CSIRO FISHERIES AND OCEANOGRAPHY
Fisheries Synopsis No. 7

DFO/S7

SYNOPSIS OF BIOLOGICAL DATA ON THE EASTERN KING PRAWN *Penaeus plebejus* Hess, 1865

Prepared by
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DIVISION OF FISHERIES AND OCEANOGRAPHY
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION
Cronulla, Sydney, Australia, 1970

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SYNOPSIS OF BIOLOGICAL DATA ON EASTERN KING PRAWN

Penaeus plebejus Hess, 1865

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CONTENTS [1/]

1/ This synopsis has been prepared in accordance with Outline Version No. 2 in H. Rosa Jr., 1965, Preparation of synopses on the biology of species of living aquatic organisms, FAO Fisheries Synopsis 1 (Revision 1).

* As no information was available to the authors, these items have been omitted from the text.

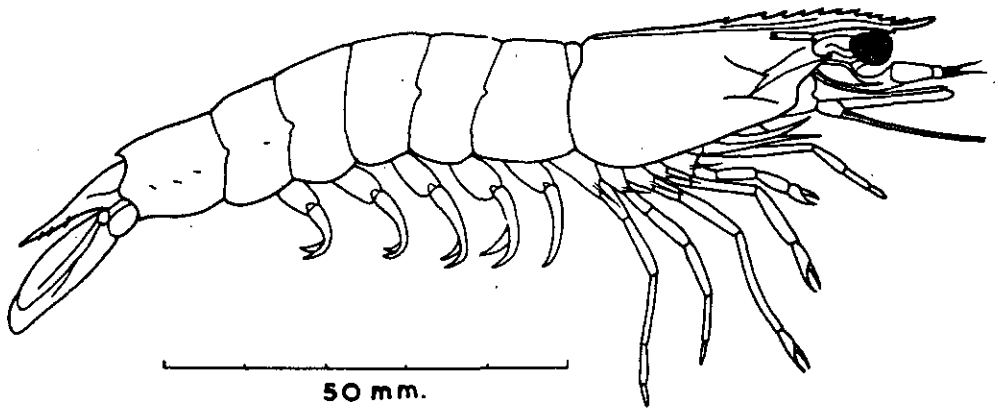

Fig. 1.- Penaeus plebejus Hess, 1865: female 121 mm long (from Dall, 1957).

1 IDENTITY

1.1 Nomenclature

1.11 Valid name

Penaeus plebejus Hess, 1865, Arch. Naturgesch. 1, 127-73.

1.12 Objective synonymy

None.

1.2 Taxonomy

1.21 Affinities

- Suprageneric

Phylum Arthropoda
Class Crustacea
Subclass Malacostraca
Series Eumalacostraca
Superorder Eucarida
Order Decapoda
Suborder Natantia
Section Penaeidea
Family Penaeidae
Subfamily Penaeinae

- Generic

Genus: Penaeus Fabricius, 1798, Supplementum Entomologiae Systematicae, p. 408.

Genotype: Penaeus monodon Fabricius, 1798 (neotype Holthuis, 1949).

Generic concept is that of Dall (1957, pp. 141-2):

"Rostrum toothed ventrally. Carapace without longitudinal or transverse sutures; cervical and orbito-antennal sulci and antennal carinae always present. Hepatic and antennal spines pronounced, pterygostomial angle rounded. Telson with deep sulcus, without fixed subapical spines, with or without lateral movable spines. First antennular segment without a spine on ventral distomedian border. Antennular flagella shorter than carapace. Maxillulary palp with 2 or 3 segments, usually 3. Maxilliped 3 sexually dimorphic. Basial spines on 1st and 2nd pereiopods, exopods on 1st 4 pereiopods, usually

