknown, but related species with long, finely toothed fingers capture small fish and crustaceans.

References

Yaldwyn & Dawson (1976).

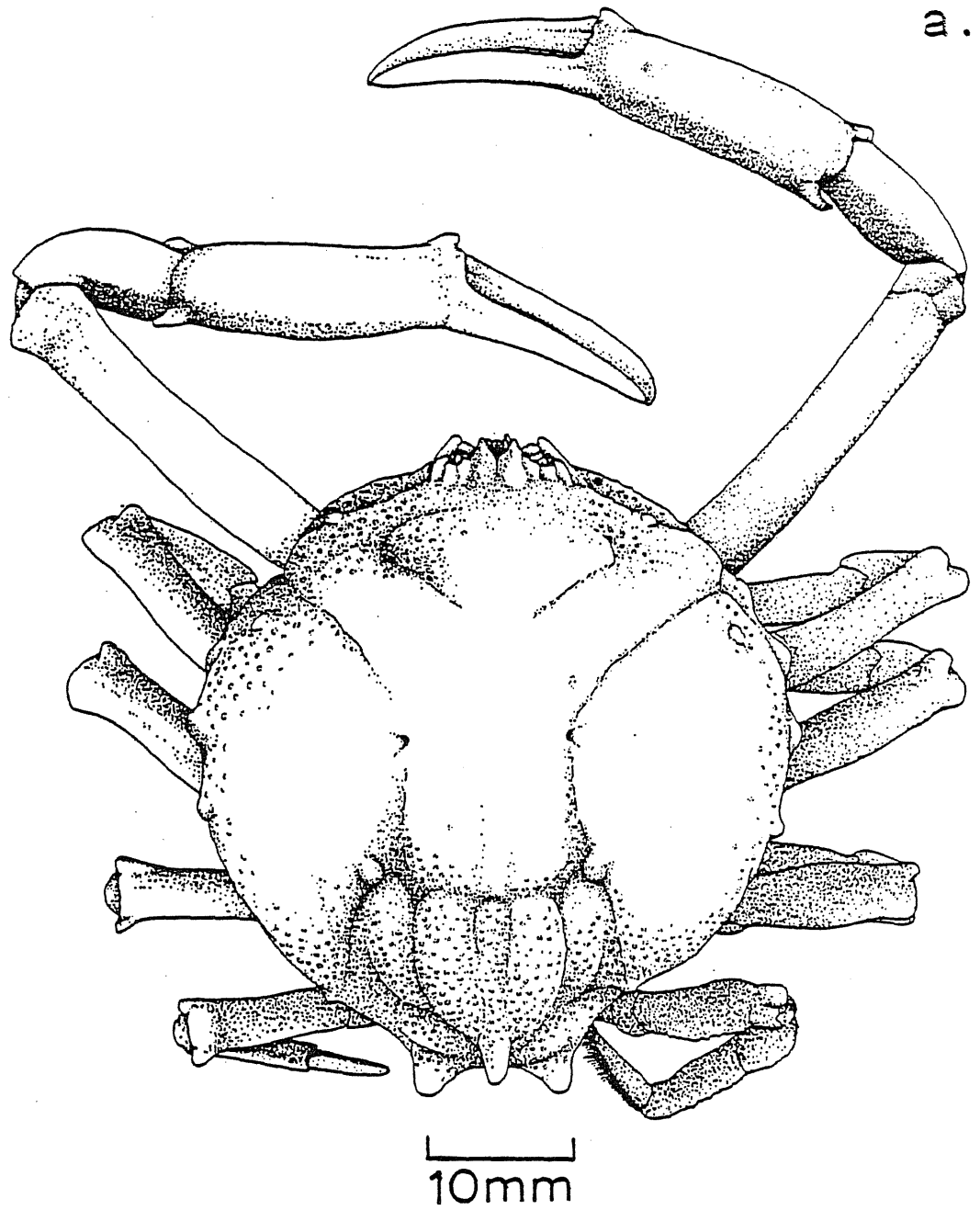


Fig. 20 - *Randallia pustulosa*: a - female, dorsal view
(by C. Duffy, based on a photo from Yaldwyn &
Dawson, 1976).

HETEROTREMATA

MAJIDAE

Eurynome bituberculata Griffin, 1964Synonymy

Griffin, 1964; 1966a; Griffin & Tranter, 1986a (key).

Type Locality

Off Glen Burn (East Wairarapa Coast, North Island), in 200m.

Distribution

North Cape, lower half of North Island, Cape Egmont to Cape Palliser.

Diagnosis (Fig. 21a-e)

Carapace pyriform, surface setose, bearing flat-topped tubercles, flattened lobes and short conical spines. Almost uniformly convex in profile. Tubercles irregularly crenulate and arranged in groups separated by wide smooth areas. Rostrum of two, short, flattened truncate lobes. Orbit consisting of supraorbital eave, intercalated spine and postorbital lobe, the three closely approximated. Orbit completed below by basal antennal article and infraorbital plate. Lateral margins of carapace with three prominent, triangular, flattened lobes, one postorbital, one hepatic and one branchial at the widest part of the carapace. A fourth, branchial lobe, situated subdorsally behind marginal lobe and surrounded by flat-topped tubercles. Chelipeds very long, slender, subcylindrical, covered by numerous blunt tubercles. Merus very long, fingers acute, weakly toothed, down-turned. Legs short, cylindrical, covered by short, blunt tubercles. Abdomen of six segments in both sexes.

Colour

Pale pink with white tubercles when preserved.

Size

Male 8mm CW, CL 11.5mm. Female 8.5mm CW, 11.5mm CL.

Habitat

On bottoms with sponges and on muddy sand with broken shell.

Depth

Lower continental shelf, 80 to 280m.

Breeding

Ovigerous females have been collected in September and March (Wear & Fielder, 1985).

Development and Growth

Unknown, but probably two zoeal stages (Wear & Fielder, 1985).

Behaviour & Ecology

Unknown.

References

Griffin (1964, 1966a), Wear & Fielder (1985).

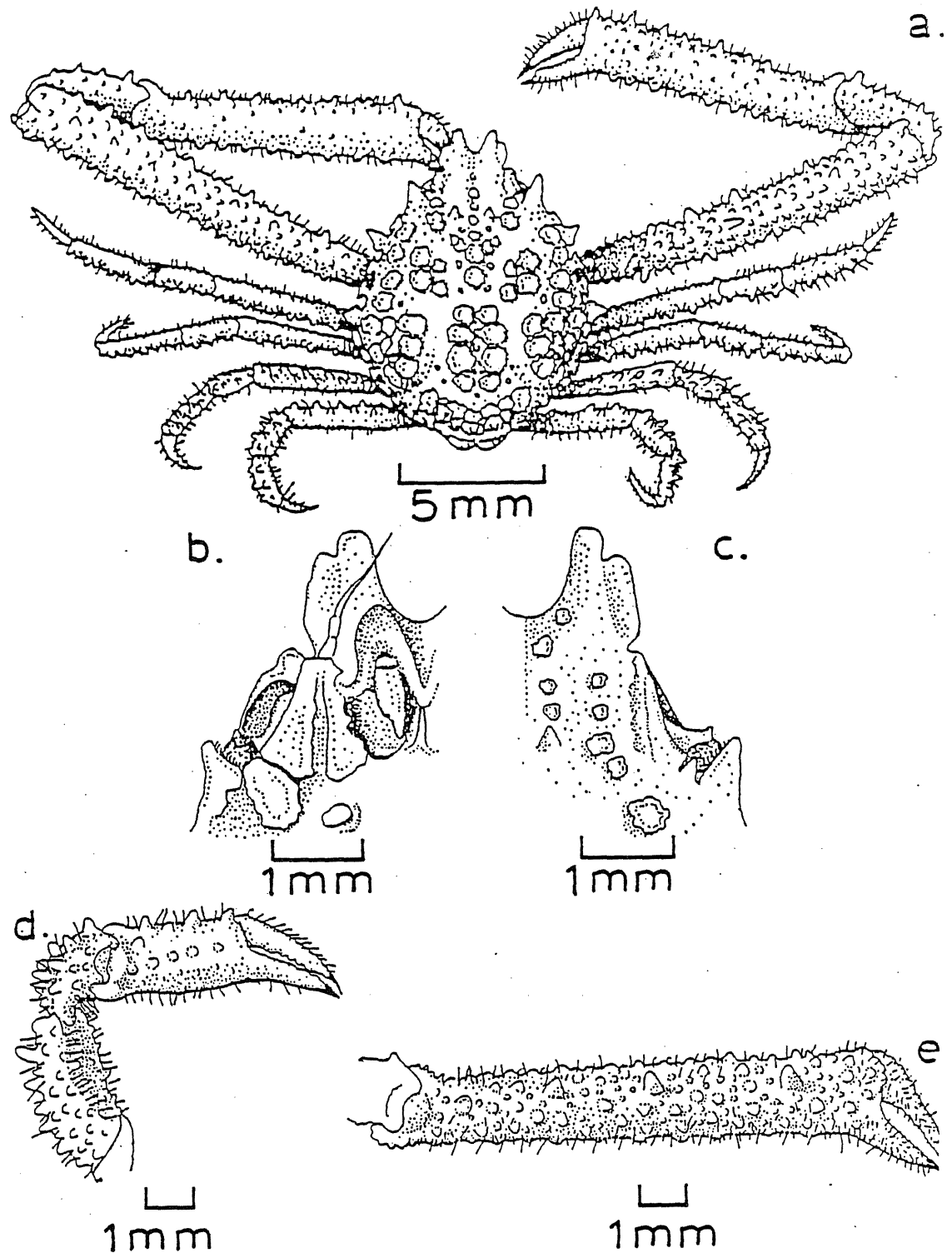


Fig. 21 - *Eurynome bituberculata*: a - male, dorsal view; b - ventral view of orbit; c - dorsal view of orbit; d - right cheliped, female, outer face; e - right chela, male, outer face (after Griffin, 1966).

HETEROTREMATA

MAJIDAE

Cyrtomaia lamellata Rathbun, 1906Synonymy

Cyrtomaia lamellata Rathbun, 1906; Echinomaia hispida Borradaile, 1916; Chilton & Bennett, 1929; Cyrtomaia hispida Balss, 1929; Ihle & Ihle-Landenberg, 1931; Cyrtomaia platypes Yokoya, 1933; Sakai, 1938; Echinomaia hispida Richardson, 1949b; Cyrtomaia hispida Bennett, 1964; Griffin, 1966a; Dell, 1968a; Cyrtomaia platypes Takeda & Miyake, 1969; Cyrtomaia hispida Serene & Lohavanijaya, 1973; Griffin & Brown, 1976; Sakai, 1976; Cyrtomaia platypes Takeda & Kurata, 1976; Cyrtomaia lamellata Guinot & Richer de Forges, 1982; Cyrtomaia hispida Guinot & Richer de Forges, 1982; Wear & Fielder, 1985; Cyrtomaia lamellata Griffin & Tranter, 1986a.

Type Locality

Hawaiian Islands.

Distribution

Japan, Ryukyu Is., Ogasawara Is., Timor, New Caledonia, Hawaii, New Zealand (Three Kings Islands, off North Cape and east of Papanui Inlet, Otago).

The 17 species of Cyrtomaia have been reviewed and keyed by Griffin & Tranter (1986a).

Diagnosis (Fig. 22a-d)

Carapace subcircular, slightly broader than long, swollen in profile, margins armed with a few spines and numerous spinules. Rostrum of three short, slender, sharply pointed, hooked spines. Dorsal surface of carapace with a single medial urogastric spine and a pair of prominent submedial cardiac spines. Carapace surface otherwise bearing numerous small tubercles. Eystalks exposed, ornamented, post-orbital spine strong. Hepatic margin with a single spine. Branchial region also with a single long spine and a row of about 15 spinules along anterolateral part of branchial margin. Chelipeds moderately long (slightly more than twice CL), bearing sharp spines. Fingers moderately gaping for their entire length, irregularly toothed along inner edges. Legs long and armed with spines. Propodus and dactyl of first leg with long spines which intersect when dactyl is folded back. This prehensile arrangement may be involved in prey capture (Guinot & Richer de Forges 1982). Abdomen of six segments plus telson. The first segment with a sharp medial spine and the second with a pair of lateral spines on each side and a single medial spine. Margin of telson broadly rounded.

Colour

Unknown.

Size

Male 16.9mm CW, 15.5mm CL. Female (ovigerous) 15mm CW, 13.7mm CL. Smallest ovigerous female 11.5mm CL.

Habitat

Associated with bryozoa and shell together with sponges, hydroids, gorgonian and soft corals.

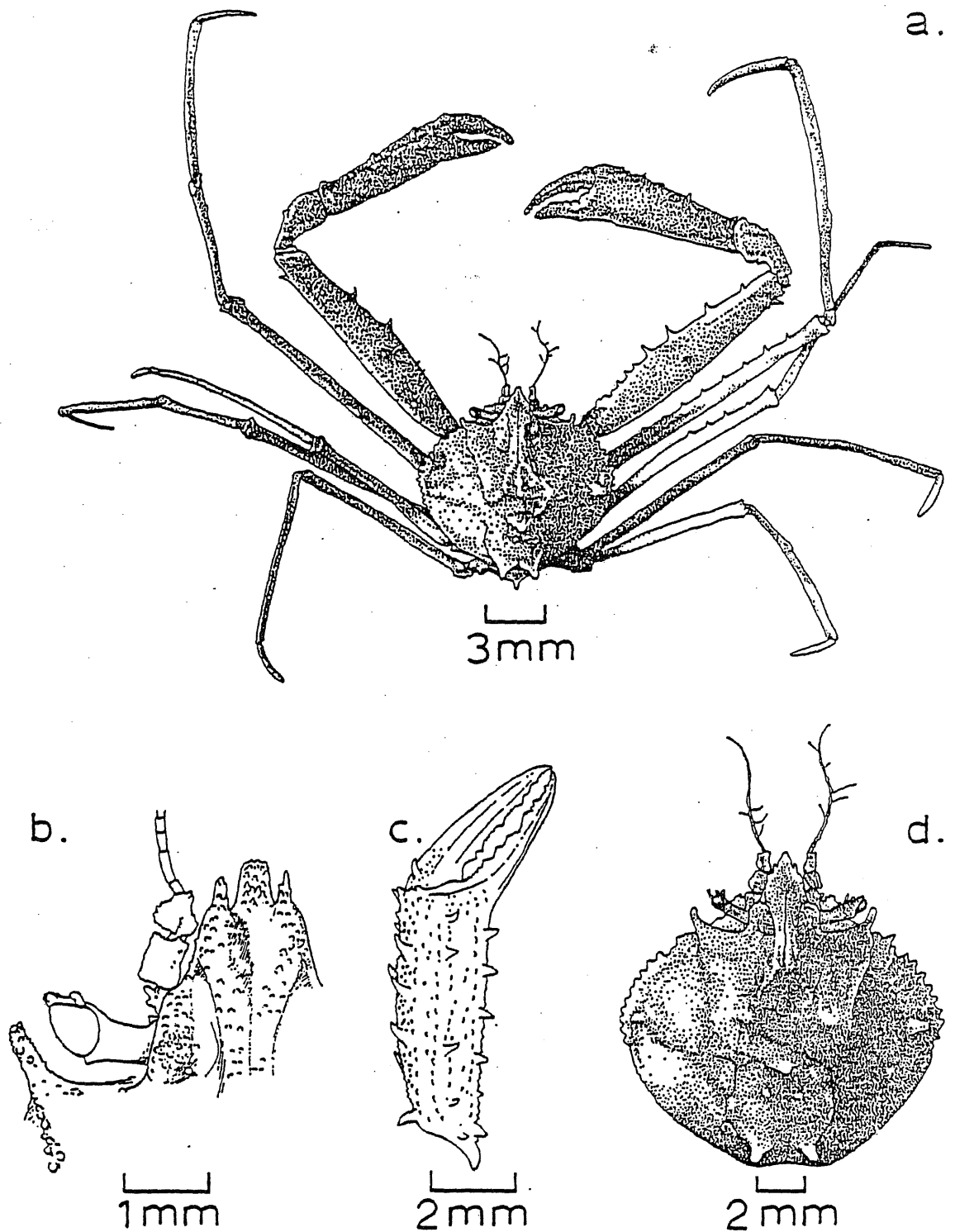


Fig. 22 - *Cyrtomaia lamellata*: a - male, dorsal view (by C. Duffy, based on a photo from Guinot & Richer de Forges, 1982); b - orbit, dorsal view (after Guinot & Richer de Forges, 1982); c - right chela, male, outer face (after Bennett, 1964); d - detail of carapace, male, dorsal view (by C. Duffy, based on a photo from Guinot & Richer de Forges, 1982).

Depth

Off-shore on continental shelf 70-216m.

Breeding

Ovigerous females have been collected in January and February from SE of Three Kings Island. Newly laid eggs are red, 0.63mm diam and eggs ready to hatch are 0.72mm.

Development and Growth

Two zoeal stages (Wear & Fielder 1985). Megalopa unknown.

Behaviour, Ecology

Unknown.

References

Bennett (1964), Griffin (1966a), Griffin & Tranter (1986a), Guinot & Richer de Forges (1982), Sakai (1976), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Platymaia maoria Dell, 1963Synonymy

Platymaia maoria Dell, 1963b; Griffin, 1966a; Dell, 1968a; Serene & Lohavanijaya, 1973; Guinot & Richer de Forges, 1985; Wear & Fielder, 1985 (list); Griffin & Tranter, 1986a.

Type Locality

ENE of Poor Knights Is., 555-618m.

Distribution

Eastern Australia and New Zealand (East-North-East of Poor Knights Islands, North of Cape Brett, North-East of Cavalli Islands, Challenger Plateau 168°23'E, 38°41.1'S).

Six species of Platymaia have been reviewed and keyed by Griffin & Tranter (1986a) who note that another species (intensely spinous) from Australia and New Zealand remains to be described. Guinot & Richer de Forges (1985) provide a key to 9 species of Platymaia with some differences from Griffin & Tranter.

Diagnosis (Fig. 23a-d)

Carapace subcircular, irregularly granular with sparse spines. Rostrum consisting of a single spine (about twice as long as lateral spines) which curves upward. Lateral rostral spines extending obliquely upwards. All three spines long, narrow and tapering. Carapace with three mesogastric spines, a single central metagastric spine, two cardiac spines, a single epibranchial spine and several smaller mesobranchial spines. Margins of carapace with two prominent hepatic spines, five medium branchial spines and a single prominent spine on the posterolateral margin. Chelipeds long (less than twice CL), spinous (especially propodi), fingers acute, dactyl with three short spines above, and cutting edges with strong, rounded teeth. Legs very long (first pair 4.4 times CL) and spinous (especially on first pair). Abdomen of six segments plus telson in both sexes.

Colour

Dull white-greyish when preserved. Tips of dactyli brown, tips of all spines pinkish.

Size

Male 60mm CW, 60mm CL. Smallest ovigerous female 51mm CL, 48mm CW.

Habitat

Unknown.

Depth

Deep water 275m-937m.

Breeding

An ovigerous female has been collected in November.

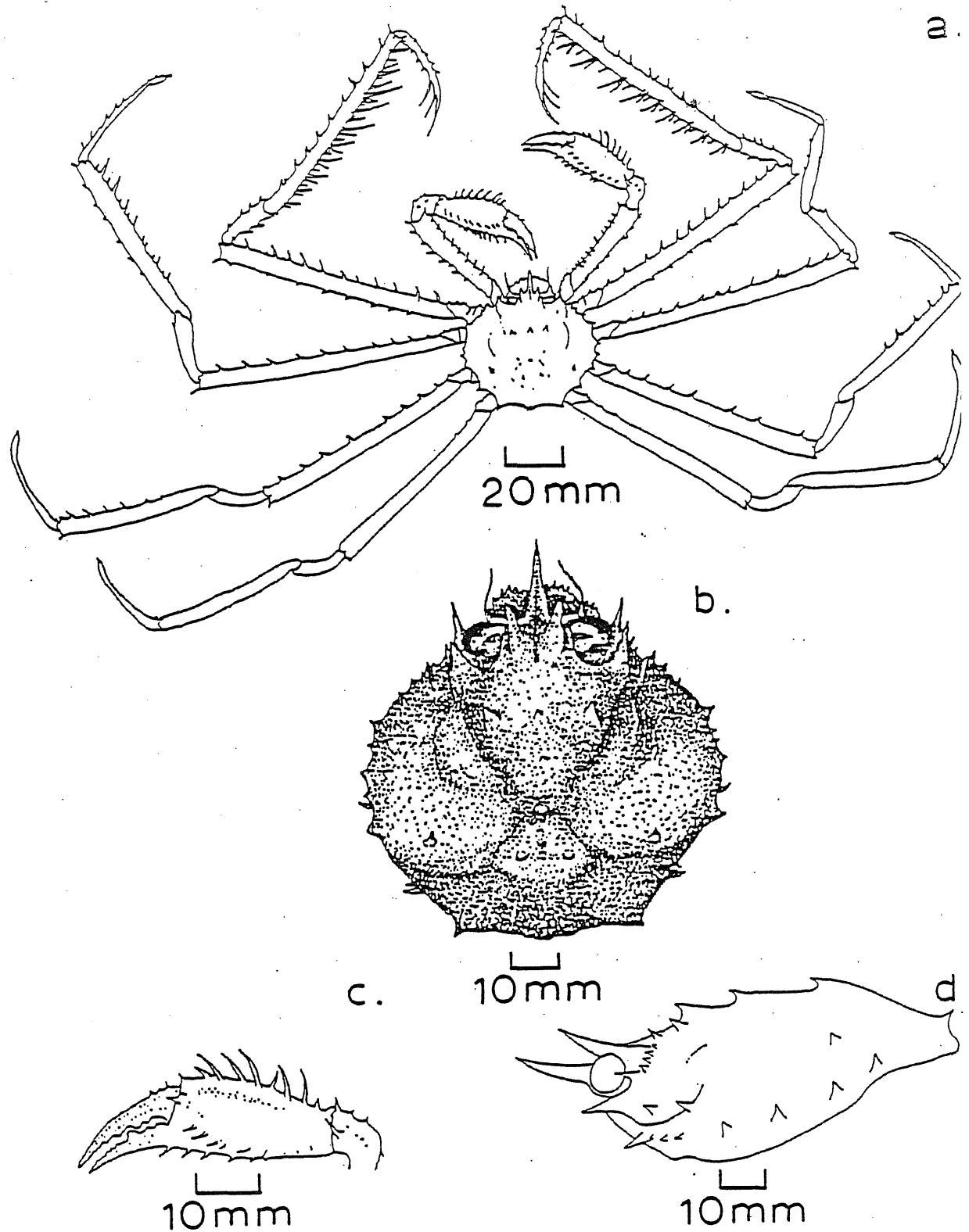


Fig. 23 - *Platymaia maoria*: a - male, dorsal view; b - detail of carapace; c - right chela, male, inner face; d - carapace, female, lateral view (after Dell, 1963b).

Development and Growth, Behaviour, Ecology
Unknown.

References

Dell (1963b), Griffin & Tranter (1986a).

HETEROTREMATA

MAJIDAE

Pyromaia tuberculata (Lockington, 1877)Synonymy

Inachus tuberculatus Lockington, 1877; Miers, 1886;
Inachoides magdalensis Rathbun, 1893a; Neorhynchus mexicanus
 Rathbun, 1893a; Dasygyvius tuberculatus Rathbun, 1898; Holmes,
 1900; Weymouth, 1910; Hilton, 1916; Inachoides tuberculatus
 Schmitt, 1921; Pyromaia tuberculata Rathbun, 1925; 1926; Collodes
granosus Boone, 1930; Pyromaia tuberculata Crane, 1937; Ricketts
 & Calvin, 1939; Garth, 1948; 1958; Ricketts & Calvin, 1968;
 Sakai, 1971b; Smith & Carlton, 1975; Sakai, 1976; Morris et al,
 1980; Webber & Wear, 1981; Wear & Fielder, 1985.

Type Locality

Mouth of San Diego Bay (type not extant, Rathbun 1925).

Distribution

New Zealand, Orere Point, Firth of Thames, Tamaki Estuary,
 Auckland. West Coast of North America, San Francisco to Bay of
 Panama, Sagami Bay, Japan. Probably introduced to Japan and New
 Zealand as megalopa larvae attached to bottom of ships.