present on 5th. Petasma pod-like with thin median lobes, usually with small thickened distal protuberances and forming a posterior tube-like projection; lateral lobes usually with thickened distal rounded margins. Appendix masculina with an ovoid distal segment, bearing numerous spinules. Thelycum usually with an anterior process, variable in shape, lying between the coxae of 4th pereiopods and seminal receptacle occupying ventral surface of last thoracic sternite, receptacle often closed by 2 flaps which meet or overlap on the mid line; seminal receptacle sometimes open. Zygocardiac ossicle consisting of a principal tooth followed by a longitudinal row of smaller teeth which often end in a cluster of minute teeth. Pleurobranchiae on 3rd to 4th thoracic somites; a rudimentary arthrobranch on 1st, and a posterior arthrobranch on 7th thoracic somites; mastigobranchiae on 1st to 6th thoracic somites. Body glabrous."

- Specific

Type specimen: Adult female, 15 cm, at University Museum of Gottingen, is believed to be the type (Kuenzer, personal communication).

Type locality: Sydney, Australia.

Diagnosis: P. plebejus is illustrated in Figure 1. A colour illustration is given by Grant (1965, Plate 14). The following description is from Dall (1957, pp. 147-8).

"Rostrum.—Teeth 10-11/1, rostrum slightly recurved beyond ventral tooth, reaching not quite or to tip of antennular peduncle. The 5th tooth above anterior edge of carapace. An accessory rostral carina running forward from 1st rostral tooth, extent and distinctness depending on maturity, indistinct in prawns below 50 mm length. Adrostral sulcus as wide as postrostral carina.

Carapace.—Gastrofrontal sulcus deep, extending to 1/6 carapace, a trifurcate posterior extremity. Orbito-antennal sulcus wide anteriorly, narrowing to junction with the narrow cervical and hepatic sulci. Hepatic carina curving obliquely downwards anteriorly ending 1/6 its length from carapace margin (Fig. 2a).

Antennules.—Outer flagellum longer than inner and $\frac{1}{2}$ length peduncle. Prosartema almost reaching distal end of basal segment; stylocerite attaining more than $\frac{1}{2}$, but not exceeding $\frac{3}{4}$ basal segment.

Thoracic appendages.—Dactyl 3rd maxilliped 0.6-0.7 length propodus, in male bearing an apical tuft of setae $\frac{1}{2}$ length dactyl. Third maxilliped reaching tip of basal segment of antennular peduncle; 1st pereiopod reaching base of carpocerite; 2nd exceeding carpocerite by dactyl; 3rd almost reaching as far as 1st segment of antennular peduncle; 4th and 5th reaching as far as 1st. Ischial spine absent on 1st pereiopod.

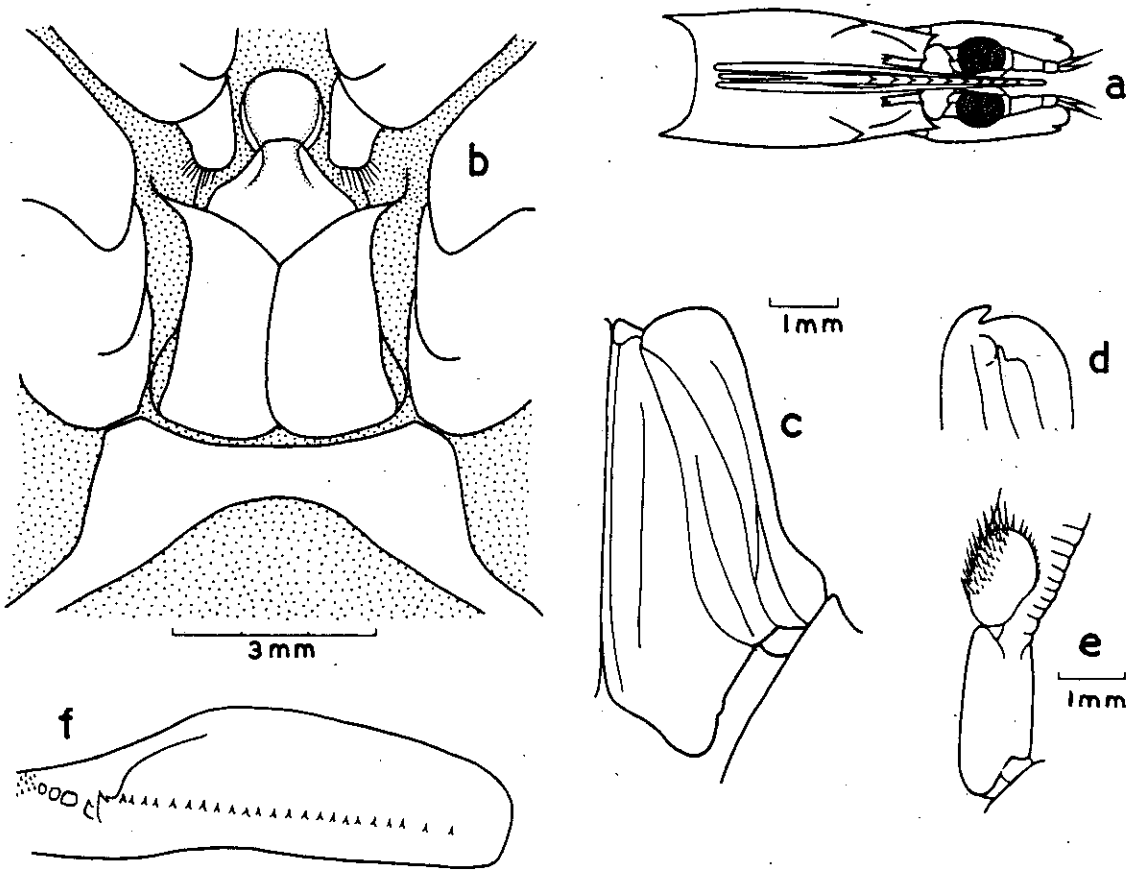

Fig. 2.- Penaeus plebejus Hess. a, dorsal cephalothorax of 121 mm female; b, thelycum of 150 mm female; c, inner aspect of left half of petasma, 125 mm male; d, outer lateral distal portion of petasma (same scale); e, appendix masculina; f, cardiac plate and zygocardiac ossicle (from Dall, 1957).

Abdomen.—Dorsally carinated from middle of 4th somite, 5th with 1 small lateral, 6th with 3 lateral cicatrices. Telson with 3 pairs of spines.

Gastric mill.—Cardiac plate with 23-24 spinules; zygocardiac ossicle with principal + 2-3 large teeth and a number of small teeth (Fig. 2f).

Petasma.—Median protuberances projecting very slightly ventrally over distal margins of lateral lobes (Fig. 2c and d).

Appendix masculina.—Distal piece 1.3 times width, inner edge straight, outer edge convex (Fig. 2e).

Thelycum.—A rounded anterior plate lying between coxae of 4th legs and a posterior subrectangular plate, with median groove continuous with anterior piece, fading out posteriorly flanked by 2 prominent ridges. Flaps of seminal receptacle overlapping medially with outer margins slightly concave (Fig. 2b).

Colour (live mature specimens).—Body cream to yellow; rostrum finely speckled with dark spots, tip banded; postrostral and abdominal carinae dark brown; posterior edge of carapace and abdominal segments light-brown; tips of antennal scales and uropods blue, the fringing setae of both bright red; proximal podomeres of pereiopods and pleopods yellow. Immature prawns.—Usually cream, sometimes with blue in place of the brown noted above, and short vertical blue bands on pleura of first 4 abdominal somites."

P. plebejus is closely related to three other species found in the Australian region: P. latisulcatus Kishinouye, P. longistylus Kubo and P. japonicus Bate. Table 1 lists features which distinguish these four species.