Diagnosis (Fig. 24a)

Carapace pyriform (pear-shaped), convex, finely pubescent,
 rough with tubercles and spines. A large tubercle, often
 spiniform, on the mesogastric, cardiac and intestinal regions and
 sometimes on summit of branchial regions. Rostrum simple, of
 variable length. Supra-orbital spine usually present,
 post-orbital tooth large, curving about the extremity of the eye,
 tip directed nearly forward. Sternum conspicuously granulate or
 tuberculate, pubescent, deeply grooved between segments, a large
 tubercle opposite base of each cheliped. A short spiniform
 tubercle pointing upward and backward on first segment of the
 abdomen. Chelipeds stout, shorter than first two or three pairs
 of walking legs. Propodus inflated, sub-globular, sparsely
 granulate, a longitudinal row of four or five tubercles through
 middle of proximal end of outer surface. Fingers nearly as long
 as propodus, triangularly gaping when closed, a large tooth at
 proximal third of fixed finger. Fingers not gaping in female.
 Walking legs long, slender, similar, diminishing in length from
 first to fourth pair, dactyli moderately curved, almost smooth.

Colour

Unknown.

Size

Males 17.7mm CW. Females 15.1mm CW.

Habitat

Under rocks in bays, sub-littoral on protected wharf
 pilings, often encrusted with sponges and algae. Also on sand and
 mud.

Depth

Intertidal to 650m.

a.

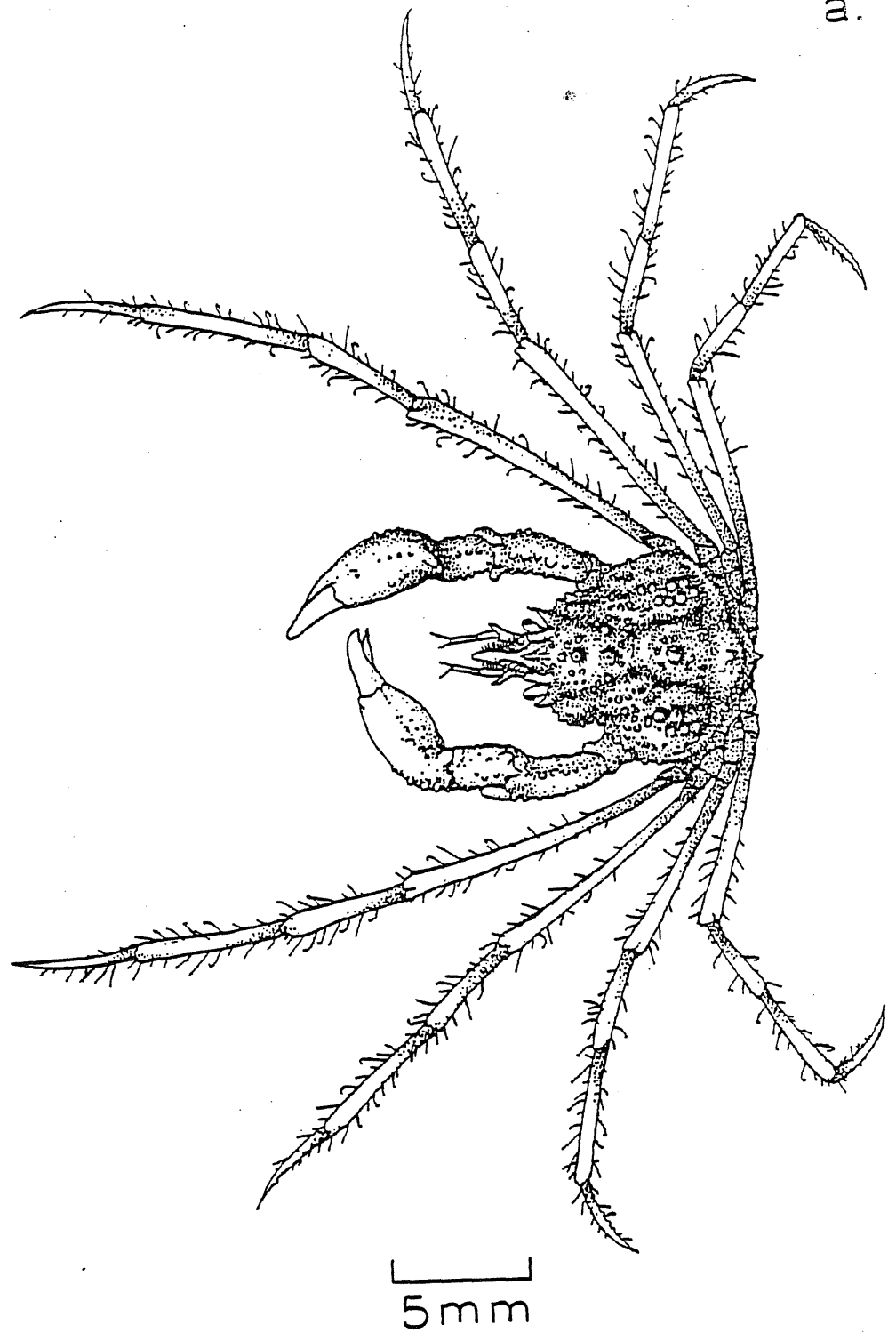


Fig. 24 - *Pyromaia tuberculata*: a - male, dorsal view (after Sakai, 1971b).

Breeding

In Southern California ovigerous females occur over most of the year with maximum numbers in summer months. In New Zealand ovigerous females have been collected April to August which suggests that this species has not yet modified its breeding pattern since its introduction to the Southern Hemisphere. Eggs are red or orange-red when new and measure 0.6 x 0.5mm when ready to hatch Webber & Wear (1981).

Development and Growth

The first stage zoea larva has been described by Webber and Wear (1981) and the second zoea by Wear & Fielder (1985). Megalopa unknown.

Behaviour

Nothing is known about the behaviour of this species but since it is usually covered by sponges and algae it probably exhibits similar masking behaviour to other spider crabs.

Ecology

Unknown.

References

Garth (1958), Morris, Abbott & Haderlie (1980), Ricketts & Calvin (1968), Sakai (1971b, 1976), Schmitt (1921), Smith & Carlton (1975), Wear & Fielder (1985), Webber and Wear (1981).

HETEROTREMATA

MAJIDAE

Achaeopsis ramusculus (Baker, 1906)Synonymy

Stenorhynchus ramusculus Baker, 1906; Achaeopsis thomsoni Rathbun, 1918c; Achaeopsis ramusculus Hale, 1927b; Griffin, 1966a; Dell, 1968a; Wear & Fielder, 1985(list); Griffin & Tranter, 1986a.

Type Locality

Off Neptune Islands, South Australia coast, 200m.

Distribution

South Australia, New Zealand, N.E. of Mayor Is.

The 4 species of Achaeopsis are reviewed by Griffin & Tranter (1986a).

Diagnosis (Fig. 25a-d)

Carapace broadly pyriform, inflated and weakly convex, margins with several long spines and numerous spinules. Rostrum of two long spines (almost one third of CL) and a few curled hairs above orbit and on dorsal surface. Margins of carapace with 10 prominent spines : 1 supraorbital, 1 postorbital, 4 hepatic and 4 branchial (the last subdorsal), and several spinules. Dorsal surface of carapace with two subequal, slender spines posteriorly. Carapace otherwise smooth and minutely granular. Chelipeds long (slightly longer than carapace in female), spinous, hairy. Fingers acute, curved inwardly at tips, finely denticulate along adjacent inner edges for entire length. Legs long, slender, first pair longest (almost three times CL), following legs decreasing slightly in length. Curled and long hairs scattered along dorsal surfaces of legs. Female abdomen of six segments.

Colour

White after preservation.

Size

Male 9mm CL. Female 6mm CW, 10mm CL.

Habitat

Unknown.

Depth

Deep water 200-800m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown.

References

Griffin (1966a), Griffin & Tranter (1986a).

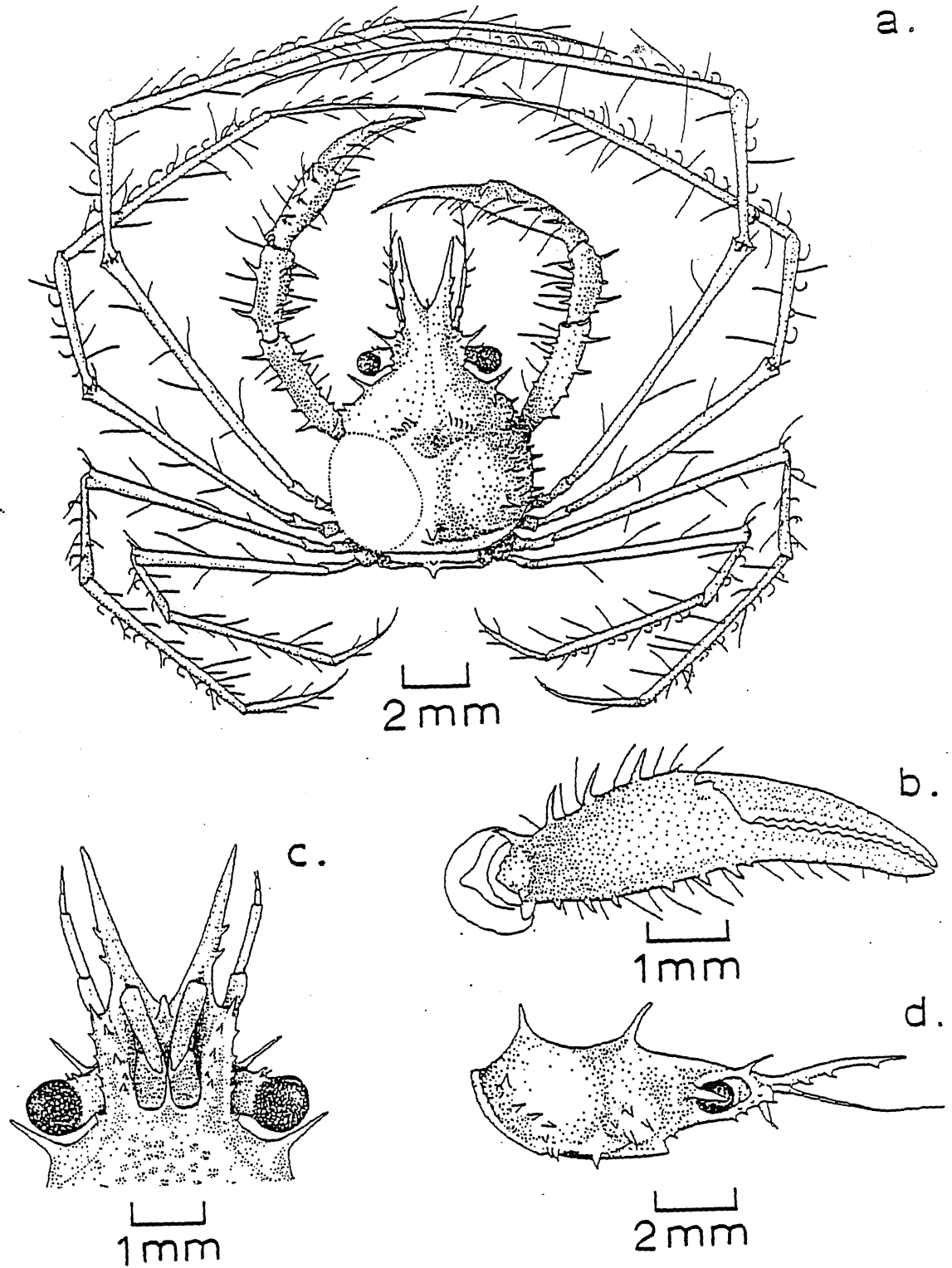


Fig. 25 - *Achaeopsis ramusculus*: a - female, dorsal view; b - left chela, female; c - anterior end, ventral view; d - carapace, lateral view (after Griffin, 1966).

HETEROTREMATA

MAJIDAE

Achaeus curvirostris (A. Milne Edwards, 1873)Synonymy

Stenorhynchus curvirostris A. Milne Edwards, 1873;
Stenorhynchus fissifrons Haswell, 1879; 1880a; 1880b; 1882a;
Achaeopsis fissifrons Miers, 1886; Achaeus tenuicollis Miers,
 1886; Whitelegge, 1900; Rathbun, 1918c; Stenorhynchus fissifrons
 Chilton & Bennett, 1929; Bennett, 1930; Achaeus elongatus Sakai,
 1938; Stenorhynchus fissifrons Richardson, 1949b; Achaeus
fissifrons Griffin & Yaldwyn, 1965; Griffin, 1966a; Dell, 1968a;
 Campbell & Stephenson, 1970; Griffin, 1970; Achaeus curvirostris
 Griffin, 1974; Achaeus fissifrons Wear & Fielder, 1985; Achaeus
curvirostris Griffin & Tranter, 1986a.

Type Locality

Bass Strait.

Distribution

Widespread Indo-West Pacific: eastern Africa, Philippine Is., Japan, western and eastern Australia and New Zealand (predominantly northern half of the North Island).

The 27 Indo-West Pacific species of Achaeus are reviewed by Griffin & Tranter (1986a).

Diagnosis (Fig. 26a-c)

Carapace elongate, subtriangular (length 1.3 times width), almost truncate anteriorly, branchial regions inflated. Margins of carapace with few prominent spines and several spinules. Dorsal surface weakly tuberculate and sparsely pubescent. Rostrum consists of two very short, slender, acute spines. Chelipeds very long (almost twice CL in adult male), stout, surfaces granular, spines and long hairs scattered along dorsal and ventral surfaces. Fingers acute, curved inward distally, adjacent inner edges toothed irregularly for entire length. Legs extremely long and slender. First leg longest (5 times CL), following legs decreasing. Abdomen of five segments plus telson in both sexes.

Colour

Preserved specimens are dull creamy white.

Size

Male 6mm CW, 8mm CL. Female 7.2mm CL. Smallest ovigerous female 5.5mm CL.

Habitat

On sandy bottom associated with extensive sponges, pink and white coralline algae, Petrolisthes novaezelandiae, Petalomera wilsoni, Liocarcinus corrugatus.

Depth

Continental shelf 36-170m.

Breeding

Ovigerous females have been collected in January - March, July and September. Females carry only 20-30 eggs, newly laid

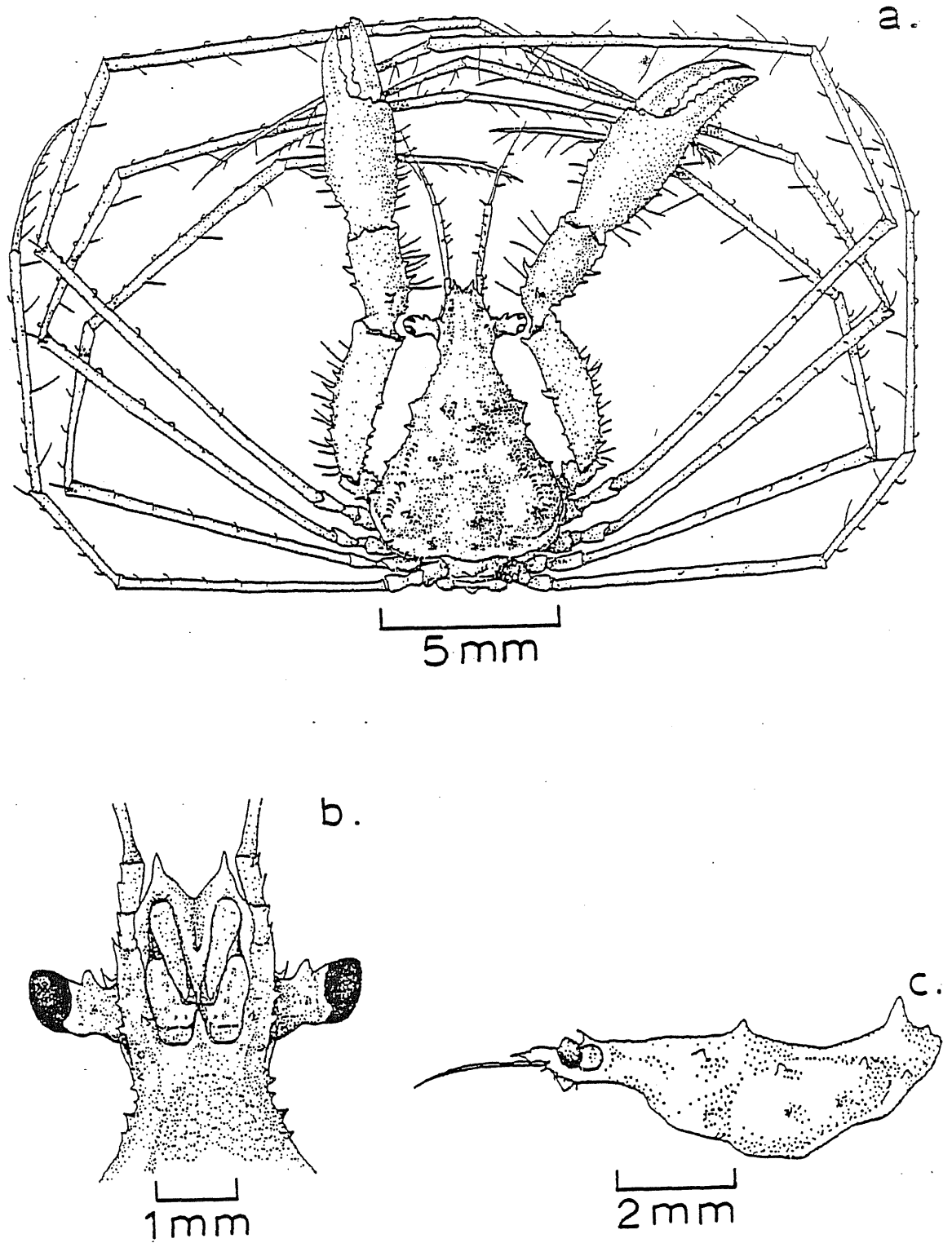


Fig. 26 - *Achaeus curvirostris*: a - male, dorsal view; b - anterior end, ventral view; c - carapace, lateral view (after Griffin, 1966).

0.62 x 0.58mm, yellow and when ready to hatch, 0.61 x 0.67mm, pale yellow.

Development and Growth

A.curvirostris is the only majid crab with a single planktonic zoeal stage (usual number is 2 zoeae). The zoea and megalopa have been described by Wear & Fielder (1985).

Behaviour, Ecology

Unknown.

References

Bennett (1964), Campbell & Stephenson (1970), Griffin (1966a), Griffin & Tranter (1986a), Griffin & Yaldwyn (1965), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Rochinia riversandersoni (Alcock, 1895)Synonymy

Scyramathia rivers-andersoni Alcock, 1895; Alcock & Anderson, 1896; Alcock, 1899; Doflein, 1904; Rochinia rivers-andersoni Serene, 1968; Rochinia rivers-andersoni Serene & Lohavanijaya, 1973; Rochinia riversandersoni Yaldwyn & Dawson, 1976; Griffin, 1976; Wear & Fielder, 1985; Griffin & Tranter, 1986a.

Type Locality

India.

Distribution

Indo-West Pacific off East Africa, Arabian Sea (Malabar Coast), Bay of Bengal (Nicobar Islands), South China Sea, Philippine Is., and off northern New Zealand and the Kermadec Islands.

The 29 Indo-West Pacific species of Rochinia from the Pacific coast of America are reviewed by Griffin & Tranter (1986a).

Diagnosis (Fig. 27a-c)

Carapace pyriform (pear-shaped), rostrum of two very long, divergent, sharp spines. Surface spinous and bearing scattered, hooked hairs in among a short, close pubescence. Three medial spines, the last at the posterior margin of the carapace and two spines on either side of these. Margins with two spines : 1 hepatic and 1 long branchial spine. Chelipeds not enlarged, fingers acute, curved, gaping basally and hooked distally. Legs relatively long, first pair longest. Abdomen of six segments and telson in both sexes.

Colour

White when preserved.

Size

Male 26.5mm CL. Female 25mm CL. Smallest ovigerous female 11mm CL (not including rostrum).

Habitat

Pumice pebbles, coral, small angular boulders on sand and mud.

Depth

Deep water 375-1362m.

Breeding, Development and Growth, Behaviour, Ecology

Unknown.

References

Griffin & Tranter (1986a), Serene & Lohavanijaya (1973), Wear & Fielder (1985), Yaldwyn & Dawson (1976).

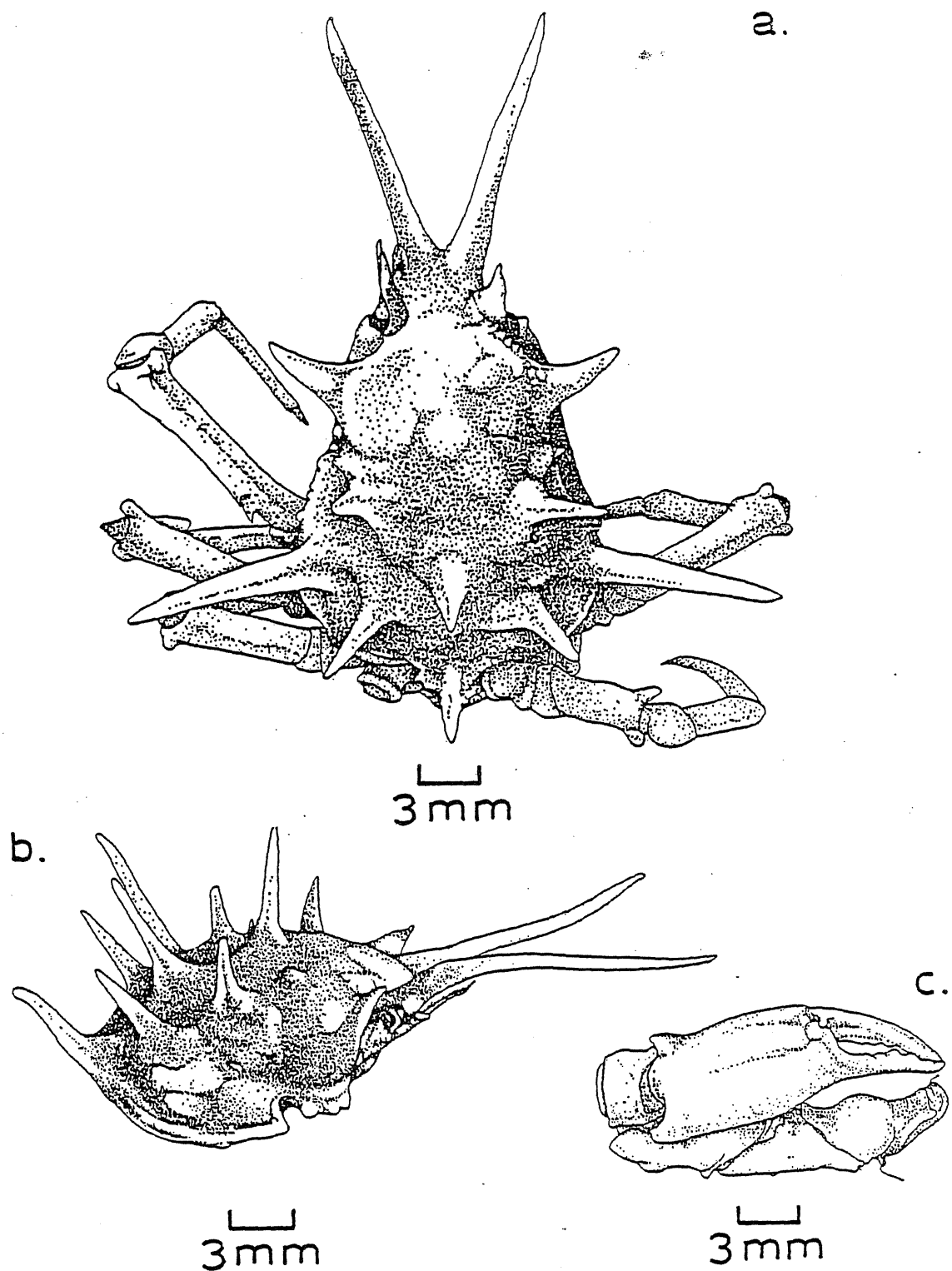


Fig. 27 - *Rochinia riversandersoni*: a - female, dorsal view; b - carapace, oblique lateral view; c - right chela, male, outer face (by C. Duffy, based on photos from Yaldwyn & Dawson, 1976).

HETEROTREMATA

MAJIDAE

Eurynolambrus australis H. Milne Edwards & Lucas, 1841
Triangle crab

Synonymy

Eurynolambrus australis H. Milne Edwards & Lucas, 1841; Dana, 1852; Miers, 1876b; Filhol, 1885d; 1886; Lenz, 1901; Thomson, 1912; Thomson & Anderton, 1921; Chilton & Bennett, 1929; Richardson, 1949b; Krefft, 1952; Dell, 1960; 1963a; Bennett, 1964; Griffin, 1966a; Dell, 1968a; Probert et al., 1979; Marsden, 1981; Webber & Wear, 1981; Wear & Fielder, 1985; Griffin & Tranter, 1986a.

Type Locality

New Zealand.

Distribution

Endemic to New Zealand. Cape Maria van Diemen to Stewart Island, also Chatham Islands.

Diagnosis (Fig. 28a-c)

Carapace broadly sub-triangular, depressed, branchial region greatly expanded laterally on each side to overhang the legs. Rostrum of two short lobes (bearing opposing rows of hooked hairs) separated by a narrow groove. Dorsal surface of carapace naked, margin coarsely scalloped, forming four short teeth. Chelipeds stout long (1.8 times CL in male) surface irregularly tuberculated and ridged. Fingers acute, weakly curved inward at tips, closely approximated, inner edges finely toothed for their entire length. Legs short, weakly compressed, lateral and medial surfaces expanded as irregular crests.

Colour

Claws purple, inner margins white. Carapace dark red irregularly mottled with white. Cavities under carapace margins are contrasting white. Antennules pale yellow, eyestalks deep red above, pale beneath, cornea darkly translucent. Legs mottled, white, orange and dark red. Leg bases honeycombed, orange and spotted white.

Size

Male 65mm CW, 41.5mm CL. Female 49mm CW, 32mm CL.

Habitat

A littoral species frequenting rocky, muddy shores on moderately exposed coasts, found under boulders covered with coralline algae. Also found offshore frequently associated with bryozoans.

Depth

Intertidal to 80m.

Breeding

Ovigerous females found from October to February. New eggs are bright orange, 0.65mm diam., eggs ready to hatch are brown, 0.84mm x 0.79mm.

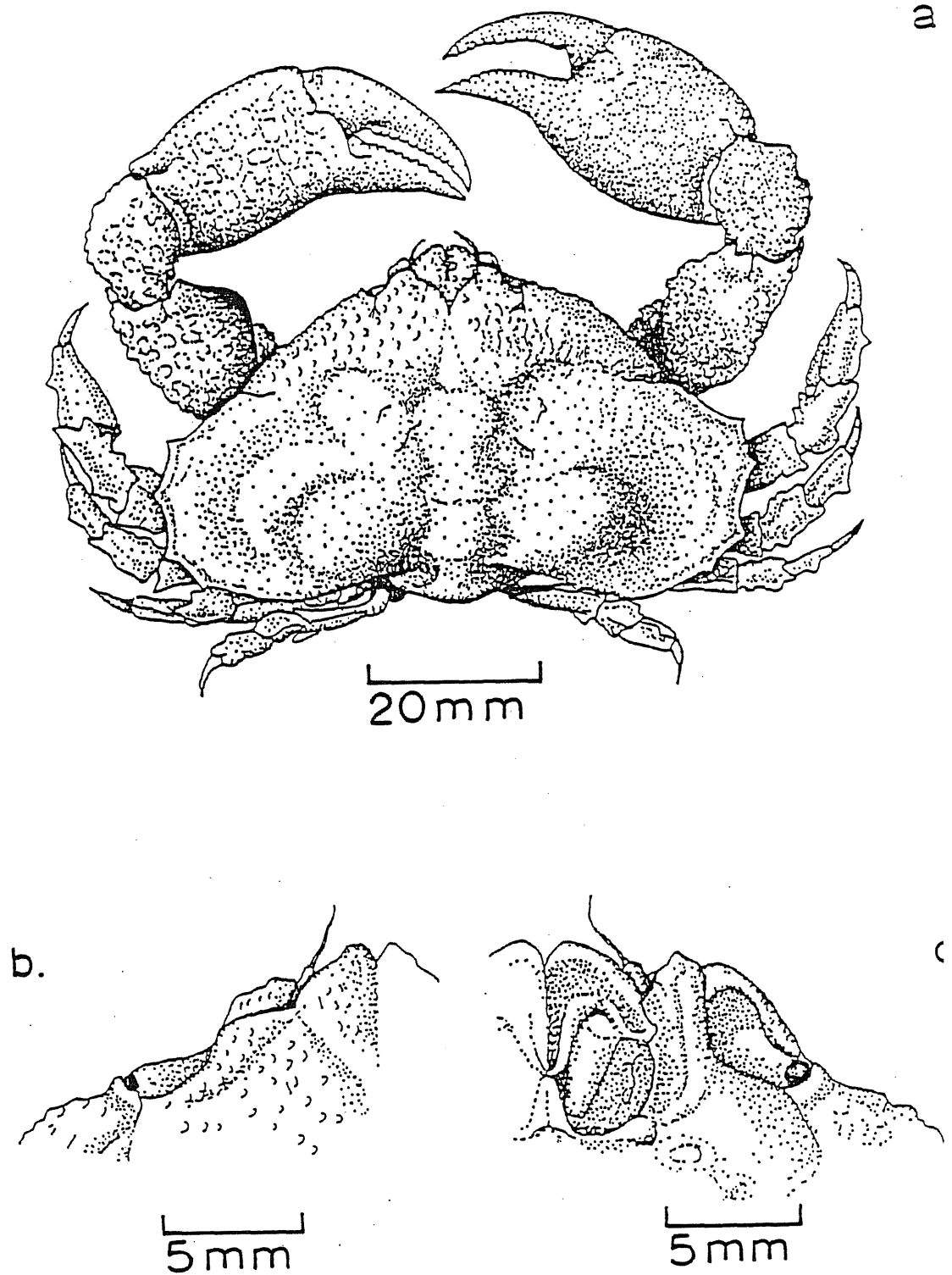


Fig. 28 - *Eurynolambrus australis*: a - male, dorsal view; b - orbit, dorsal view; c - orbit, ventral view (after Griffin, 1966).

Development and Growth

Pre-zoea, 2 zoeal stages and megalopa larva have been described by Webber & Wear (1981) and Wear & Fielder (1985). The zoeal stages last 6-8 days each and the longest surviving megalopa lasted a further 15 days. Post-larval, juvenile stages have been described by Krefft (1952). Juveniles have well developed rows of hooked hairs and lack the laterally expanded carapace of adults, giving a more pyriform shape.

Behaviour

Unlike the other spider crabs this species does not actively camouflage itself. The shape of the adult carapace excludes the chelipeds access to the dorsal surface although they can reach up on to the frontal area. When uncovered beneath a boulder this crab usually remains immobile, the mottled colour patterns making it difficult to see. The legs and bright purple chelipeds are folded and hidden underneath.

Ecology

Carapace surface often has small tubiculous polychaetes and occasionally small anemones (Anthopleura aureoradiata).

King & Clark (1984) found that rig (Mustelus lenticulatus) from Golden Bay ate small numbers of E.australis.

References

Bennett (1964), Dell (1963a), Griffin (1966a), King & Clark (1984), Krefft (1952), Probert & Batham (1979), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Leptomaia tuberculata Griffin & Tranter, 1986Synonymy

Leptomaia tuberculata Griffin & Tranter 1986a.

Type Locality

Middleton Reef, Tasman Sea, 54-72m.

Distribution

Middleton Reef, Lord Howe Is, Kermadec Is, North New Zealand.

Diagnosis (Fig. 29a-d)

Carapace much longer than wide, narrow pyriform, with many low tubercles. Rostral spines slender, divergent, widely separated from base. Orbital eave expanded, preorbital angle produced into a broad spine, antorbital lobe short and blunt, postorbital lobe separated from eave by only a narrow slit, narrowing distally, apex subacute. Eyestalks short, stout, a row of club setae distally above cornea. Hepatic region weakly elevated, a short spine and two tubercles on margin. Branchial margin with a tubercle on anterior border and a second tubercle behind it. Beginning more ventrally an irregular row of about twelve small tubercles extend to posterolateral margin. Posterior margin produced backward as a broad triangular lobe, a short blunt spine at its apex. Cheliped of male slightly shorter than postrostral CL, merus smooth with a short, blunt terminal spine, carpus with a small proximal tubercle and a terminal tubercle, palm smooth, fingers with a few low teeth and a narrow gape. Female cheliped similar but shorter. First leg slightly longer than postrostral CL, merus with a low terminal tubercle. Fourth leg shorter, dactyl with about five very small teeth ventrally on distal half. Abdomen of six segments and telson in both sexes.

Colour

Unknown.

Size

Male and female 15mm CL.

Habitat

Rocky bottom, gravel and stones.

Depth

Shallow water, 21.5-72m.

Breeding

Ovigerous female collected in November.

Development and Growth, Behaviour, Ecology

Unknown.

Reference

Griffin & Tranter 1986a.

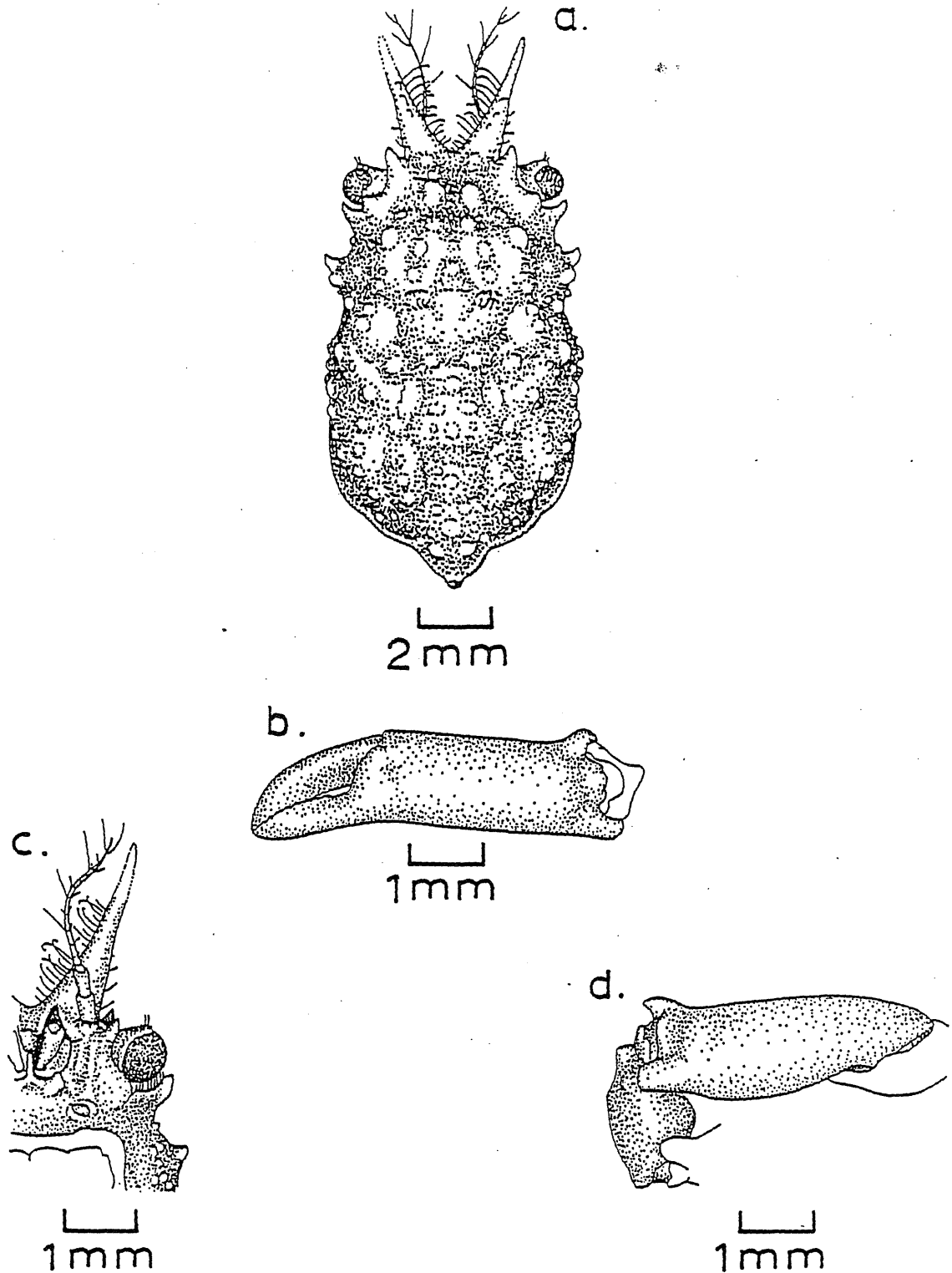


Fig. 29 - *Leptomaia tuberculata*: a - female, carapace, dorsal view; b - left chela, female, outer face; c - left orbit, ventral view; d - left cheliped, female, merus and carpus (after Griffin & Tranter, 1986).

HETEROTREMATA

MAJIDAE

Trichoplatus huttoni A. Milne Edwards, 1876
Hutton's Masking Crab

Synonymy

Trichoplatus huttoni A. Milne Edwards, 1876; Halimus hectori Miers, 1876a; 1876b; Trichoplatus huttoni Hector, 1877; Halimus rubiginosus Kirk, 1881; Trichoplatus huttoni Filhol, 1885d; 1886; Halimus rubiginosus Filhol, 1886; Trichoplatus huttoni Thomson, 1912; Thomson & Anderton, 1921; Chilton & Bennett, 1929; Naxia huttoni Richardson, 1949b; Dell, 1963a; Trichoplatus huttoni Bennett, 1964; Naxia huttoni Griffin, 1966a; Trichoplatus huttoni Griffin & Tranter, 1986a.

Type Locality

Coast of New Zealand.

Distribution

Endemic to New Zealand, mainly southern, including Stewart and Chatham Islands. Northern limits Napier and Cavalli Islands.

Diagnosis (Fig. 30a-c)

Carapace narrowly pyriform, in profile almost uniformly convex. Several prominent spinous tubercles, longer anteriorly, scattered over the carapace. Regions moderately well defined by shallow grooves. Tubercles arranged in a medial series of two anteriorly, and submedial of two pairs posteriorly, with five pairs more distant from midline. Two prominent medial mesogastric tubercles, cardiac region with a pair of small submedial tubercles and a smaller pair on posterior intestinal margin. Four prominent protogastric tubercles arranged in pairs, six small branchial tubercles. Very straight, stiff, long hairs on the supraorbital eave and arising in tufts from tubercles. Surface of carapace otherwise covered by a thick mat of short fine hairs. Rostrum of two long slender cylindrical, weakly divergent spines. Short, curled hairs fringing rostral spines. Margins of carapace have three prominent outwardly directed spines. Orbit consisting of supraorbital eave, intercalated spine and postorbital spine remote from orbit. Close behind an hepatic spine, slightly longer than postorbital, sharply pointed. Chelipeds very long, stout; merus long with a row of strong spines along dorsal edge; propodus compressed, enlarged in male, fingers acute, weakly curved gaping basally in male, closely approximated in female, finely toothed. Legs of moderate length, stout, smooth except for a few small ventral spinules, covered by a mat of short hairs, groups of curled hairs in a dorsal row and long stout hairs. Propodi strongly compressed and greatly expanded with dactyli strongly curved to make all legs subchelate. Abdomen of five segments in male and female, with sixth segment and telson almost completely fused.

Colour

Carapace and chelipeds pink to deep red or pale purple.

Size

Male 49mm CW, 82mm CL. Female (ovigerous) 43mm CW, 62mm CL.

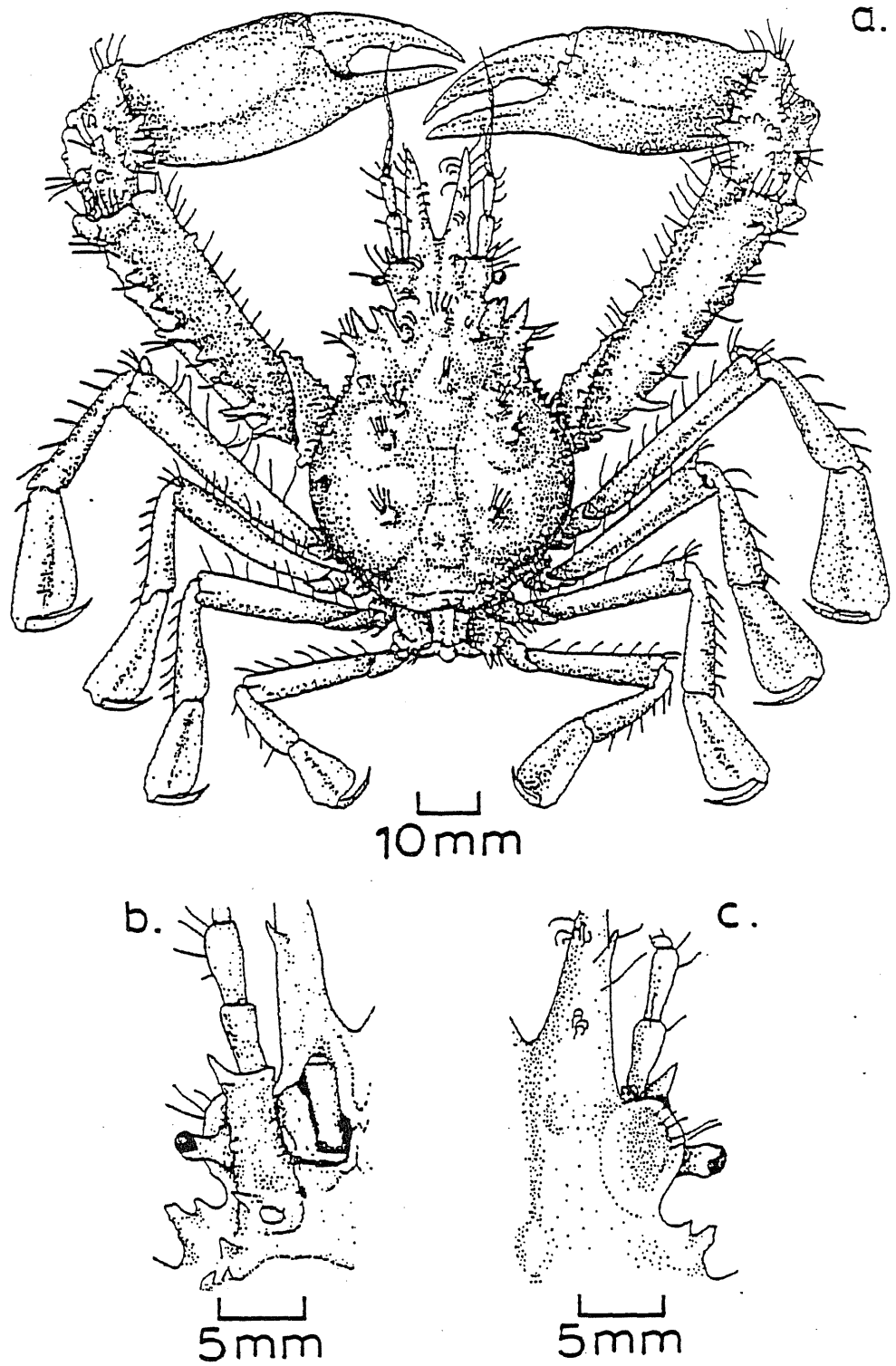


Fig. 30 - *Trichoplatus huttoni*: a - male, dorsal view; b - orbit, ventral view; c - orbit, dorsal view (after Griffin, 1966).

Habitat

Exposed rocky coasts, among seaweed.

Depth

Low tide to 60m.

Breeding, Development and Growth

Unknown.

Behaviour

T.huttoni sparsely decorates its carapace and legs with pieces of red seaweed. The behaviour may be similar to that used by Notomithrax ursus but it has not been studied.

Ecology

Only ever collected in small numbers, sometimes in crayfish pots. The subchelate legs are used to cling to seaweed. T. huttoni has rarely been recorded from fish guts. Habib (1975) found it in red cod (Pseudophycis bacchus) from the Canterbury area: 5.1% of gut volume in December and 1.0% in June.

References

Bennett (1964), Dell (1963a), Griffin (1966a).

HETEROTREMATA

MAJIDAE

Notomithrax minor (Filhol, 1885)Synonymy

Paramithrax (Paramithrax) peronii Haswell, 1880a; 1880b; Paramithrax minor Filhol, 1885d; 1886; Paramithrax peronii, Fulton & Grant, 1906; Grant & McCulloch, 1906; Chilton, 1911a; Paramithrax parvus Borradaile, 1916; Paramithrax minor Rathbun, 1918c; Chilton & Bennett, 1929; Paramithrax parvus Chilton & Bennett, 1929; Paramithrax minor Powell, 1937; Paramithrax parvus Richardson, 1949b; Paramithrax minor Richardson, 1949b; Dell, 1963a; Notomithrax minor Griffin, 1963; Paramithrax minor Bennett, 1964; Notomithrax minor Griffin, 1966a; Dell, 1968a; Batham, 1969; Hayward, 1974; Knox & Bolton, 1978; Webber & Wear, 1981; Wear & Fielder, 1985; Griffin & Tranter, 1986a (key).

Type locality

Massacre Bay, Cook Strait, 15m.

Distribution

New Zealand from Cape Maria van Diemen to Stewart Island. Southeast Australia including Tasmania.

Diagnosis (Fig. 31a-d)

Carapace broadly pyriform, rostrum of two short, sharp spines. Short hooked hairs scattered over the dorsal surface of the carapace. Margins with 12 short, outwardly directed spines: 3 supraorbital, 2 hepatic and 7 branchial (the last 3 sub-dorsal). Dorsal carapace surface covered by small spines and tubercles. Chelipeds long (1.5 times CL in adult male), dactyl almost as long as palm, fingers acute, finely toothed along inner edges, fixed finger for distal half and dactyl for entire length. Legs long and slender, first pair longest, following legs decreasing in length. Dorsal surface of legs bearing a double row of hooked hairs arranged in opposing groups. Abdomen of six segments plus telson in both sexes.

Colour

Pale yellowish, 'muddy', dorsal surface of chelae dark red or purple. Tips of fingers are white. Thickly covered by brownish hairs.

Size

Male 31.5mm CW, 40mm CL. Female (ovigerous) 24mm CW, 30.5mm CL.

Habitat

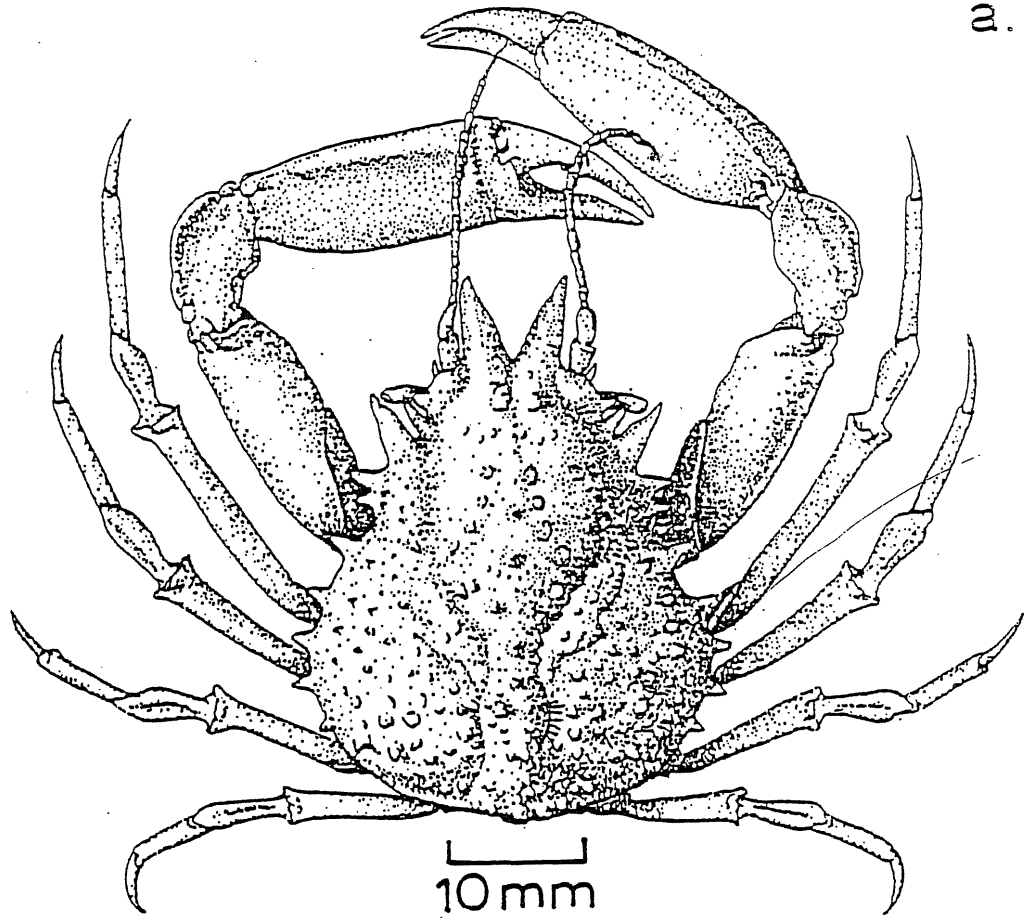
Sand, mud or coarse shell bottoms and rocky shores. Usually covered by small pieces of seaweed or more commonly by sponges which are permanently fixed.