TABLE 1

FEATURES DISTINGUISHING P. PLEBEJUS FROM RELATED AUSTRALIAN SPECIES

Feature	P. plebejus	P. longistylus	P. latisulcatus	P. japonicus
Red spot on 3rd abdominal somite	Not present	Present	Not present	Not present
Accessory rostral carina	Well developed	Not present	Very small in large specimens	Not present
Posterior end of gastrofrontal sulcus	Trifurcate	Bifurcate	Bifurcate	Bifurcate
Thelycum	Anterior plate rounded	Anterior plate bluntly pointed	Anterior plate bifid	Anterior plate rounded

Material examined by present authors: Specimens from Moreton Bay and deep waters (145-220 m) off Caloundra were examined, and a male and female have been lodged in the Queensland Museum (Reg. No. W3167).

Subjective synonymy:

Penaeus canaliculatus Haswell, 1879, placed in synonymy by Racek (1955), reasons not given.

Penaeus canaliculatus var. australiensis Bate (1888) placed in synonymy by Racek (1955), reasons not given.

Peneus plebejus Schmitt, 1926, placed in synonymy by Racek (1955), reasons not given.

Penaeus maccullochi Schmitt, 1926, placed in synonymy by Dall (1957), with reasons.

Key to the Indo-Pacific species of Penaeus (Dall, 1957):

1 Adrostral carina reaching almost to posterior border of carapace; gastrofrontal carina present 2
Adrostral carina not reaching behind middle of carapace; gastrofrontal carina absent 10

2(1) Telson armed, usually with 3 pairs of spinules 3
Telson unarmed 8

3(2) Postrostral carina sulcate; not more than 1 ventral rostral tooth .. 4
Postrostral carina non-sulcate; usually 2 ventral rostral teeth 7

4(3) Sulcus on postrostral carina less than $\frac{1}{2}$ length of carapace; ischial spine on 1st pereiopod ..... P. longistylus Kubo
Sulcus on postrostral carina more than $\frac{1}{2}$ length of carapace; no ischial spine on 1st pereiopod 5

5(4) Rostrum with accessory pair of carinae on blade of rostrum; gastrofrontal sulcus with trifurcate posterior end ..... P. plebejus Hess (=P. maccullochi Schmitt)
Rostrum without accessory pair of carinae; gastrofrontal sulcus with bifurcate posterior end 6

6(5) Thelycum with apex of anterior plate rounded; seminal receptacle cylindrical, not closed by 2 flaps; adrostral sulcus narrower than postrostral carina ..... P. japonicus Bate
Thelycum with apex of anterior plate bifid; seminal receptacle flat, closed by 2 flaps; adrostral sulcus as wide as postrostral carina .... P. latisulcatus Kishinouye

7(3) Adrostral carinae continuing almost to posterior edge of carapace; anterior plate of thelycum with lanceolate apical process ..... P. teraoi Kubo
Adrostral carinae becoming indistinct posteriorly; anterior plate of thelycum without lanceolate apical process ..... P. marginatus Randall

8(2) Rostrum with 1 ventral tooth ..... P. canaliculatus Olivier
Rostrum with more than 1 ventral tooth 9

9(8) Thelycum with a median longitudinal carina on sternite of 7th thoracic somite; ventral surface of flaps of seminal receptacle not pubescent ..... P. californiensis Holmes
Thelycum without a median carina on sternite of 7th thoracic somite; ventral surface of flaps of seminal receptacle pubescent ..... P. brevirostris Kingsley

10(1) Hepatic carina present 11
Hepatic carina absent 17

11(10) Third maxilliped in male with apical tuft of setae on propodus; lateral lobe of petasma thickened distally; thelycum with seminal receptacle closed by 2 flaps 12
Third maxilliped in male without apical tuft of setae on propodus; lateral lobe of petasma not thickened distally; thelycum with oper seminal receptacle (spp. limited to Pacific America) 15