Depth

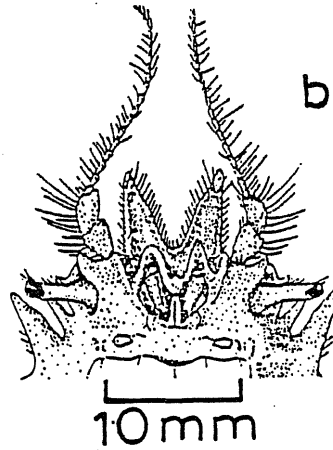
Intertidal to 35m, rarely 90m.

Breeding

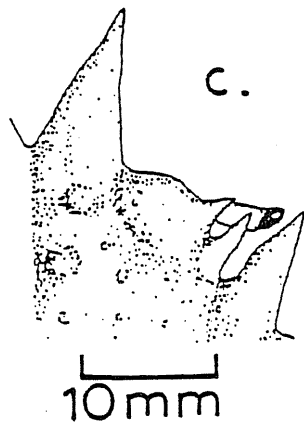
Ovigerous females have been previously collected from September to April. At Leigh females with advanced eggs have been found in June and with new eggs in June, July and November. In



b.



c.



d.

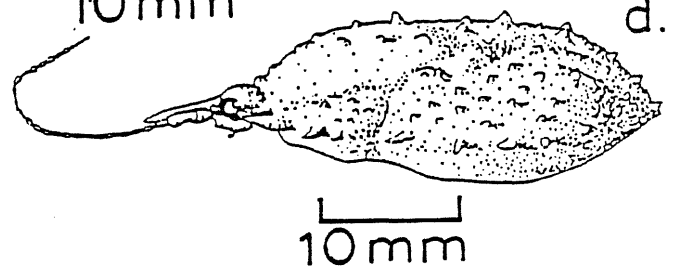


Fig. 31 - *Notomithrax minor*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Wellington Harbour larvae occur in plankton throughout the year (Webber & Wear 1981) but in the Avon Heathcote Estuary very few were found from March to August, 1982 (Roper, Simons & Jones 1983). Probably breeds throughout the year near Wellington. New eggs are bright orange (0.6 x 0.56mm) and eggs ready to hatch are bright orange (0.63 x 0.61mm).

Development and Growth

Pre-zoea, 2 zoeal stages and megalopa larva have been described by Webber and Wear (1981). The zoeal stages last for approximately 9 days each. Zoeae are most abundant during spring and summer.

Behaviour

Carapace commonly adorned with sponge. As sponges become permanently fixed to the carapace it is likely that this species makes only very limited use of its masking behaviour, perhaps only once after each moult. Like other spider crabs movement is rather sluggish.

Ecology

N.minor is eaten (0.1-2.4% of gut volume) by Hauraki Gulf and Bay of Plenty snapper (Chrysophrys auratus) (Godfriaux 1969, 1974b, Colman 1972) and rarely by tarakihi (Cheilodactylus macropterus) from western Bay of Plenty (Godfriaux 1974a). Rig (Mustelus lenticulatus) from West Coast also eat this crab (King & Clark 1984). Habib (1975) found that Banks Peninsula red cod (Pseudophycis bacchus) ate N.minor in May (0.6%) and July (0.3%).

Glaessner (1960) has recorded upper pleistocene fossil specimens of N.minor.

References

Bennett (1964), Colman (1972), Dell (1963a), Godfriaux (1969, 1974a, 1974b), Griffin (1963, 1966a), Habib (1975), King & Clark (1984), Roper, Simons & Jones (1983), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Notomithrax peronii (H. Milne Edwards, 1834)Synonymy

Paramithrax peronii H. Milne Edwards, 1834; Jacquinot & Lucas, 1853; Paramithrax (Paramithrax) peronii Miers, 1876a; 1876b; Paramithrax peroni Filhol, 1885d; Paramithrax (Paramithrax) peronii Rathbun, 1893b; Paramithrax peronii Lenz, 1901; Chilton, 1906a; 1911a; Thomson, 1912; Thomson & Anderton, 1921; Chilton & Bennett, 1929; Young, 1929; Richardson, 1949b; Notomithrax peronii Griffin, 1963b; Paramithrax peroni Dell, 1963a; Bennett, 1964; Notomithrax peronii Griffin, 1966a; Dell, 1968a; Webber & Wear, 1981; Wear & Fielder, 1985; Griffin & Tranter, 1986a (key).

Type Locality

New Zealand.

Distribution

Endemic to New Zealand. Cape Maria van Diemen to Stewart Island and also Chatham Islands.

Diagnosis (Fig. 32a-d)

Carapace broadly pyriform, rostrum of two moderately long sharp spines, weakly divergent. Long, stout hooked hairs along the dorsal surface of the rostral spines and also present on the dorsal surface of the carapace. Margins of carapace with 10 outwardly directed spines: 3 supraorbital, 2 hepatic and 5 branchial (the last 2 being sub-dorsal). A characteristic feature of this species are a pair of small spines on posterior carapace margin. Dorsal surface of carapace densely covered by spines and tubercles. Chelipeds long (nearly twice the CL in adult male). Fingers acute, toothed along inner edges for entire length, male dactyl has a large basal tooth. Legs long and slender, lacking spines, dorsal surface with groups of hooked hairs. First pair of legs longest and following legs decreasing in length. Abdomen of six segments plus telson in both sexes.

Colour

Dorsal surface of carapace, chelipeds and legs are deep brownish orange to dark red. Tips of fingers are white. Hairs are brownish.

Size

Male 54mm CW, 77mm CL. Female (ovigerous) 41.5mm CW, 57mm CL. Smallest ovigerous female 18mm CL (Chilton 1911a).

Habitat

Rocky shores, among seaweed, rock pools also on sand or mud. Usually thickly covered by small pieces of seaweed.

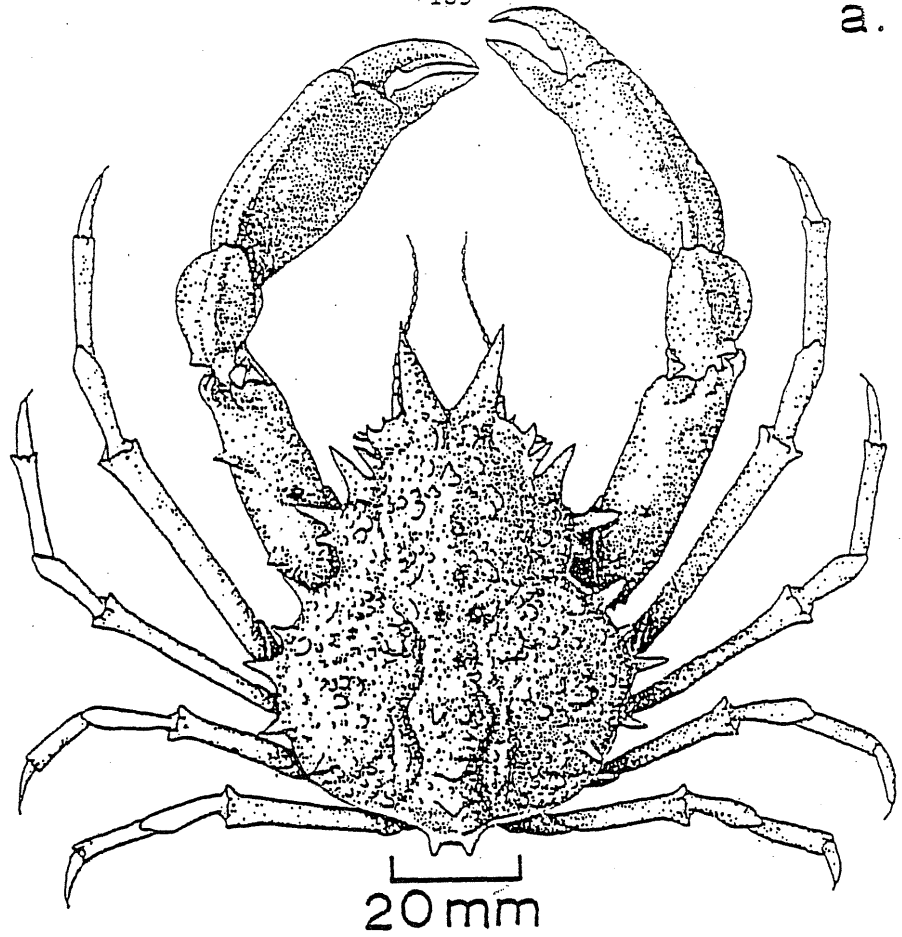
Depth

Intertidal to 50m but most common just off-shore.

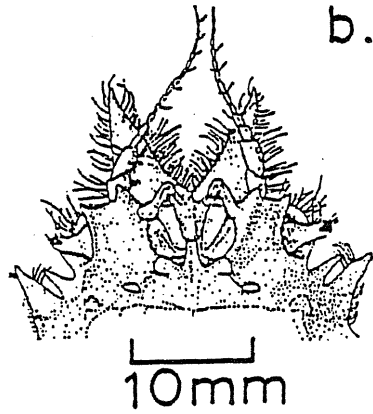
Breeding

Ovigerous females found from late July to end of March. New eggs are bright orange and dark brown when ready to hatch (0.79 x 0.78mm). At Kaikoura Pack (1982) recorded peak breeding in late

a.



b.



c.



d.

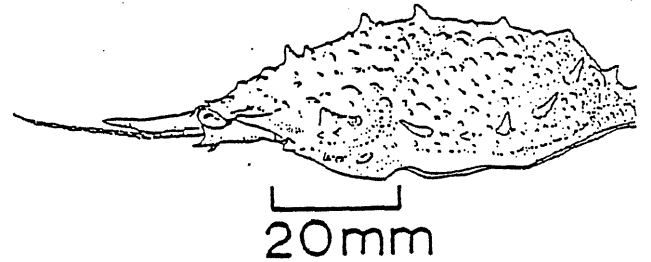


Fig. 32 - *Notomithrax peronii*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

July, August and October, about 2 months later than N.ursus in the same study area.

Development and Growth

Larval life is 34 days at 17°C. The pre-zoea, 2 zoeal stages and megalopa larva have been described by Webber & Wear (1981). The first zoea lasts about 7-9 days and the second zoea 5-9 days. Larvae occur mainly in shallow water plankton samples taken near the bottom (Wear & Fielder 1985).

Behaviour

The seaweed camouflage on carapace and legs is attached to the hooked hairs using chelipeds. This masking behaviour is used continually by the crabs to change its covering and thereby match its surroundings. At Kaikoura seasonal migrations are made from shallow to deeper water and back again. Like other spider crabs movement is sluggish. N.peronii is active at night and concealed during the day (Pack 1982).

Ecology

At Kaikoura N.peronii was found in an intertidal study area throughout the year in small numbers with a large influx in late July when females greatly outnumbered (3:1) males (Pack 1982). At other times the sex ratio was approx. equal. In this area N.ursus was encountered much more frequently than N.peronii (6:1).

King & Clark (1984) found that rig (Mustelus lenticulatus) from Golden Bay ate small numbers of N.peronii. Banks Peninsula red cod (Pseudophycis bacchus) also eat this crab (Habib 1975). Crabs that have died from other causes are consumed by Coscinasterias calamaria in Otago Harbour (Crump 1969).

References

Bennett (1964), Dell (1963a), Griffin (1963b, 1966a), Habib (1975), King & Clark (1984), Pack (1982), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Notomithrax ursus (Herbst, 1788)
Hairy Seaweed Crab

Synonymy

Cancer (Mithrax) ursus Herbst, 1788; Paramithrax ursus Gerstaecker, 1856; Paramithrax (Paramithrax) barbicornis Miers, 1876a; 1876b; Paramithrax (Paramithrax) latreillei Miers, 1876a; 1876b; Paramithrax (Paramithrax) barbicornis Haswell, 1880a; 1882a; Paramithrax cristatus Filhol, 1885d; Paramithrax (Paramithrax) latreillei Rathbun, 1893b; Paramithrax latreillei Chilton, 1906b; 1911a; Thomson, 1912; Paramithrax (Paramithrax) latreillei Borradaile, 1916; Paramithrax latreilli Thomson & Anderton, 1921; Paramithrax ursus Balss, 1929; Paramithrax latreillei Young, 1929; Chilton & Bennett, 1929; Richardson, 1949b; McNeill, 1953; Dell, 1960; Paramithrax ursus Dell, 1963a; Notomithrax ursus Griffin, 1963b; Paramithrax ursus Bennett, 1964; Notomithrax ursus Griffin, 1966a; Dell, 1968a; Hayward, 1974; Marsden & Fenwick, 1978; Webber & Wear, 1981; Marsden, 1981; Wear & Fielder, 1985; Griffin & Tranter, 1986a (key).

Type Locality

Pacific Ocean.

Distribution

South-east Australia, New Zealand mainland, Stewart Island and Chatham Islands.

Diagnosis (Fig. 33a-d)

Carapace broadly pyriform, rostrum of two short, sharp spines. Short, stout, hooked hairs on dorsal surface of rostral spines and carapace. Very long, dense hairs along lateral margins of rostrum and also covering carapace, almost concealing hooked hairs. Margins of carapace with nine outwardly directed, sharp spines: 3 supraorbital, 3 hepatic and 3 branchial. Dorsal carapace surface entirely lacking spines, densely covered by numerous large and small tubercles. Chelipeds of moderate length, propodus compressed, fingers acute. Fingers in male are widely gaping, toothed along inner edges for distal third only, in female adjacent and toothed for entire length. Dactyl in male has a large tooth, absent in female. Legs long and slender, dorsal surface with a longitudinal row of short, hooked hairs, obscured by very long straight hairs. First leg longest, following legs decreasing in length. Abdomen of six segments plus telson in both sexes.

Colour

Dorsal surface of carapace, chelipeds and legs are orange to deep red. Hairs of carapace and legs are brownish.

Size

Male 42mm CW, 60mm CL. Female 36mm CW, 43mm CL.

Habitat

Along rocky shores, in rock pools among seaweed. Whole crab usually thickly covered by red, green or brown seaweed.

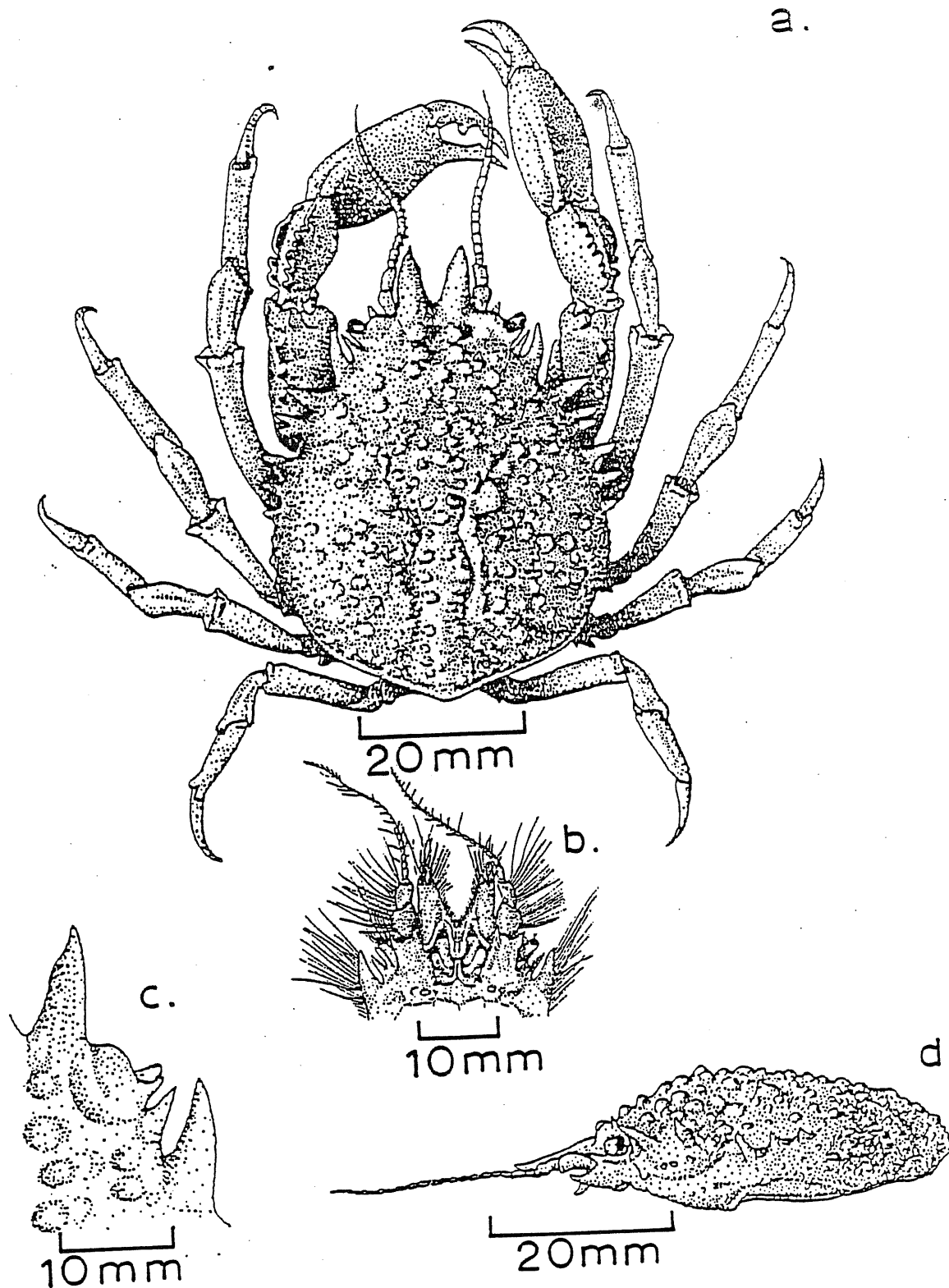


Fig. 33 - *Notomithrax ursus*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Depth

Intertidal to 75m.

Breeding

Ovigerous females found from June to February at Kaikoura with a peak from June to August (Pack 1982). New eggs are bright orange and just before hatching they are brown (0.75 x 0.7mm). At Kaikoura, stage 1 eggs first appeared in June and stage 4 eggs in late July. Since ovigerous females were found until March, it is likely that they can produce more than one brood per breeding season. A few of these may breed a second time in the following year, however males are probably longer lived and may survive for 2 or more years.

At Leigh ovigerous females have been found in May and June. Females collected in May had advanced eggs so that breeding clearly begins in March or April.

Development and Growth

The pre-zoea, 2 zoeal stages and megalopa larva have been described by Webber & Wear (1981). Larval life is 40 days at 16°C. First stage zoeae live from 8-16 days and second stage zoeae live 12-15 days. Zoeae occur chiefly in shallow water plankton samples taken near the bottom. They are very similar to zoea of N. peronii.

At Kaikoura late stage eggs first appear near the end of July and very small juveniles were first found in October, suggesting that larval development is probably about 60 days.

Pack (1982) has investigated relative growth of N. ursus at Kaikoura. Majid crabs have 3 identifiable growth stages: immature, pre-pubescent and mature (Hartnoll 1963). These stages are separated by 2 important moults in the growth of the crab: the moult of pre-puberty (coincident with gonad development) and the puberty moult (which is terminal). Maturity is associated with changes in relative growth of the abdomen and chelipeds, which are important in reproduction. Fitting the power function, $\log y = a + b \log x$ gives values of 'b' which allow assessment of relative rate of growth, $b < 1$ (negative allometric growth), $b = 1$ (isometric growth), $b > 1$ (positive allometric growth). Growth of male abdomen width and female chela width of N. ursus are both isometric ($b = 0.9$ and $b = 1.09$ respectively), while growth of female abdomen width and male cheliped width are both positively allometric ($b = 1.29$ and $b = 1.34$ respectively). For all sizes (>10mm CL) females have broader abdomens than males of the same CL and the pubertal moult can occur in females as small as 23-24mm CL.

Only after this moult do the female genital openings become large enough to accommodate the male pleopod. Small males (<20mm CL) have similar chela widths to females but the divergent trend becomes more pronounced in larger males. The male pubertal moult can occur in males as small as 31-32mm CL after which they have substantially larger chelae. A pre-pubescent stage is not evident in female N. ursus but male gonad development suggests that males may have a pre-pubescent stage.

O'Brien (1984) found that the Californian kelp crab Pugettia producta parasitized by the rhizocephalan barnacle, Heterosaccus californicus, show precocious maturity by moulting to puberty after fewer juvenile instars.

Behaviour

Almost all kinds of seaweed are applied to the body and legs using the chelipeds. Small pieces of seaweed are snipped off by chelipeds and poked into the hooked hairs so that the uncut end is upper-most. Camouflage is continually changed with 10 -20% of the cover being replaced each day. The number of seaweed pieces applied is independent of crab-size but larger crabs achieve the same cover by using larger pieces. Like other spider crabs movement is sluggish.

In the field nearly all hard shelled N.ursus are camouflaged and usually closely match their immediate surroundings (89.2% of 813 crabs). Only 11.4% were covered in different algal species and were most commonly found in June and July. But even these crabs may still be cryptic because they are concealed beneath the algae. Even newly moulted soft crabs carry a few pieces of algae, usually over the rostral area. The only unmasked crabs were those which had lost both chelipeds (Pack 1982).

Wicksten (1980) has proposed an hypothesis about the origin and evolution of masking behaviour by spider crabs. She suggests that masking evolved as an extension of normal feeding behaviour with the attachment of food items to the body serving as camouflage against predators and perhaps as a food store. The next stage may have involved the attachment of non-edible, offensive materials. Wicksten suggests that some crabs may have lost the masking habit but her arguments for this are unconvincing. There is an opportunity here for someone to make a valuable contribution by making a comparative study which encompasses not only masking behaviour but also distribution of hooked hairs on the bodies of both decorator and non-decorator crabs. Wilson (1987) suggests that the spider crab Acanthonyx petiveri can acquire pigment from the algae on which it feeds. This adds a new dimension to the problem of spider crab camouflage.

Copulation with hard-shelled N.ursus females has been observed in the laboratory. The male approached the female, rostrum to rostrum, gripped her carapace with the first 2 pairs of walking legs, manipulated her into the sternum to sternum position using his chelipeds and then rocked backward into a female over male position. The female was held closely with the male chelipeds folded over her carapace and the male's legs interlocked with hers and grasping her carapace. The male was usually larger than his mate. One female spawned within 24 hrs of copulation. The algal mask does not seem to be important in copulation. Mating probably occurs soon after the pubertal moult but several weeks may elapse until eggs are laid.

During the day N.ursus remains under cover of seaweed and/or rocks, sometimes partially buried in the sand. By contrast, at night, crabs are more active and some venture away from their place of concealment. Activity is clearly nocturnal and shows no superimposed tidal rhythm. Pack (1982) found a rapid loss of

marked crabs from her study area in February (less than 10% remaining after 4 days) and corresponding immigration of unmarked crabs to keep the population density roughly the same. Marked crabs moved out and back into the area several times during the study. This suggests a high turnover rate of the population composition.

N.ursus is negatively phototactic and can bury itself in sandy substrates by excavating a depression using its chelipeds. These are pushed away from the body, shovelling sand forward and to the sides. In coarse substrates individual stones are picked up and released at the point of fullest extension of the cheliped. As the depression deepens the legs on one side and then the other move into it, causing the crab to rock from side to side. Excavation continued until the crab is buried with only the eyestalks and part of the carapace visible (Pack 1982).

During the day N.ursus has a clumped distribution often occurring with conspecifics in groups as large as 15 and containing both males and females. They also occur in groups as large as 28 with the congeneric masking crab N.peronii. Clumping was more apparent during the breeding season, January to August (Pack 1982).

Ecology

At Kaikoura Pack (1982) found that abundance of N.ursus fluctuated seasonally with lowest numbers in October and highest numbers in April. Sex ratio also fluctuated seasonally: Dec.-Feb. 1.36 males/female, Mar.-May 0.73, June-July 1.08 and Aug.-Nov. 2.29. Over a year the population composition was unimodal (mean CL = 28mm) with no difference between average size of males (28.3mm) and females (27.6mm), but males attained a larger maximum size. Smallest average size was recorded in October, increasing through the summer and autumn to reach the largest average size in June and then declining again. Males and females had essentially the same pattern except in February when males were larger and in September when they were significantly smaller than females. Recently moulted crabs were only recorded from September to May, mostly during March and April.

Recruitment occurs during October-December producing the smallest average size and by March these crabs are undergoing their pubertal moult. During February-April there is an influx of large males from deeper water. Growth of the new cohort plus immigration from deeper water produces the largest average size in June. The small average size in the spring and early summer is partly due to recruitment and partly due to off-shore migration of larger crabs. Similar migrations of the kelp crab, Pugettia producta, off California have been recorded by Wicksten & Bostick (1983).

Leader & Bedford (1978) examined the composition of muscles and haemolymph of N.ursus and found that ion concentrations were similar to other crabs from the same habitat.

N.ursus is eaten by blue cod (Parapercis colias) at the Chatham Islands (Young 1929) and by red cod (Pseudophycis bacchus) from Banks Peninsula in January (1.0% of gut volume), May (0.6%) and September (0.8%) (Habib 1975). Town (1979) found

that the large starfish Astrostole scabra ate small numbers of this crab. In the laboratory Octopus maorum and Robsonella australis will eat both masked and unmasked N. ursus (Pack 1982). The crab is also eaten by another crab, Ovalipes catharus (Wear & Haddon, 1987).

References

Bennett (1964), Dell (1963a), Griffin (1963b, 1966a), Leader & Bedford (1978b), Pack (1982), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Leptomithrax australis (Jacquinot, 1853)
Giant Masking Crab or Painted Spider Crab

Synonymy

Maia australis Jacquinot & Lucas, 1853; Paramithrax (Leptomithrax) australis Miers, 1876a; 1876b; Leptomithrax brevirostris Miers, 1879a; Leptomithrax australis Filhol, 1885d; 1886; Paramithrax (Leptomithrax) australis Rathbun, 1893b; Leptomithrax australis Chilton, 1909; Thomson, 1913; Thomson & Anderton, 1921; Stephensen, 1927; Chilton & Bennett, 1929; Balss 1930; Richardson, 1949b; Dell, 1960; 1963a; 1963b; Leptomithrax (Leptomithrax) australis Bennett, 1964; Leptomithrax australis Griffin, 1966a; Dell, 1968a; Calcott, 1970; Ritchie, 1970; Roberts, 1972b; Webb, 1972; Ritchie, 1973; Fenwick, 1975; Yaldwyn, 1975; Ryff & Voller, 1976; Fenwick, 1978; Griffin & Tranter, 1986a.

Type Locality

Auckland Islands.

Distribution

Cook Strait to Stewart Island, Chatham Islands, Snares Island, Auckland Island, Bounty Islands, Pukaki Rise and Campbell Island.

The 13 recent species of Leptomithrax are keyed out by Griffin & Tranter (1986a).

Diagnosis (Fig. 34a-d)

Carapace broadly pyriform, moderately swollen, surface covered by short hairs and small spinous tubercles surrounded by hooked hairs. Rostrum of two short spines, weakly convergent. Orbit consisting of supraorbital eave, intercalated spine and postorbital lobe, closely approximated. Postorbital lobe with a small accessory spinule midway along anterior, upper edge. Margins of carapace with six prominent, conical equidistant spines, one postorbital, one hepatic, and four branchials, curving on to dorsal surface posteriorly. Chelipeds very long, upper surface of merus and carpus covered by small, closely set conical spines. Propodus compressed, smooth, fingers acute, finely toothed and gaping basally. Dactyl with large basal tooth in male, absent in female. Legs long, slender, dorsal surfaces bearing a double row of opposing hooked hairs. Abdomen of six segments and telson in both sexes.

Colour

Orange-red to very deep red, propodus of cheliped finely marked with white and fingers white. Limb joints marked by patches of dark orange-red.

Size

Male 88mm CW, 102mm CL. Female 48mm CW, 62mm CL.

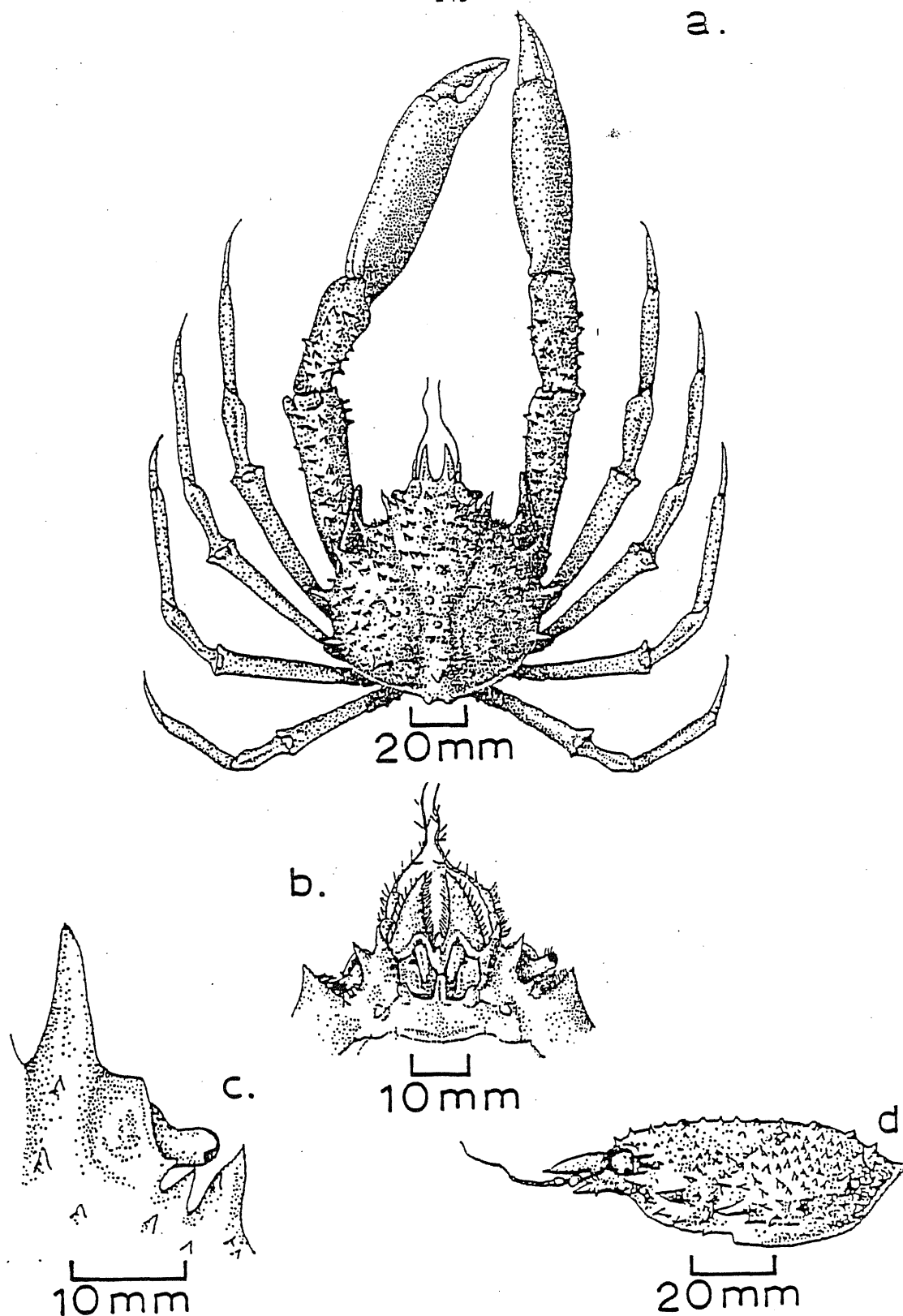


Fig. 34 - *Leptomithrax australis*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Habitat

On southern off-shore islands this crab occurs intertidally and has been observed among seaweeds in areas of strong tidal currents and surge (Ritchie 1970, 1973, Fenwick 1978). * On the mainland it only occurs in deeper water.

Depth

Intertidal to 100m.

Breeding

No ovigerous females have been collected.

Development and Growth

Larval stages are unknown (Wear & Fielder 1985).

Behaviour

L. australis masks itself with pieces of seaweed when it lives in shallow water. These are placed on the carapace and legs by the long chelipeds, each piece of seaweed being selected and cut to an appropriate size before being placed on the body where it is held by the rows of hooked hairs. At Campbell Island the crabs use the algae Shizoseris davisii, Streblocladia glomerulata, Chondria macrocarpa, Rhodophyllis acanthocarpa, Delessaria sp., Callophyllis sp. and Ceramium sp. Crabs from deeper water are uncouflaged except for pieces of sponge and polychaete tubes which probably colonize the crab as larvae. Hence the size of these epizoids will be related to the length of time since the crab last moulted.

Ritchie (1970) found that L. australis was common at the Auckland Islands but it did not enter crayfish pots. However, Ryff & Voller (1976) potted large numbers on the Pukaki Rise.

While diving at the Bounty Islands Westerkov (1987) recorded a gathering of L. australis and he published a photo showing two large males fighting while surrounded by many, smaller females. Each male grasped his opponent by the cheliped merus or carpus and stood 'face-to-face' for over 30 min. The males may have been contesting the ownership of females.

Ecology

Ritchie (1973) observed a large male L. australis feeding on ribbed mussels (Aulacomya maoriana) at the Auckland Islands and also saw many small weed-covered females which appeared to be feeding on red algae. He also observed females 3m up a Macrocystis stipe (see also Calcott 1970). Around the Auckland Islands this crab was relatively common.

L. australis is eaten by rig (Mustelus lenticulatus) caught off Kaikoura (King & Clark, 1984) and by red cod (Pseudophycis bacchus) in February from the Canterbury area, 2.3% of gut volume (Habib, 1975). Ritchie (1970) found one crab in the stomach of a notothenid fish captured at Campbell Island.

Glaessner (1960) has recorded three fossil species of Leptomithrax: L. irirangi from the lower pliocene and L. atavus, L. uruti from the upper miocene. These species appear to be more closely related to recent Australian species rather than recent New Zealand species of Leptomithrax (Griffin, 1966a).

References

Bennett (1964), Dell (1963a, 1963b), Griffin (1966a), Ritchie (1973).

HETEROTREMATA

MAJIDAE

Leptomithrax garricki Griffin, 1966
Garrick's Masking Crab

Synonymy

Leptomithrax garricki Griffin, 1966a; Dell, 1968a; Takeda & Miyake, 1969; Webb, 1972; Wear & Fielder, 1985 (list); Griffin & Tranter, 1986a (key).

Type Locality

Off Kaikoura, South Island, 785m.

Distribution

Cape Palliser to Kaikoura and eastward on Chatham Rise.

The 13 recent species of Leptomithrax are keyed out by Griffin & Tranter (1986a).

Diagnosis (Fig. 35a-g)

Carapace broadly subpyriform, inflated and weakly convex in profile, margins strongly spinous. Surface sparsely covered by short spines and tubercles, finely pubescent, slender hooked hairs fringing margins of rostral and marginal spines and in groups on protogastric and branchial regions. Rostrum of two short subconical spines, weakly convergent. Orbit consisting of supraorbital eave, intercalated spine and postorbital lobe, the three closely approximated. A small accessory tubercle on upper anterior edge of postorbital lobe. Margins of carapace with seven strong, outwardly directed spines, one postorbital, two hepatic and four branchials forming a semi-ellipse, the last distant from margin. Chelipeds very long, subcylindrical except for compressed propodus, merus and carpus covered on all surfaces by short spines. Fingers acute, moderately gaping for basal half in male, for entire length in female, inner edges finely toothed in both sexes. Legs of moderate length, cylindrical, smooth faintly pubescent. Abdomen of six segments and telson in both sexes.

Colour

Carapace yellowish-brown to greenish-white mottled with brick red. Tubercles on cheliped coloured with orange, inner surface reticulated with brick red. Irregular regions of pale orange on legs.

Size

Male 77mm CW, 100mm CL. Female 53mm CW, 67mm CL.

Habitat

Mud, rocks and sea anemones.

Depth

Edge of continental shelf and slope, 180-785m. L. garricki is one of our deepest-living spider crabs.

Breeding

Ovigerous females of L. garricki are unknown.

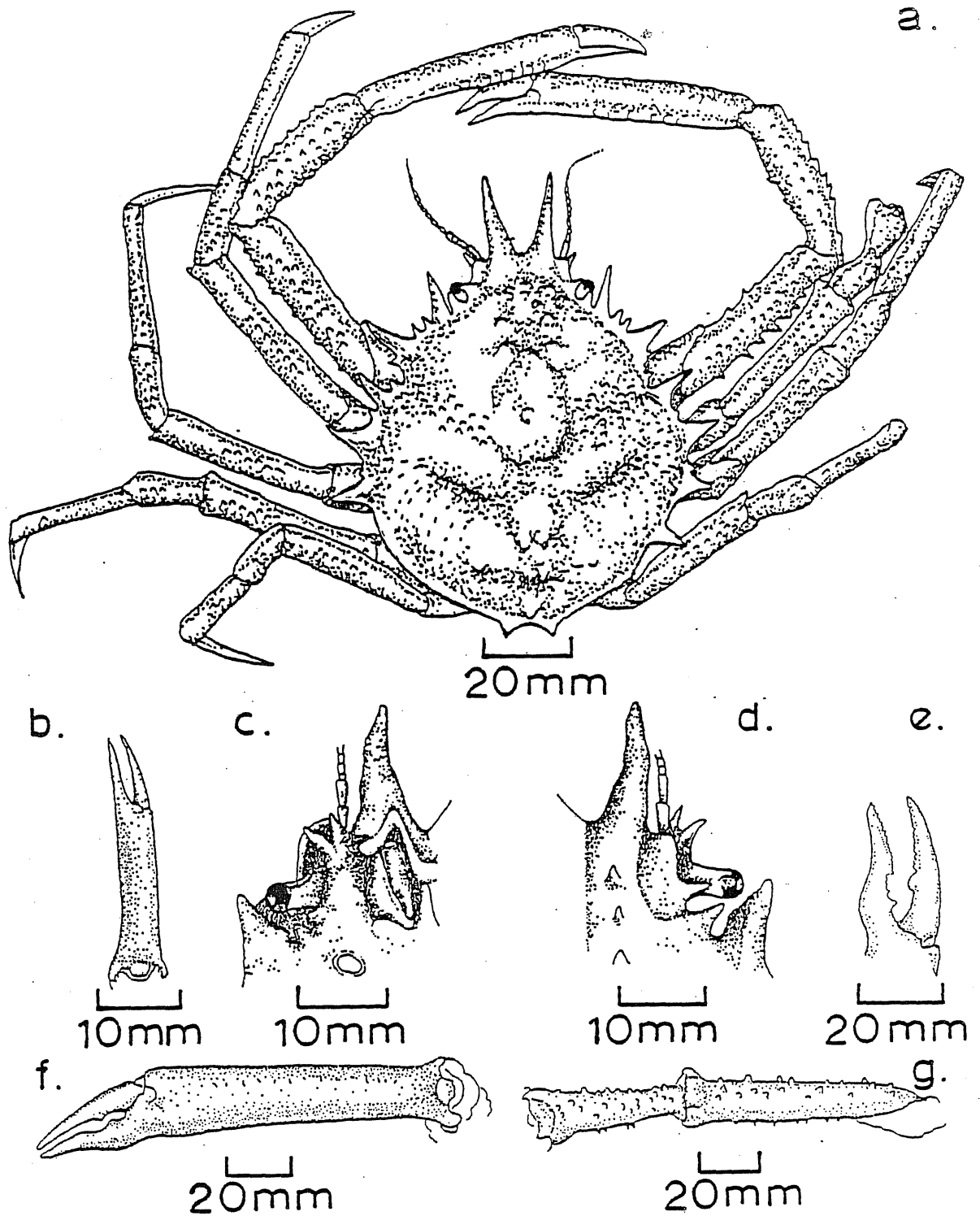


Fig. 35 - *Leptomithrax garricki*: a - male, dorsal view (by C. Duffy, based on a photo from Takeda & Miyake, 1969); b - left chela, female, outer face; c - orbit, ventral view; d - orbit, dorsal view; e - fingers, male cheliped; f - left chela, male, outer face; g - left cheliped, male, merus and carpus (after Griffin, 1966).

Development and Growth

Unknown.

Behaviour

Griffin (1966a) recorded that the carapace of the holotype male was completely covered by a single large sea anemone which was probably 'planted' by the crab. Hand (1975) has described the behaviour of Leptomithrax longipes towards the anemones Calliactis conchicola and Paracalliactis rosea.

Ecology

Unknown.

References

Griffin (1966a), Hand (1975), Takeda & Miyake (1969).

HETEROTREMATA

MAJIDAE

Leptomithrax longimanus Miers, 1876Synonymy

Paramithrax (Leptomithrax) longimanus Miers, 1876a; 1876b; Leptomithrax longimanus Filhol, 1885d; 1886; Paramithrax (Leptomithrax) longimanus Rathbun, 1893b; Paramithrax (Leptomithrax) affinis Borradaile, 1916; Leptomithrax affinis Chilton & Bennett, 1929; Balss, 1929; Leptomithrax longimanus Chilton & Bennett, 1929; Richardson, 1949b; Leptomithrax affinis Richardson, 1949b; Leptomithrax longimanus Dell, 1963a; Leptomithrax (Leptomithrax) longimanus Bennett, 1964; Leptomithrax longimanus Griffin, 1966a; Dell, 1968a; Webber & Wear, 1981; Wear & Fielder, 1985; Griffin & Tranter, 1986a (key).

Type Locality

New Zealand.

Distribution

Endemic to New Zealand. Three Kings Islands to Stewart Island.

The 13 recent species of Leptomithrax are keyed out by Griffin & Tranter (1986a).

Diagnosis (Fig. 36a-d)

Carapace broadly pyriform, rostrum of two short spines weakly convergent. Short hooked hairs fringe margins of rostral spines and also occur on carapace borne on small rounded tubercles. Margins of carapace with six very short conical, equidistant spines, 1 postorbital, 1 hepatic and 4 branchial (the last subdorsal). Dorsal surface of carapace densely covered by small rounded tubercles. Chelipeds very long (2.2 times CL of adult male) covered on all surfaces by numerous small tubercles. Fingers acute, widely gaping in male and coarsely toothed along inner edges for distal halves of both fingers. Dactyl with a large tooth about one third from base, absent in female. Legs long and slender with a double row of opposing hooked hairs. First pair of legs longest, others decreasing in length. Abdomen of six segments plus telson in both sexes.

Colour

Dull yellowish brown body and legs. Chelipeds in adult males dark brown with yellowish markings on propodus. Females paler in colour.

Size

Male 49mm CW, 60.5mm CL. Female 34mm CW, 47.5mm CL.

Habitat

Occasionally found in rock pools but much more common offshore on muddy or sandy bottom associated with polychaetes, bivalve molluscs, sponges and bryozoans.

Depth

Intertidal (rarely) to 200m, occasionally to 550m.

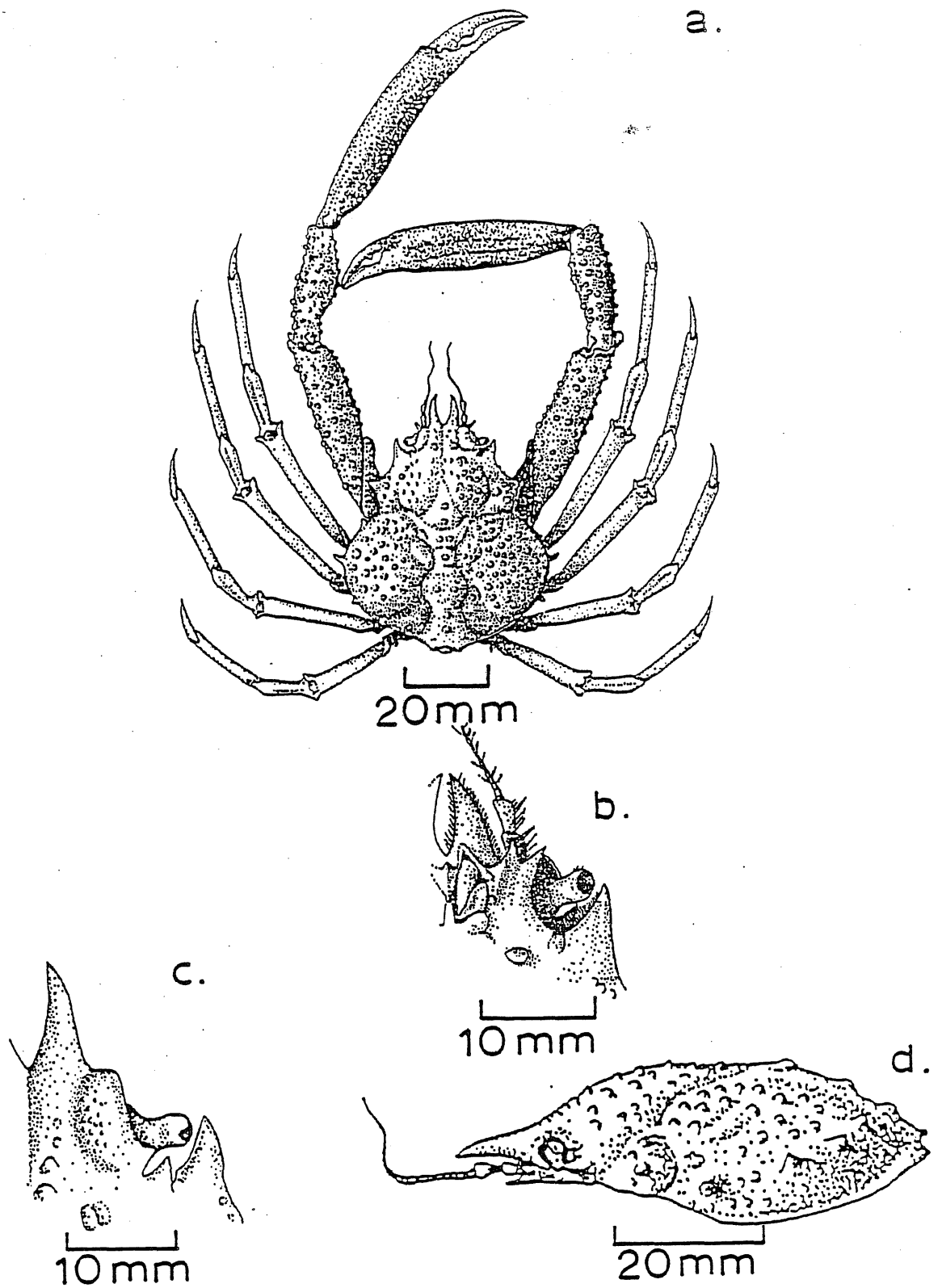


Fig. 36 - *Leptomithrax longimanus*: a - male, dorsal view; b - orbit, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Breeding

Ovigerous females found from October to April. New eggs are bright orange-yellow, 0.6mm diam., becoming dark brown, 0.63-0.65mm, before hatching.

Development and Growth

The pre-zoea and first stage zoea have been described by Webber & Wear (1981). Second zoea and megalopa unknown. Larval stages have not been collected in plankton (Wear & Fielder 1985).

Behaviour

Unknown.

Ecology

Carapace of adults often carries serpulid worm tubes and sponge.