12(11) Fifth pereiopods with small but distinct exopods 13
Fifth pereiopods without exopods ..... P. monodon Fabricius (=P. carinatus Dana)

13(12) Postrostral carina sulcate ..... P. semisulcatus de Haan
Postrostral carina non-sulcate 14

14(13) Hepatic carina arcuate, extending behind posterior end of antennal carina; rostral teeth 9/2 ..... P. gracilirostris Thallwitz
Hepatic carina straight not extending beyond posterior end of antennal carina; rostral teeth 5-7/3-4 ..... P. esculentus Haswell

15(11) Adrostral carina reaching as far as epigastric tooth; rostral teeth usually 9/2 ..... P. vannamei Boone
Adrostral carina extending posteriorly to epigastric tooth; ventral rostral teeth more than 2 16

16(15) Antennular flagella longer than peduncle; thelycum with prominent pyramidal upheaval on 8th thoracic somite; an expanded coxal projection on 5th pereiopod in female ..... P. stylirostris Stimpson
Antennular flagella as long as or shorter than peduncle; thelycum without pyramidal upheaval; no coxal projections on 5th pereiopods of female ..... P. occidentalis Streets

17(10) Third pereiopod exceeding scaphocerite by at least dactyl; maxillulary palp 2-segmented 18
Third pereiopod not quite reaching tip of scaphocerite; maxillulary palp 3-segmented ..... P. orientalis Kishinouye

18(17) Gastro-orbital carina occupying the posterior 2/3 distance between hepatic spine and orbital angle ..... P. indicus H. Milne Edwards
Gastro-orbital carina absent or not reaching hepatic spine and occupying the middle $\frac{1}{3}$ distance between hepatic spine and orbital angle ... .19

19(18) Dactyl of 3rd maxilliped adult male $\frac{1}{2}$ propodus; adrostral carina not reaching as far as epigastric tooth ..... P. merguiensis de Man
Dactyl of 3rd maxilliped adult male much longer than propodus; adrostral carina reaching just beyond epigastric tooth .... P. penicillatus Alcock

1.22 Taxonomic status

P. plebejus is a morphospecies.

1.23 Subspecies

P. plebejus is monotypic.

1.24 Standard common names, vernacular names

Standard common name, eastern king prawn; vernacular name, king prawn.

1.3 Morphology

1.31 External morphology (For description of spawn, larvae, and juveniles, see 3.17; 3.22; 3.23.)

Two compound eyes are borne on eyestalks which arise under the anterior edge of the carapace on either side of the rostrum. Thereafter the following pairs of appendages are found attached to the sternites of the cephalothoracic segments; antennules, antennae, mandibles, maxillae I and II, maxillipeds I, II and III, and pereiopods I to V, pereiopods I, II and III with small chelae. In females the segment bearing pereiopod V is modified into a thelycum. The abdomen is formed of six individually distinct segments and a telson. The sternites of the first five abdominal segments carry pleopods and the sixth uropods. In the male the endopods of the first pleopods are joined to form the petasma and second pair of pleopods bear an appendix masculina each.