Rig (Mustelus lenticulatus) from Tasman Bay and Kaikoura eat L. longimanus (King & Clark 1984). Red cod (Pseudophycis bacchus) from Banks Peninsula ate L. longimanus in October (1.2% of gut volume) and also red cod from Otago, February (0.11%) (Habib 1975). In Otago Harbour Crump (1969) observed over 200 Pateriella regularis feeding on a large crab although it is unlikely that these starfish killed it.

Glaessner (1960) has recorded three fossil species of Leptomithrax: L. irirangi from the lower pliocene and L. atavus, L. uruti from the upper miocene. These species appear to be more closely related to recent Australian species rather than recent New Zealand species of Leptomithrax (Griffin, 1966a).

References

Bennett (1964), Dell (1963a), Griffin (1966a), Hand (1975), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Leptomithrax longipes (Thomson, 1902)
Long-legged Masking Crab

Synonymy

Paramithrax longipes Thomson, 1902b; Chilton, 1911a; Thomson, 1912; Thomas & Anderton, 1921; Chilton & Bennett, 1929; Young, 1929; Leptomithrax longipes Richardson, 1949b; Dell, 1960; 1963a; Leptomithrax (Zemithrax) longipes Bennett, 1964; Leptomithrax (Zemithrax) molloch Bennett, 1964; Leptomithrax longipes Griffin, 1966a; Dell, 1968a; Takeda & Miyake, 1969; Hand, 1975; Fenwick, 1978; Roper, 1979; Probert et al., 1979; Webber & Wear, 1981; Wear & Fielder, 1985; Griffin & Tranter 1986a (key).

Type Locality

Sixteen kilometres off Cape Saunders, 100m.

Distribution

Cook Strait to Foveaux Strait, Chatham Islands, Macquarie Island.

The 13 recent species of Leptomithrax are keyed out by Griffin & Tranter (1986a).

Diagnosis (Fig. 37a-d)

Carapace broadly pyriform, swollen and almost uniformly convex in profile, margins spinous. Dorsal surface covered by groups of large and small tubercles separated by large smooth areas. Elevated in midline as a ridge of numerous small closely spaced tubercles. Single blunt spine on posterior margin of carapace. Regions poorly defined. Short hooked hairs fringing inner margins of rostral spines and also present on carapace borne on small tubercles. Rostrum of two short dorsoventrally flattened spines, distally depressed. Orbit consisting of supraorbital eave intercalated spine and postorbital lobe, the three closely approximated and separated by narrow, deep fissures. Intercalated spine excluded from rim of supraorbital margin. Margins of carapace with a series of six short, conical spines: one postorbital, one hepatic and four branchials, the latter forming a semi-ellipse, the last subdorsal. A distinctive feature is a naked, median boss at junction of ischium and merus of third maxilliped. The remainder of the surface is densely covered by short hairs. Chelipeds of moderate length, subcylindrical except for compressed propodus, surfaces of merus and carpus partially covered by small tubercles. Fingers in male gaping moderately for basal half, toothed along inner edges, in female gaping for entire length meeting only at tips, finely toothed. Legs very long, slender. Abdomen of six segments and telson in both sexes.

Colour

Very pale yellowish white. Chelipeds and legs splotched with irregularly shaped patches of dark red, especially on inner surface of propodus.

Size

Male 71.5mm CW, 84mm CL. Ovigerous female 30mm CW, 42mm CL.

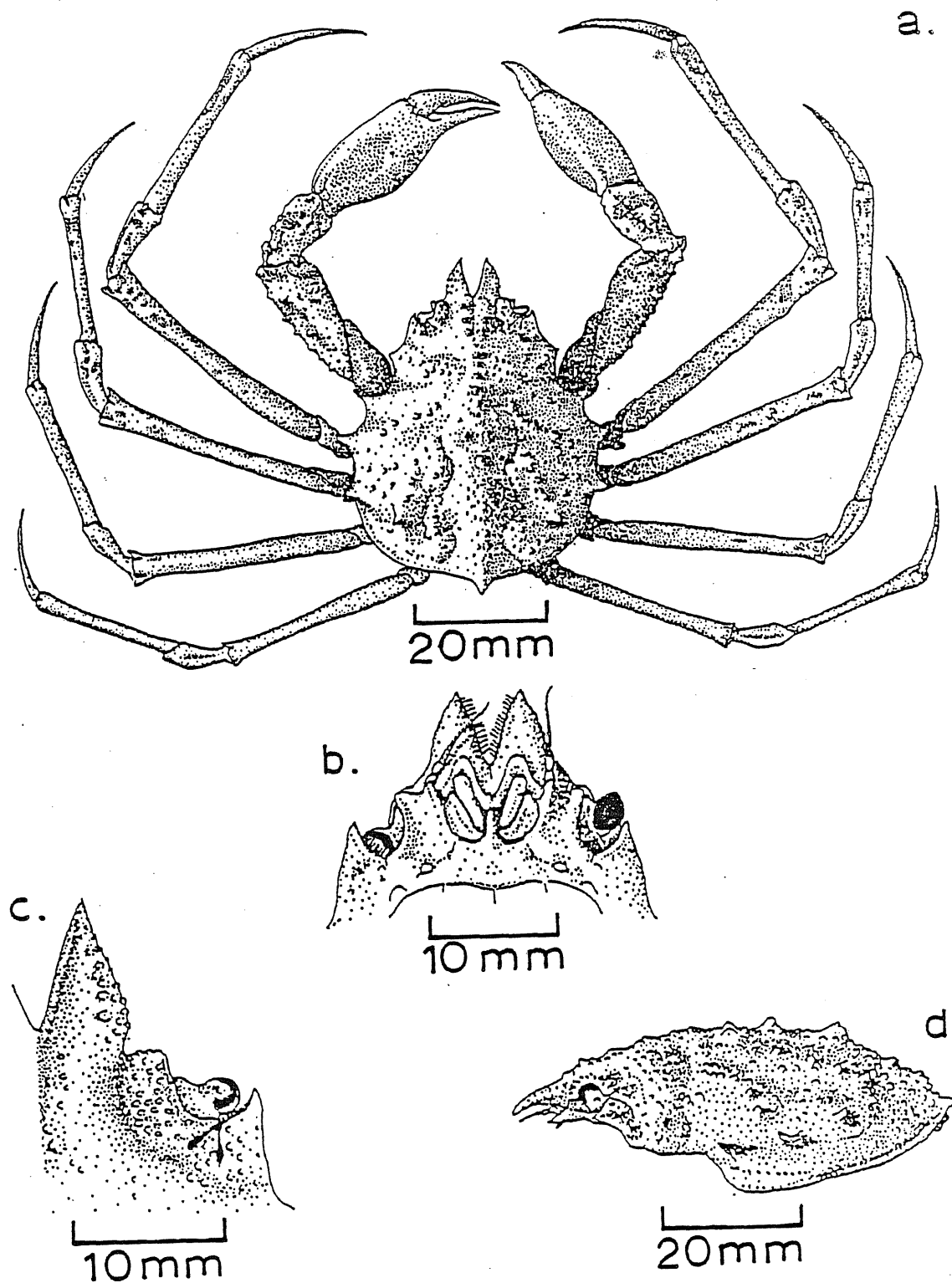


Fig. 37 - *Leptomithrax longipes*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Habitat

Usually found on continental shelf muddy or sandy bottoms in association with sponges, sea anemones, bryozoa and polychaetes.

Depth

On continental shelf, 20-380m.

Breeding

Ovigerous females have been collected September-March. Eggs are orange, size unknown.

Development and Growth

Two zoeal stages (Wear & Fielder 1985), megalopa unknown. The zoea of L. longipes differs considerably from those of other members of this genus (Webber & Wear 1981).

Roper (1979) measured growth of male propodus width relative to carapace length for L. longipes off Otago Peninsular. He found that propodus width increased gradually up to 45mm CL and then increased much more rapidly. A CL of 45mm was assumed to indicate the smallest size at maturity for males.

Behaviour

Hand (1975) reported that L. longipes carries specimens of four kinds of sea anemones: Calliactis conchicola, Paracalliactis rosea, Bunodactis chrysobathys and Phellia aucklandica. Of 256 male crabs 38 (14.8%) carried anemones on their carapaces and legs. Larger crabs tended to carry more and larger anemones. In touching a Calliactis with a dactyl, the crab moves over it, touching the anemone with its chelae and the walking legs. These actions usually cause the anemone to close. Prising the anemone loose involves placement of the tips of both chelae around the basal margin with the crab raising itself upwards and repeatedly pushing with the chelipeds. The pushing is not rhythmical but it eventually leads to insertion of one or both chelae between the substrate and the base of the anemone. Once the chelipeds are under the base the anemone quickly releases its hold whereupon the crab lifts it to its mouth. The anemone is manipulated by the chelae and slowly turned around against the maxillipeds. This cleaning activity seems to remove adherent debris from the anemone and may last for only a few minutes or more than 20 minutes. Following cleaning the crab holds the anemone in one chela and lifts it over on to the carapace or legs where it is held until it reattaches to the crab. During the cleaning process the anemone commonly expands almost fully. Before finally releasing hold of the anemone the crab will tug once or twice and then release it. If the anemone is unattached, it is returned to the mouth for further cleaning and then replaced on the carapace. Male crabs smaller than about 55mm CL and all females show little interest in planting anemones on their body. Given an abundance of anemones a large male L. longipes will cover itself in anemones except for the chelipeds. Once the available sites for attachment are occupied the crab ceases to respond to anemones it encounters. Removal of anemones renews the interest of the crab. When several crabs carrying anemones are placed together an interminable series of "robberies" is initiated. If small crabs with anemones are placed with large crabs, then all the anemones will end up on the large crabs! None of the four species of anemones listed above show any mounting

response towards the crab, its isolated carapace or legs. Thus the anemones are a passive partner in the interaction. By contrast Calliactis and Paracalliactis both mount gastropod shells e.g. Austrofusus glans.

Hand (1975) conducted preliminary experiments with Octopus maorum to see whether Calliactis conchicola protected crabs against predation. When offered crabs with and without anemones those without anemones were rapidly consumed but the others were rejected when an arm of the octopus touched an anemone. However Calliactis does not seem to protect L. longipes from predation by rig Mustelus lenticulatus: John Ottway (see Hand 1975) found crabs bearing anemones in stomachs of these fish caught off Kaikoura. It is puzzling that females show little interest in the anemones. Lack of anemones on females in nature could be due to stealing by dominant males but even in the laboratory females do not pick them up. The low incidence of males with anemones (14.8%) may indicate that anemones are a resource in short supply.

Leptomithrax longipes also applies algae, sponges, hydroids and foreign objects such as bits of paper to itself (Hand 1975). These are picked up, sometimes torn or cut into smaller pieces by the chelae, mouthed and placed on the carapace and legs. The bits are trapped among the hooked hairs by skillful use of the chelipeds. This behaviour is similar to that shown by Notomithrax ursus and results in a mask of camouflage rather than deterring predators. Other epizootes such as barnacles, oysters, tubiculous polychaetes and ascidians also colonize the crab's surface and provide camouflage.

Ecology

Hand (1975) sampled the L. longipes population off Otago Peninsula and of 833 specimens, 256 (30.7%) were males and 498 (59.8%) were females but 79 (9.5%) were of indeterminate sex. The ranges of CL of the crabs were: males 28-82mm, females 35-59mm and indeterminate 19-60mm. These observations led Roper (1979) to investigate why some crabs possessed a combination of female and male characters. He found that the sex ratio was different in different areas. Higher densities were recorded in deeper water near the edge of the continental shelf where the sex ratio was 1 male:21 females, but inshore the ratio was 10 males:1 female. Also immature females and mature males tend to be found inshore and mature females offshore. This suggests inshore transport of larvae, settlement in coastal waters and offshore migration of females to deeper water as they mature. Roper (1979) found a much lower percentage (only 1%) of crabs of indeterminate sex. They occurred at most depths greater than 33m. These had both male and female pleopods, closed female genital openings, small chelipeds and an oval abdomen resembling a young female. The gonad was similar to a normal female but sometimes spermathecae were absent. Tissue and blood smears contained a rod shaped bacterium not found in normal crabs. Roper suggested that the bacterium may have caused the feminisation of male crabs by upsetting hormone balance. Unfortunately these crabs were not kept alive to see whether they became sexually mature.

L. longipes off Kaikoura is eaten by rig (Mustelus lenticulatus) (Hand 1975) and also recorded from the same fish caught off Banks Peninsula by King & Clark (1984). Red cod (Pseudophycis bacchus) from the east coast of the South Island also eat significant amounts of L. longipes: October (0.5% of gut volume), November (2.8), December (7.2) and February (3.8) from the Canterbury area, February (0.11) from the Otago area and May (0.1) from Cloudy Bay-Cape Campbell area (Habib, 1975). Godfriaux (1974a) reported L. longipes (<.01%) in tarakihi (Cheilodactylus morocropterus) guts from Western Bay of Plenty but since this is well outside the known range for L. longipes it is likely that this is an error and perhaps refers to L. longimanus.

Glaessner (1960) has recorded three fossil species of Leptomithrax: L. irirangi from the lower pliocene and L. atavus, L. uruti from the upper miocene. These species appear to be more closely related to recent Australian species rather than recent New Zealand species of Leptomithrax (Griffin 1966a).

References

Griffin (1966a), Hand (1975), Roper (1979), Webber & Wear (1981), Wear & Fielder (1985).

HETEROTREMATA

MAJIDAE

Leptomithrax tuberculatus mortenseni Bennett, 1964Synonymy

Leptomithrax (Austromithrax) mortenseni Bennett, 1964;
Leptomithrax tuberculatus mortenseni Griffin, 1966a; 1966b; Dell,
 1968a; Wear & Fielder, 1985; Griffin & Tranter, 1986a. This is
 regarded as a sub-species of Leptomithrax tuberculatus
 (Whitelegge 1900) from eastern Australia.

Type Locality

Off Little Barrier Island, Hauraki Gulf, 60m.

Distribution

This species occurs in south-eastern Australia and is
 represented in New Zealand by a sub-species. Kermadec Islands,
 northern part of New Zealand from Cape Maria van Diemen to
 Hauraki Gulf.

The 13 species of Leptomithrax are keyed out by Griffin &
 Tranter (1986a).

Diagnosis (Fig. 38a-e)

Carapace narrowly pyriform, rostrum of two moderately short,
 weakly divergent, sharp spines. Hooked hairs fringing margins of
 rostral spines and scattered in groups on carapace. Margins of
 carapace with six spines : 2 hepatic and 4 branchials, all
 conical and outwardly directed except the last. Hepatic spines
 very short. Chelipeds naked, moderately long (1.1 times CL in
 male), fingers acute with an oval gape basally, inner edges
 finely toothed for distal two-thirds in male, smooth in female.
 Fixed finger has a small tubercle at base in male (not in
 female), dactyl with a slightly more distal tubercle. Legs
 moderately long, slender, smooth, dorsal groups of hooked hairs
 except on dactyl. First leg longest, others decreasing in length.
 Abdomen of six segments plus telson in both sexes.

Colour

Uniformly white when preserved.

Size

Male 23mm CW, 33.5mm CL. Female 18.5mm CW, 26.5mm CL.

Habitat

Among sponges and bryozoans on rough bottoms.

Depth

Upper continental shelf, 10-100m.

Breeding

Ovigerous females have been collected in November to
 February. Eggs newly laid are orange, 0.6mm diam. and when ready
 to hatch, 0.78 x 0.72mm.

Development and Growth

Two zoeal stages (Wear & Fielder 1985), megalopa unknown.

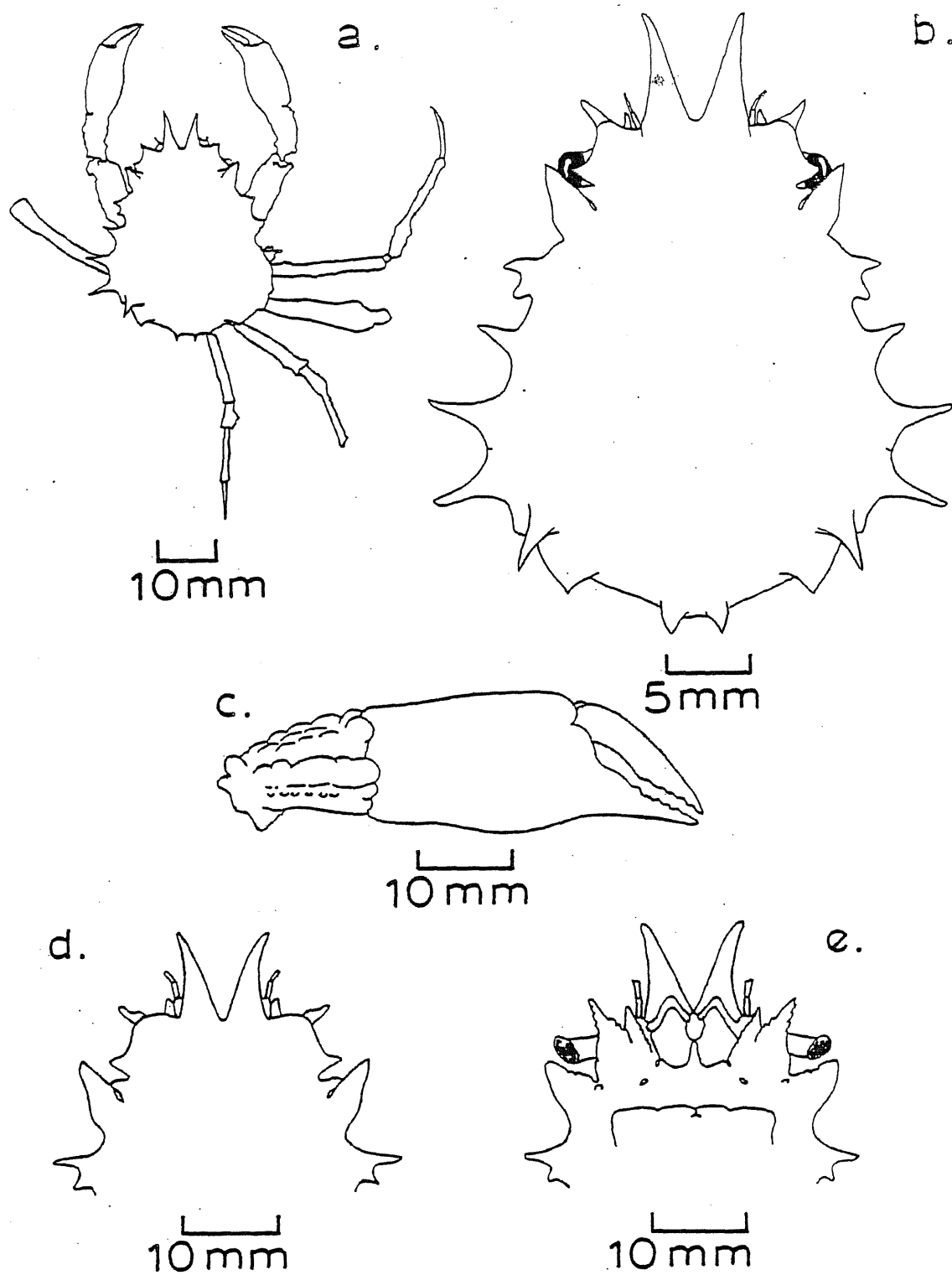


Fig. 38 - Leptomithrax tuberculatus mortenseni: a - male, dorsal view; b - carapace, dorsal view (by J. Black, based on a photo from Bennett, 1964); c - right chela, male, outer face; d - anterior end, dorsal view; e - anterior end, ventral view (modified, after Bennett, 1964).

Behaviour

It is not known whether this species has the normal spider crab masking behaviour. Bennett (1964) states that these crabs are free from attached organisms except for small quantities of sponge, serpulids and bryozoans.

Ecology

Unknown.

References

Bennett (1964), Dell (1963a), Griffin (1966a,1966b), Wear & Fielder (1985), Whitelegge (1900).

HETEROTREMATA

MAJIDAE

Teratomaia richardsoni (Dell, 1960)
Spiny Masking Crab

Synonymy

Leptomithrax richardsoni Dell, 1960; 1963a; Griffin, 1966a; Griffin & Brown, 1976; Wear & Fielder, 1985 (list); Teratomaia richardsoni Griffin & Tranter, 1986a; 1986b.

Type Locality

Chatham Rise, between Banks Peninsula and Chatham Islands, 44°04'S, 178°04'W, 500m.

Distribution

Endemic to New Zealand, known from Chatham Rise and off Milford Sound.

Diagnosis (Fig. 39a-f)

Carapace pyriform, margins and dorsal surface set with moderately long, conical spines and sparse raised tubercles. Numerous fine curled hairs. Dorsal surface of carapace with three subequal median spines, and four pairs of submedian spines or tubercles. Regions moderately well defined. Rostrum of two long slender, acuminate divergent spines. Orbit consists of supraorbital eave bearing a preorbital and antorbital spine, intercalated spine and postorbital lobe which has two small tubercles on the posterior edge near base. Margins of carapace with eight prominent, outwardly directed spines: two orbital, two hepatic and four branchial (fourth spine subdorsal). A single large, sharp spine on the posterior margin of the carapace. Chelipeds long (especially in male), slender, merus and carpus strongly tuberculate. Fingers acute, very coarsely toothed along inner edges, moderately gaping basally in male, adjacent in female, a large basal tooth on both fixed finger and dactyl. Legs of moderate length, cylindrical, first legs longest. Abdomen of six segments and telson in both sexes.

Colour

Dull creamy white (preserved material).

Size

Male 48mm CW, 65mm CL. Female (ovigerous) 40mm CW, 53mm CL.

Habitat

Fine sandy mud bottoms in deep water.

Depth

310-610m.

Breeding, Development and Growth, Behaviour

Unknown.

Ecology

Mitchell (1984) recorded L. richardsoni from the guts of ling (Genypterus blacodes) captured on the Chatham rise (125-177m).

References

Dell (1960, 1963a), Griffin (1966a), Griffin & Tranter (1986a).

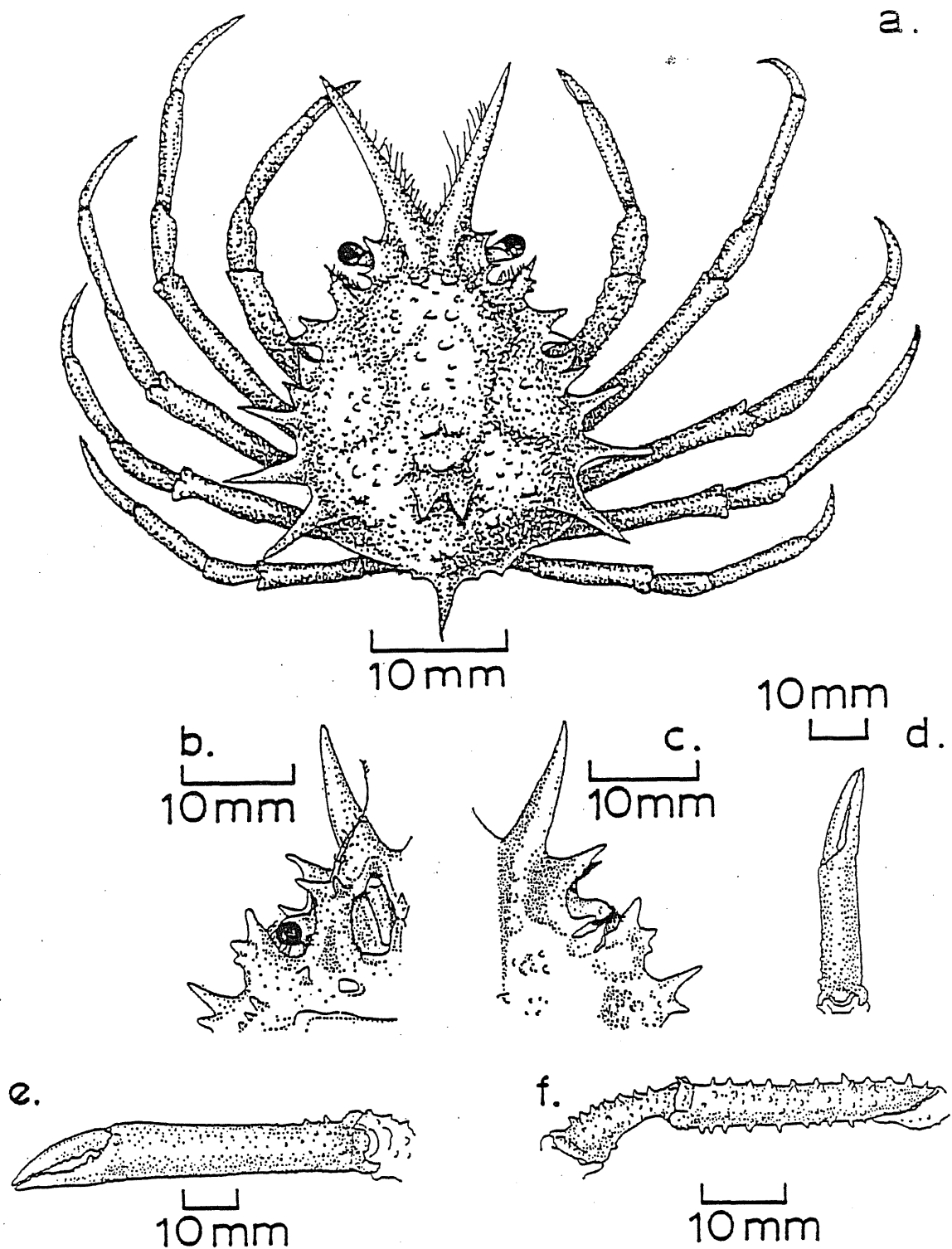


Fig. 39 - *Teratomaia richardsoni*: a - female, dorsal view (by C. Duffy, based on a photo from Dell, 1960); b - orbit, ventral view; c - orbit, dorsal view; d - right chela, female, outer face; e - left chela, male, outer face; f - left chela male, merus and carpus (after Griffin, 1966).

HETEROTREMATA

MAJIDAE

Thacanophrys filholi (A.Milne Edwards, 1876)
Plate-Backed Crab

Synonymy

Acanthophrys filholi A.Milne Edwards, 1876; Acantophrys filholi Filhol, 1885d; Chlorinoides filholi Miers, 1886; Acanthophrys filholi Chilton, 1911a; Thomson, 1912; Thomson & Anderton, 1921; Chilton & Bennett, 1929; Richardson, 1949b; Dell, 1960; 1963a; Bennett, 1964; Chlorinoides filholi Griffin, 1966a; Dell, 1968a; Takeda & Miyake, 1969; Probert et al., 1979; Wear & Fielder, 1985; Thacanophrys filholi Griffin & Tranter, 1986a (key).

Type Locality

Stewart Island, deep rock pool.

Distribution

Endemic to New Zealand. North, South and Stewart Islands. Mainly southern, including Chatham Islands and Auckland Islands, but also recorded 16 km North-West of Cape Maria van Diemen, off West King, Three Kings Islands.

The 12 species of Thacanophrys are reviewed by Griffin & Tranter (1986a).

Diagnosis (Fig. 40a-d)

Carapace narrowly pyriform (pear-shaped), rostrum of two long, sharp, widely divergent spines fringed with hooked hairs. Dorsal surface of carapace with spines, tubercles and hooked hairs. There are three median spines and two prominent mesogastric spines at the posterior end. Margins of carapace with eight spinous or lamellate lateral projections: 4 supraorbital, 1 hepatic and 3 branchial. Chelipeds long (about 1.5 times CL of adult male), crested and naked. Fingers acute, gaping basally, coarsely toothed along inner edges for entire length. Legs of moderate length, much shorter than chelipeds and slender. Long, hooked hairs scattered in groups along dorsal and ventral surfaces. Abdomen of six segments plus telson in both sexes.

Colour

Carapace and legs orange. Chelipeds reddish orange, propodus red, dactyl purple.

Size

Male 39mm CW, 58.5mm CL. Female (ovigerous) 30mm CW, 43.5mm CL. Smallest ovigerous female 22.3mm CW, 30.8mm CL.

Habitat

On sand, mud or muddy gravel among seaweed and sponges. Often covered with large sponges, polychaete tubes, encrusting bryozoa and brown algae.

Depth

Continental shelf, 25m to 550m, most common between 75 and 150m.

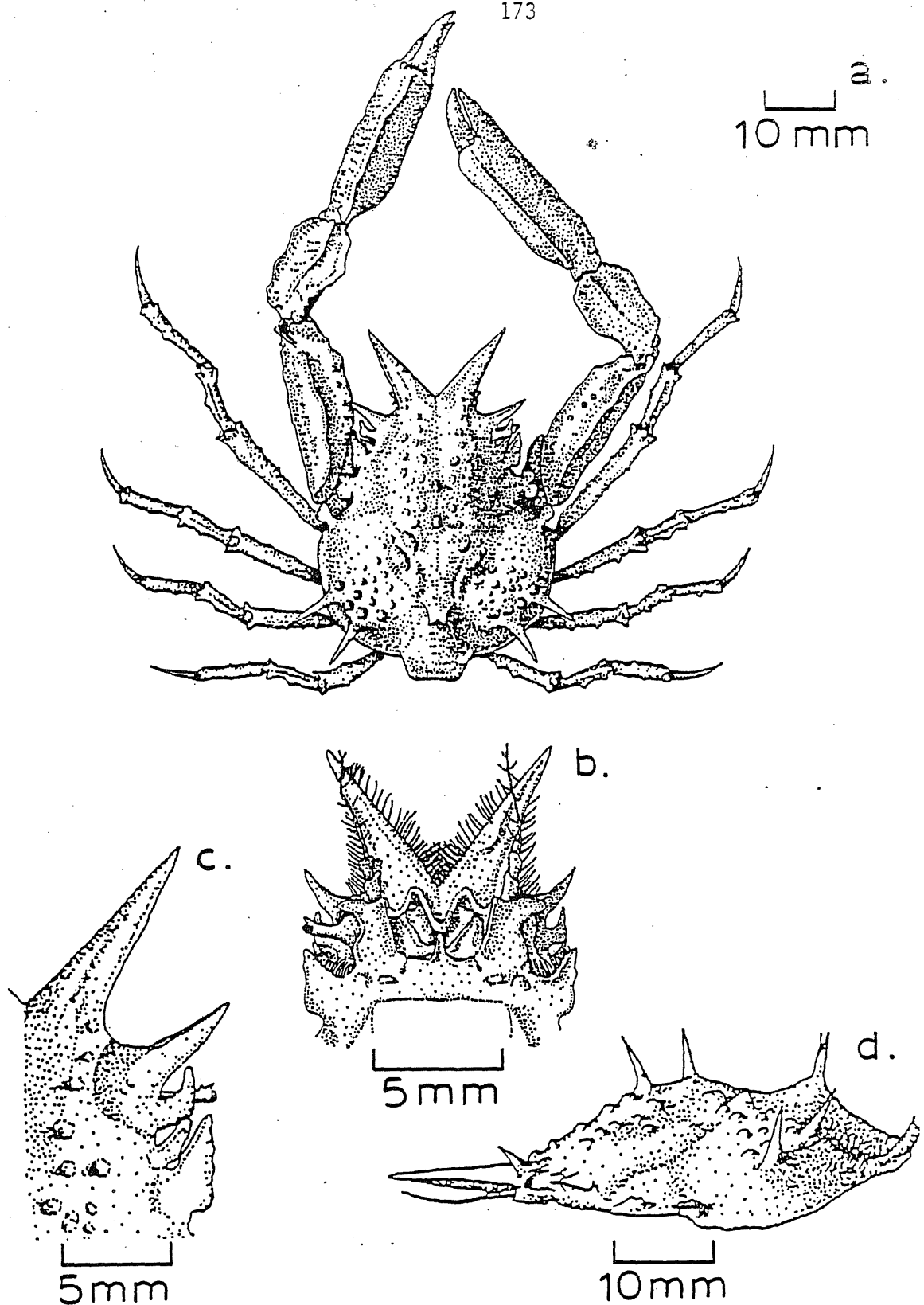


Fig. 40 - *Thacanophrys filholi*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Breeding

Ovigerous females found from March to July.

Development and Growth

Unknown.

Behaviour

T.filholi shows the masking behaviour typical of spider crabs although the presence of large sponges suggests that turnover of the camouflage may only be intermittent.

Ecology

Often heavily covered with polchaete tubes.

References

Bennett (1964), Dell (1963a), Griffin (1966a), Takeda & Miyake (1969), Griffin & Tranter (1986a).

Jacquinotia edwardsii (Jacquinot, 1853)
Jacquinot's Southern Spider Crab

Synonymy

Prionorhynchus edwardsii Jacquinot, in Jacquinot & Lucas, 1853; Miers, 1876b; Filhol, 1886; Rathbun, 1892; Paramicippa grandis Hector, 1899; Prionorhynchus edwardsii Hodgson, 1902; Chilton, 1909; 1911a; Thomson, 1912; Thomson & Anderton, 1921; Stephensen, 1927; Chilton & Bennett, 1929; Campbellia kohli Balss, 1930; Jacquinotia edwardsii Balss, 1930; Richardson, 1949b; Campbellia kohli Richardson, 1949b; Jacquinotia edwardsii Griffin, 1963a; Campbellia kohli Bennett, 1964; Jacquinotia edwardsii Dell, 1963a; Bennett, 1964; Jacquinotia edwardsii Griffin, 1966a; Inoue, Arai & Abe, 1968; Dell, 1968a; Ritchie, 1970; Roberts, 1972b; Webb, 1972; Ritchie, 1973; Rae, 1974; Fenwick, 1975; Yaldwyn, 1975; Ryff & Voller, 1976; Yaldwyn & Beu, 1977; Fenwick, 1978; Griffin & Tranter, 1986a.

Type Locality

Auckland Islands.

Distribution

Southern New Zealand (northern limit, Kaikoura Peninsula), Stewart Island, Chatham Island, Auckland Islands, Pukaki Rise, Snares Island, Campbell Island, Bounty Is.

In the early pleistocene (1.8m yr. ago) J. edwardsii extended as far north as the latitude of Napier when the cold Southland current flowed further up the coast making sea surface temperatures 4° lower than at present (Beu, Grant-Taylor & Hornibrook 1977). At present J. edwardsii does not extend further north than the sub-tropical convergence off the Kaikoura coast. The best preserved structures are the large fingers on the chelae found in limestone rocks. These fossils have been collected on land and also from eroded material deposited in the sea off the Kaikoura coast.

Diagnosis (Fig. 41a-d)

Carapace very broadly pyriform, swollen and almost uniformly convex in profile, surface granular and weakly tuberculate. A few large tubercles scattered along midline and on branchial regions. Rostrum short, strongly deflexed, flattened, wide basally, consisting of two lobes fused for almost their entire length, separated only by a small V-shaped indentation at the tip. Orbit consisting of supraorbital eave, intercalated spine and postorbital lobe, all three adjacent, not separated by fissures. Eye stalk concealed in both dorsal and ventral view when retracted. This results from the expansion of the basal antennal article to form a floor to the orbit. Margins of carapace ornamented by a series of seven conical, spinous tubercles, two hepatic and five branchial branchiols forming a semi-ellipse, last two subdorsal. Chelipeds very long, subcylindrical except for compressed propodus, surfaces granular. Merus long, carpus smaller, propodus almost half total length of cheliped. Merus and carpus with tubercles scattered all over surface. Palm very high in male, fingers acute, bluntly toothed or smooth, moderately gaping for entire length in both sexes.

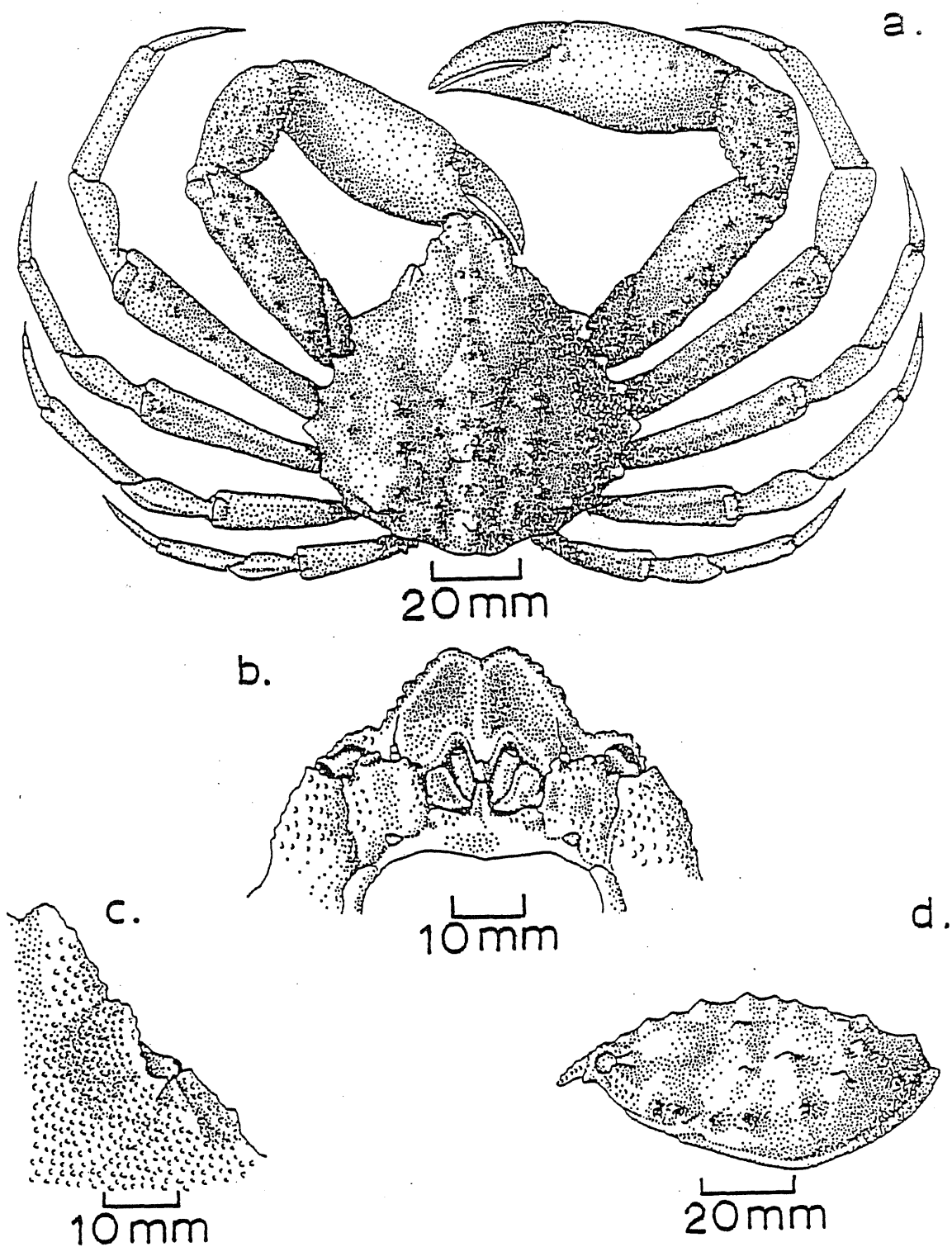


Fig. 41 - *Jacquinotia edwardsi*: a - male, dorsal view; b - anterior end, ventral view; c - orbit, dorsal view; d - carapace, lateral view (after Griffin, 1966).

Legs very long, stout, minutely granular. First leg longest. Abdomen of six segments plus telson in both sexes.

Colour

Carapace brick red, chelae brighter red to yellowish white, often marbled or blotched with red on outer surface.

Size

Male 200mm CW, 220mm CL. Female 128mm CW, 144mm CL.

Habitat

On offshore islands, found in rockpools among seaweed at certain times, even walking over intertidal rocks, also in deeper water on sandy bottoms. J.edwardsii is a southern, stenothermal, cold-water species.

Depth

Intertidal down to 550m.

Breeding

Egg-laying occurs from September to February (probably concentrated in late September - early October) but ovigerous females are found throughout the year because eggs are carried by the female for almost 12 months. Eggs newly laid are orange-yellow, mean diameter 0.94mm, swelling to 1.0 x 1.4mm when ready to hatch the following year. Thus only one batch of eggs is produced each year and the interval between release of one lot of eggs and extrusion of the next batch of eggs is very short. A female of 101mm CL carries about 37,500 eggs and a female of 126mm, about 71,200 eggs (Ritchie 1970). Egg numbers increase at approx. 10,500/cm CL.

In the Tanner Crab Chionoecetes bairdi primiparous females are approximately 70% as fecund as equal-sized multiparous females. A 100mm CW multiparous female carries about 220,000 eggs whereas a primiparous female carries only 150,000 eggs. This is because primiparous females (reproducing for the first time) moult and grow before extruding eggs, whereas multiparous females do not moult (Somerton & Meyers 1983). As in J.edwardsii eggs are incubated for almost 12 months so that only one clutch per year is possible. Wickham (1986) recorded nemertean egg predators from C.bairdi but these worms have not been reported from New Zealand.

Development & Growth

Although eggs may be laid in September there are no signs of development until February (5 months later) when sea temperatures reach their maximum (10.5°C). Sea temperature increase may trigger development (Ritchie 1973). There are two zoeal stages but the megalopa is unknown (Webber and Wear 1981). Zoeae probably occur in the plankton during the period September-November (Roberts 1972b). Larvae of Chionoecetes spp. are pelagic for about 90 days (Jamieson 1986).

Some aspects of relative growth have been studied by Webb (1972) whose log/log regressions suggest that carapace width and length are isometric ($b = 0.923$) while length of the first leg and cheliped are negatively allometric ($b = 0.79, 0.83$) in relation to carapace length for males. Ritchie (1973) also

measured some Auckland Island specimens but did not measure relative growth. Males reach maturity at 110mm CL and females 100mm CL (Ritchie 1970). For crabs >140 mm CL weight increase is fairly linear with CL. Males reach 3600 grams wet weight at 220mm CL and females reach 765gm at 140mm CL.

Three colour phases are recognizable: 1) dark phase with prolific epizoid growth (Lithothamnion, Rhodophyceae, Pomatoceros, Balanus and bryozoa), 2) intermediate phase with a small amount of encrusting organisms, and 3) light phase with no encrusting organisms. Dark phase crabs have obviously not moulted recently and are probably post-pubertal. Like other spider crabs the moult in which maturation by female J. edwardsii is achieved is probably terminal (Hartnoll 1963). No newly forming integument was found under the old integument of dark phase crabs. By contrast light phase crabs are recent moults. Data from the Auckland Is. population suggest that in February 25% of females and 37% of males were light phase (Ritchie 1970). Moulting is probably continuous from November to March. Nothing is known about increment at each moult or intermoult intervals so it is impossible to estimate the maximum age achieved.

In male Chionoecetes bairdi growth increments decrease from 35% (20mm CW) to 15% (130mm CW), 50% of females moult to maturity at 83mm (instar 13) and males mature around 110mm CW, instar 14 or 15 (Donaldson, Cooney & Hilsinger 1981). Whereas females reach their maximum size at around 83mm, in about 5 years, males continue to moult through 18 instars to over 200mm CW and may live for about 12 years. Males become sexually mature about 1 year before they can be legally exploited (Jamieson 1986) but there are regional variations in size of male maturity (Somerton 1981b). Male and female snow crabs, C. opilio, both mature at smaller sizes (Watson 1970). Examination of setae on the maxilla can be used for moult staging (Moriyasu & Mallet 1986). Fecundity of C. opilio decreases with increasing latitude and egg size is larger (Jewett 1981).

Behaviour

Ritchie (1970, 1973) has made extensive observations of pot-caught crabs as well as underwater at the Auckland Islands. J. edwardsii show a disjunctive sex distribution with females and pre-puberty males in shallow water, close to shore, and large mature males in deeper water. Males seen to be migratory, moving inshore in spring (September - November) to pair up with females. At this time crabs may come ashore. Some large males have been tagged and recovered in approximately the same place but they were only at liberty for a few days (see also Ryff & Voller 1976). This separation of males and females makes sex-ratio estimation difficult. An extended and complicated interaction in the spring occurs between male and female Chionoecetes opilio. The male assists with moulting, provides protection, obtains food and assists with larvae release making the female very dependent upon the male (Watson 1971, 1972, Hooper 1986).

During pair formation in J. edwardsii there is considerable loss of legs by females. The male clasps the female by one of her legs and sometimes she is carried around beneath the male. Males contest each other for females and two males grasping a female in a tug-of-war often results in her losing a leg. Of

females missing legs, 38.4% had lost one leg, 24.4% (two), 14% (three), 10.5% (four), 5.8% (five) and 1.2% (eight). Some females had even lost both chelipeds. By contrast only 11% of males had lost one limb, 1% (two limbs) and 9% had lost one cheliped. Female leg loss is cumulative because mature females do not moult and therefore cannot regenerate lost limbs. Clasped females made no attempt to escape from the male. Similar observations have been made on the Snow Crab, Chionoecetes opilio, off Newfoundland (Hooper 1986). Growth per moult and limb regeneration of this species has been investigated by Miller & Watson (1976). Pairs of J.edwardsii caught in pots usually involved spent females (80%) but others were in new berry (8.6%) and old berry (11.4%). These results suggest that there is pre-copulatory male guarding and possibly post-copulatory guarding. Males clasping females with new eggs may be a pot-artifact since they are probably not receptive and these couplings usually involved small males.

Copulation by J. edwardsii has been observed underwater by Ritchie (1973). One pairing occurred while the crabs were fully exposed on a sandy bottom. The male was much larger (CW = 182mm) than the female (CW = 102mm) which was carrying mature eggs. The male raised his body into a vertical position, with his abdomen in a shallow depression in the sand, and clasped the female using his massive chelae and last pair of legs. The female rested upon his abdominal flap and with her own abdomen extended was inseminated by the male. Thus both crabs were vertical rather than one being underneath the other as is common in other species. Furthermore both crabs were in the hard-shell condition so that the female must have been a multiparous crab. Similar copulatory activity has been observed in captivity for the African spider crab Pleistacanthia moseleyi (Berry & Hartnoll 1970). In Chionoecetes bairdi Paul & Adams (1984) found that the fertile period for primiparous females ranged from less than 1 to 28 days. Multiparous females either use sperm stored from a previous mating or mate prior to egg extrusion. These crabs are only receptive to breeding from less than 1 to 7 days. Paul (1984) found that ten was the maximum number of multiparous females that could be mated by a single male. Sperm remain viable in the female for up to two years after mating. Males from 65-104mm CW are competent to fertilize the initial and subsequent clutches from a single insemination (Adams & Paul 1983). These facts are important because only male Tanner Crabs are taken by the Fishery and sufficient males must be left to ensure that all females are mated.

Bennett (1964) and Ritchie (1970) have recorded several instances of "mounding" behaviour which seems to be associated with moulting and mating. Large aggregations have been recorded in spring and these seem to be associated with mating. In March immature and moulting crabs of both sexes form large clumps which are surrounded by large males on the outside. This seems to provide protection for the soft crabs. These observations and those reported above suggest that J.edwardsii females mate either when they are soft-shelled (i.e. primiparous) or hard-shelled (i.e. multiparous). Hartnoll (1969) has found that Hyas coarctatus and Maja squinado copulate in both the hard- and soft-shell state. When a H.coarctatus male mates with a hard-shell female the liaison is very short with no

post-copulatory guarding, but when he mates with a soft-shell female he may carry her around for several days. The situation in J.edwardsii is unclear because we do not have enough information. However at least some majid crabs would seem to depart from the standard brachyuran pattern of being either hard-shell or soft-shell maters but not both.

With modifications to the proposal of Ritchie (1973) the annual cycle of events in the J.edwardsii population at the Auckland Islands consists of:

- 1) Pair formation of males and females in Spring, September-November.
- 2) Copulation during September-November when primiparous females moult to maturity and multiparous females have released their larvae.
- 3) Egg-laying September-February, with a peak probably in late September-early October.
- 4) Egg development delayed until after February.
- 5) Main moulting period (both pre-puberty moults and perhaps pubertal males) in March.
- 6) Larval release in September-November with a probable peak in late September.

Depths at which recruitment of J.edwardsii juveniles occurs is unknown but it may be similar to Chionoecetes opilio and C.bairdi in which juveniles settle in deeper water (Brethes et al. 1987).

Ecology

Male, female and juvenile J.edwardsii seem to have different feeding behaviours (Ritchie 1973). Large males have been observed feeding on ribbed mussels (Aulacomya maoriana) and probably also feed on other shellfish such as Mytilus, Mactra, Haliotis, Maurea and Struthiolaria. Although both males and females enter baited pots, only males have been observed feeding on the fish bait. The largest males seem to have priority in feeding, forming a 'peck order' over smaller males. A male would often have a female clasped in one claw and be feeding with the other claw. By contrast, females are detritus feeders, on sandy bottoms, moving slowly forwards with legs semi-buried and picking up minute detrital particles using both chelae. Juveniles of both sexes seem to feed on drift algae (red gelatinous and filamentous algae) especially in shallow water around dusk. Juveniles are rarely caught in pots.

Near Kodiak Island, Alaska, Chionoecetes bairdi are highly cannibalistic, eating juvenile C.bairdi, as well as other Crustacea (shrimps, pagurids), fishes, molluscs (mainly the bivalves Macoma spp. and Yoldia spp.) and polychaetes but there were no significant differences between the sexes. Significant differences were apparent in quantity of food consumed between times, areas, depths, size groups and crab exoskeleton classes (Jewett & Feder, 1983).

At the Auckland Islands sea lions (Neophoca forsteri) are the most important predator of J. edwardsii. Large numbers of soft-shelled crabs are eaten during the moulting period in March (Falla 1970). Fish predators have only been rarely recorded. Habib (1975) found J. edwardsii in guts (2.0% of gut volume) of red cod (Pseudophycis bacchus) caught off Banks Peninsula in April.

The existence of a large resource of crabs in southern New Zealand waters was first discovered in 1968 by fishing vessels sailing to the Auckland Islands in search of new crayfishing grounds (Rae 1974). Further investigation was carried out by Ritchie (1970, 1973) and Ryff & Voller (1976) with some incidental data coming from the study of Webb (1972) of crabs off the west coast of Stewart Island. Commercially takeable crabs have been defined as those with CL 140mm (i.e. CW 120mm or 765gm wet weight) or larger. This effectively excludes females which do not reach this size. The best type of pot is one about 1.6 x 1.6 x 0.75m, covered with coarse (10cm x 7.5cm) mesh, with a throat at each end and baited with fish carcasses. Poor catches have been recorded at Campbell Island, where takeable crabs are in deep water and localized, also Bounty Islands, but good catches have been made at Auckland Islands and on the Pukaki Rise where crabs have been taken from 452m depth. Catch rates of up to 235 crabs/10 pots have been achieved in shallow water but catch rates decline with depth although the percentage of takeable crabs increases. On the Pukaki Rise catch/unit efforts have reached 59kg/10 pots and meat recovery is in the range of 15-20% by weight. Most of the meat is in the large chelae. Length of fishing did not affect catches when all sizes and both sexes occurred but where large males predominated long fishing periods (20-28 hrs) produced bigger catches than short periods (1-12 hrs). The sex ratio in catches depends upon pot mesh-size and depth of fishing. Working 40 pots, 2 tons of takeable crabs could be caught per day and 2-3 tons/week on a voyage should be possible (Ritchie 1970).

While some J. edwardsii have been landed and sold in the South Island occasionally, no effort has been made to make regular catches. There has been strong Japanese interest in the crab resource with some catches being marketed there. Ritchie (1973) made some management recommendations which limited the Auckland Island fishery to only 3 licences each covering up to 2 boats. However Ryff & Voller (1976) recommended that the Auckland Island fishery be closed to commercial fishing until the population biology of J. edwardsii is more clearly understood. At present we know very little about growth and age and nothing about recruitment. Hence sustainable yields are unknown. If the fishery concentrated on males only then the research on competence of Chionoecetes males discussed above will be very relevant. Another management problem results from the fact that the Pukaki Rise area is outside our 200m EEZ in international waters where management regulations could not be enforced.

References

- Dell (1963a), Fenwick (1975), Griffin (1966a), Griffin & Tranter (1986a), Ritchie (1970, 1973), Ryff & Voller (1976), Webb (1972), Yaldwyn & Beu (1977).

HETEROTREMATA

ATELECYCLIDAE

Pteropeltarion novaezealandiae Dell, 1972SynonymyPteropeltarion novaezealandiae Dell, 1972.Type Locality

Campbell Plateau, 49°34.5'S, 170°51'E, 499m.

Distribution

In deep water from the latitude of Auckland (37°S) to south of Stewart Island (50°S), both west and east coasts from 169° to 176°E.

Diagnosis (Fig. 42a-e)

Carapace pentagonal with a simple, long lateral spine on each side and a moderately elongate rostrum. The rostrum is flattened, about one-fifth of CL, terminating in three broad spines (laterals longer than the central spine), and bearing a group of long, slender, stiff hairs terminally. Carapace surface finely granular, especially towards margins. Orbit marked by a weak, blunt supra-orbital spine and a more strongly developed post-orbital spine. Chelipeds in adult females and sub-mature males sub-equal in size although even in females the right cheliped is enormously developed. Legs long and slender, set with a row of feathery branched hairs along the upper surface, dactylus with two rows of stiff, short hairs. Male and female abdomens of six segments plus telson.

Colour

White when preserved.

Size

Holotype male 24.5mm CW (including spines), 16.8mm CL (including rostrum). Female 22mm CW, 16.6mm CL.

Habitat

Deep water muddy substrates. The shape of this crab, elongate rostrum, and forwardly-placed mouth-frame suggests that this crab may burrow into soft substrates.

Depth

Deep water on the continental slope 499-903m.

Breeding

Ovigerous females have been collected in October and January. One female (size not given) carried 12 eggs and another female (22mm CW, incl. spines) carried 57 eggs, many pushed out beyond the abdomen. Preserved eggs are light brown and large (up to 1.5mm diameter) which may indicate direct development (Dell 1972). Another specimen in the N.Z.O.I. collection, 21.7mm CW, carried 78 eggs, diameter 1.4-1.6mm.

Development and Growth, Behaviour, Ecology

Unknown.

References

Dell (1972).

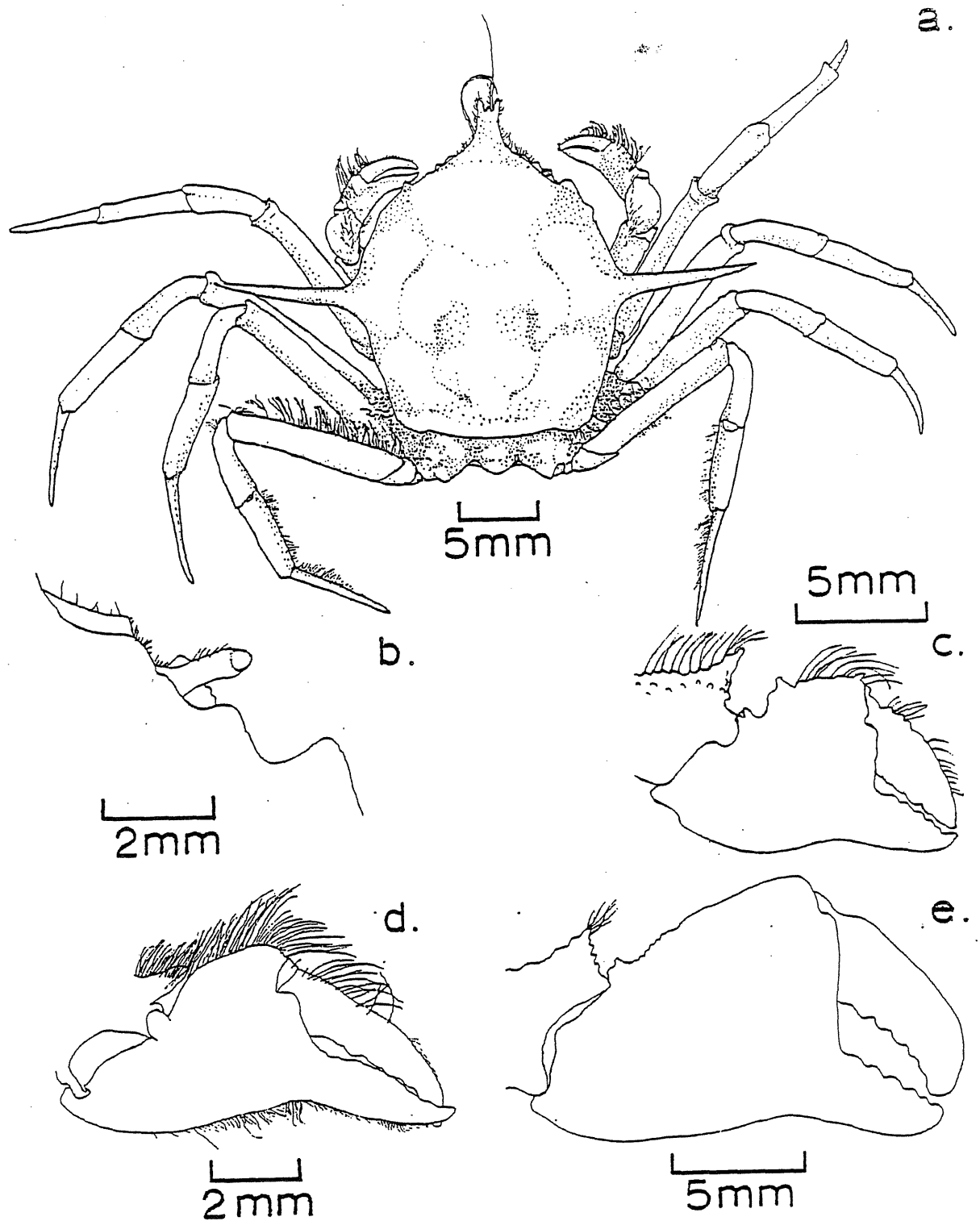


Fig. 42 - *Pteropeltarion novaezelandiae*: a - female, dorsal view;
 b - detail of orbital area, dorsal view (by J. Black);
 c - right chela, sub-adult male, outer face (after Dell, 1972);
 d - right chela, adult female, outer face (by J. Black);
 e - right chela, adult male, outer face (after Dell, 1972).

HETEROTREMATA

ATELECYCLIDAE

Trichopeltarion fantasticum Richardson & Dell, 1964
Frilled Crab

Synonymy

Trichopeltarion n.sp. Dell, 1960; Trichopeltarion sp. Dell, 1963a; Trichopeltarion fantasticum Richardson & Dell, 1964; Dell, 1968a; Takeda & Miyake, 1969; King & Clark, 1984; Dawson, 1984; Wear & Fielder, 1985.

Type Locality

Palliser Bay in c.180m, 41°32'30"S, 174°52'E.

Distribution

Endemic to New Zealand, Bay of Plenty to Foveaux Strait on the east coast, Chatham Rise, Kaipara to Fiordland on the west coast.

Diagnosis (Fig. 43a-d)

Carapace much wider than long (including lateral spines), broadly oval-shaped, front broadly rounded, margins irregularly frilled and with strong lateral spines. Surface uneven, set with sparse, short, stiff brown hairs and widely spaced rounded tubercles. Regions well marked. Rostral area has three acute spines, laterals longer than the central spine. Pre-orbital tooth strong with subsidiary lateral spines, supra-orbital tooth similar, and post-orbital tooth acute, bearing strong spines on the posterior margin. Eye stalk slender, eye comparatively small, reddish-orange in colour. Behind the post-orbital tooth are two compound anterolateral teeth bearing three or four spines. Much farther back is a long lateral spine, one-sixth the width of the carapace, set with strong subsidiary spines. Posterolateral margin also set with small spines. Chelipeds in adult females and small males, small and equally developed, set with stiff setae along outer edge, surface with sparse, short, stiff brown hairs. Upper margin of propodus spinulose with a large raised boss at the point of articulation with the carpus. Lower proximal margin of propodus with an elongate curved projection which articulates with the carpus. In mature males the right cheliped is enormously developed, length more than twice CL. Manus largely smooth, roughened along posterior margin, two granular patches distally. Carpus strongly granular along posterior border. Propodus smooth, deep, fixed finger short, obsoletely toothed, dactyl longer, stout, with six strong teeth. Legs long, slender, with stiff hairs along upper and lower margins, surface with short brown hairs, two spines on upper distal margin of merus. Abdomen of seven segments, first three segments bearing a pair of median tubercles with traces visible on the fourth. Edges of abdominal segments with long stiff hairs.

Colour

Greyish white with reddish-orange eyes.

Size

Male 85.3mm CW, 65.5mm CL. Female 86.0mm CW, 67.4mm CL.

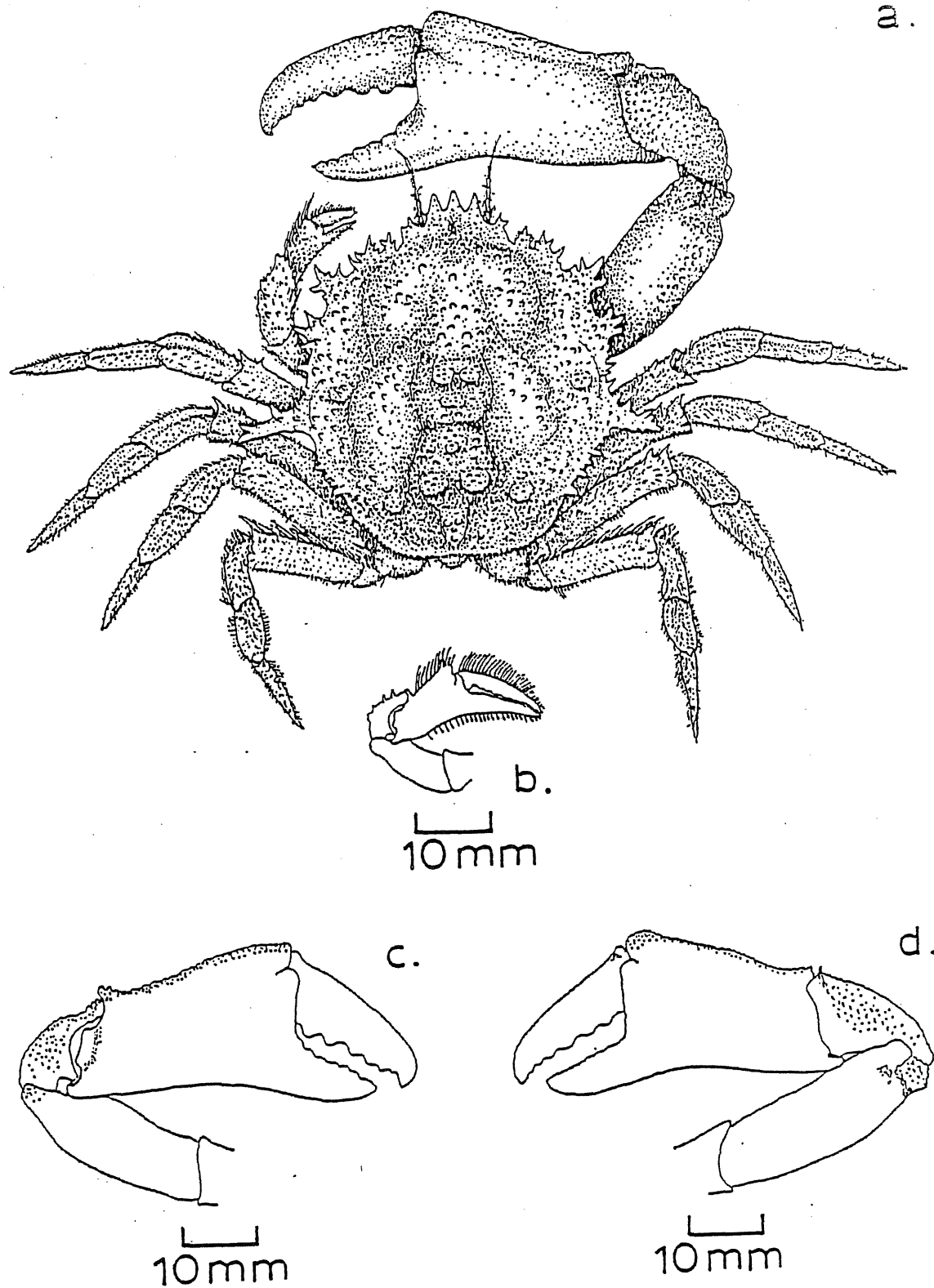


Fig. 43 - *Trichopeltarion fantasticum*: a - male, dorsal view; b - right chela, female, outer face; c - right chela, male, outer face; d - right chela, male, inner face (after Richardson & Dell, 1964).

Habitat

Fine muddy bottoms in deep water.

Depth

Usually 70-720m with an exceptional record from 15-22m in Te Waewae Bay.

Breeding

Ovigerous females have been collected in June and October. Newly laid eggs are dark maroon or dull red-orange (Richardson & Dell 1964). New eggs measure 1.44mm x 1.33mm and when ready to hatch, almost transparent and 1.75mm x 1.65mm.

Development and Growth

Probably only one zoeal stage, large, heavily built and very poor swimmers. Unlikely to be found in plankton samples because it is short-lived and remains at or near the bottom in deep water (Wear & Fielder 1985).

Behaviour

The presence of the enormous right cheliped in males raises the question of its function, whether it is used in feeding and/or aggressive interactions. When this crab is landed on the deck of a ship it is very lethargic and it shows no sign of aggression.

Ecology

Richardson & Dell (1964) recorded five females from the stomach of a dogfish (?Mustelus lenticulatus) caught at about 130m between Maunganui Bluff and Kaipara Bar. Also King & Clark (1984) found T. fantasticum in the stomach of rig (Mustelus lenticulatus) caught off Banks Peninsula. Red Cod (Pseudophycis bacchus) from the Canterbury area also eat this crab: October 0.5% of gut volume and February 1.2% (Habib 1975).

A closely related fossil species, Trichopeltarion greggi, has been described from pliocene deposits from North Canterbury by Dell (1969). These fossils are found in concretionary boulders derived from siltstone at Motunau Beach and while males have the greatly enlarged right cheliped they lack the long lateral spines of T. fantasticum. Co-occurring fossils indicate that T. greggi probably lived in shallow water, similar to Cancer novaezelandiae, whereas T. fantasticum is found mostly in deep water. It may be that T. greggi is ancestral to the modern species which is of comparatively recent origin. Dell (1969) discussed some of the difficulties concerning the validity of generic distinctions between Peltarion, Trichopeltarion and Trachycarcinus that follow from this hypothesis.

References

Dawson (1984), Dell (1963a, 1969), Richardson & Dell (1964), Wear & Fielder (1985).

HETEROTREMATA

CANCRIDAE

Cancer novaezealandiae (Jacquinot, 1853)
Pie-Crust Crab

Synonymy

Platycarcinus novae-zealandiae Jacquinot, 1853; Cancer novae-zealandiae A. Milne Edwards, 1865; Miers, 1874; 1876b; Filhol, 1886; Lenz, 1901; Chilton, 1909; 1911a; Thomson, 1912; Thomson & Anderton, 1921; Stephensen, 1927; Chilton & Bennett, 1929; Young, 1929; McNeill & Ward, 1930; Richardson, 1949a; Cancer novaezealandiae Dell, 1963a; 1968a; Dell, 1969; Vermeij, 1977; Marsden & Fenwick, 1978; Probert et al., 1979; Marsden, 1981; Knox, 1983b; Wear & Fielder, 1985.

Type Locality

New Zealand.

Distribution

Endemic to New Zealand. North, South and Stewart Island. Also Auckland and Chatham Islands. Possibly self or accidentally introduced to south-eastern Australia and Tasmania. The fossil record of and speciation in the genus Cancer has been reviewed by Nations (1975, 1979).

The European Edible Crab Cancer pagurus was introduced to New Zealand at Portobello in 1907, 1908 and again in 1913. In all 59 crabs were imported. Both larvae and adults were liberated around Otago harbour and off the coast but they failed to become established (Thomson & Anderton 1921).

Diagnosis (Fig. 44a-b)

Carapace much wider than long (approx. 1.6 times), flattened front, broadly rounded, covered with tiny granulations, regions scarcely distinct. Anterolateral margins produced and bearing numerous small lobes. Supra-orbital margins without teeth but preceded by a small pre-orbital tooth. Frontal margin with three teeth of which the median is much smaller and more depressed. Chelipeds large and granulous externally. Granules on propodus arranged in four longitudinal rows. Movable finger granulous above, both fingers strongly dentate, four teeth on each finger. Legs robust and moderate length, segments fringed with long hairs. Dactyls long, flattened, without teeth. Abdomen of six segments plus telson in both sexes.

Colour

Dark brown, dull red with darker rim around carapace margin and with black finger tips. Young crabs can be mottled dark green on the carapace with dark brown spots. Legs orange banded and with orange dactyls.

Size

Male 150mm CW, 94mm CL. Female 112mm CW, 73mm CL.

Habitat

Under stones and among large seaweeds in the lower intertidal. Adults usually only in deeper water on sandy bottoms. Sometimes caught in crayfish pots.

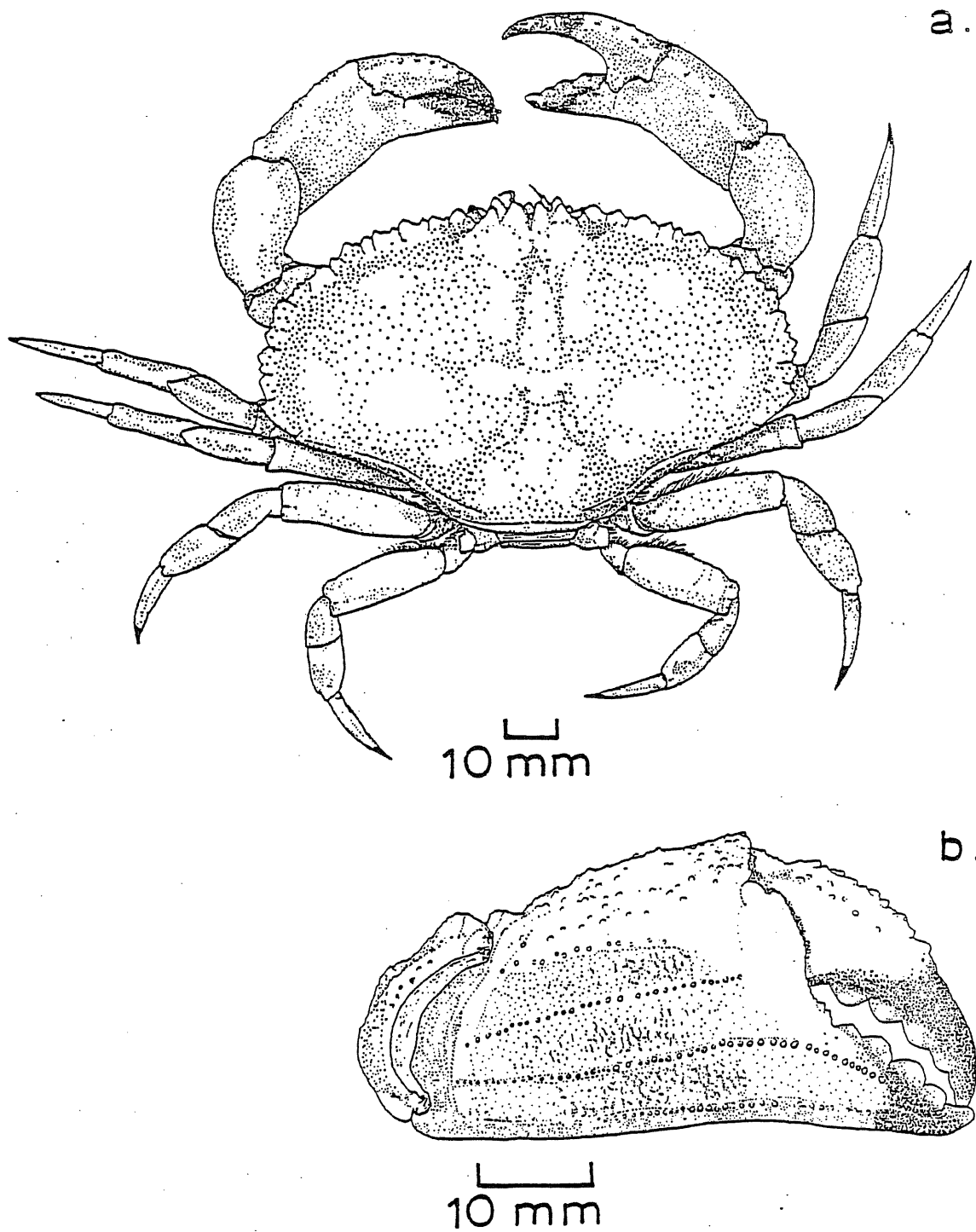


Fig. 44 - *Cancer novaezelandiae*: a - male, dorsal view; b - right chela, male, outer face (by J. Black).