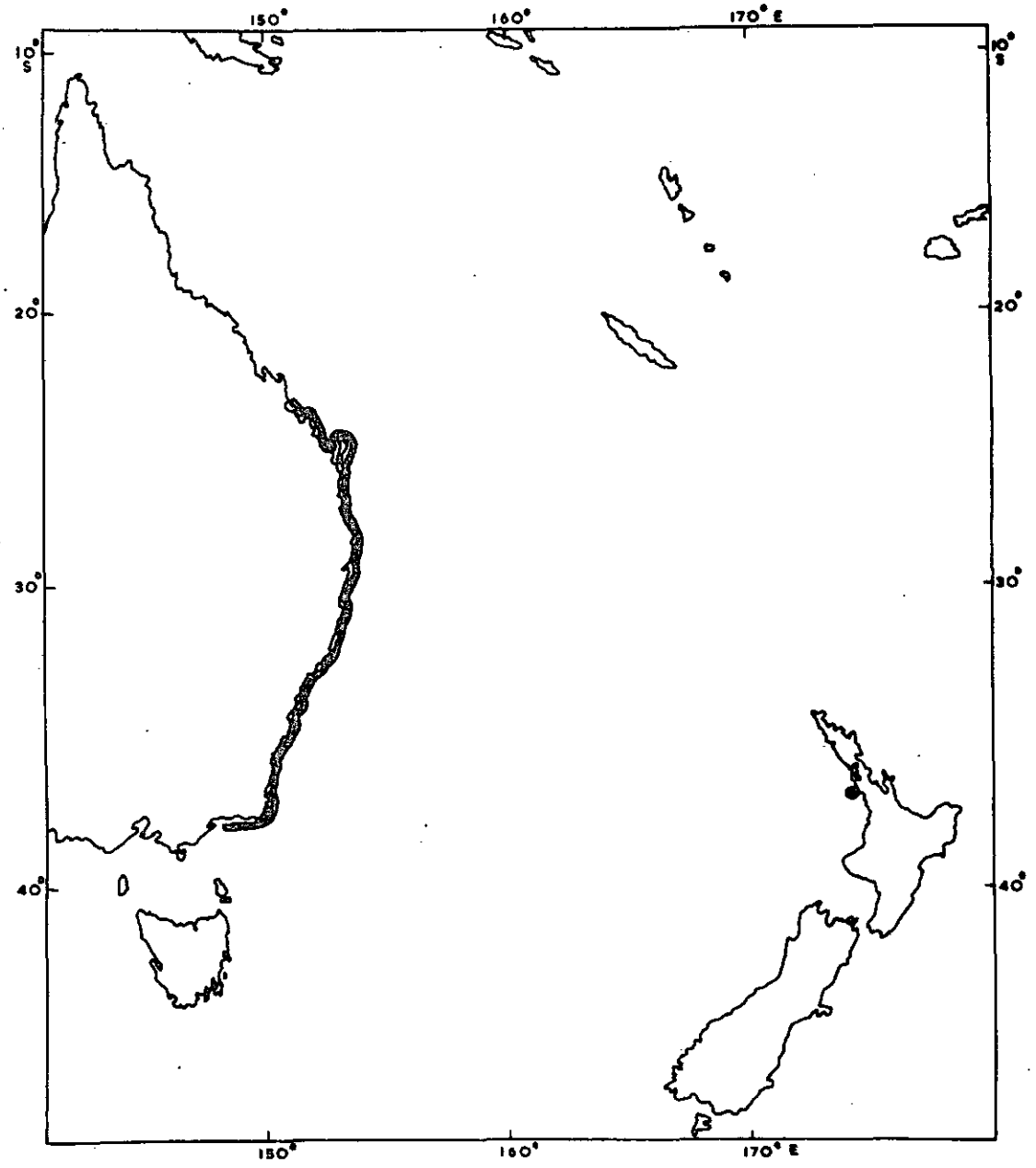

Fig. 3.- Distribution of Penaeus plebejus (from Dall, 1957).

2 DISTRIBUTION

2.1 Total area

P. plebejus occurs on the east coast of Australia from Lakes Entrance, Victoria to North Reef, Queensland (Dall, 1957). It has been recorded from Auckland, New Zealand (Pesta, 1915), although according to Richardson and Yaldwyn (1958) no penaeinine prawns are known from New Zealand waters (Fig. 3). The species occupies estuarine waters to ocean waters at depths of over 100 m at different stages of its life cycle (see 2.2).

TABLE 2

AREAS WHERE P. PLEBEJUS OCCURS

Land area	Code (Rosa, 1965)
Victoria	614
New South Wales	615
Queensland	616
New Zealand (doubtful)	630

2.2 Differential distribution

2.21 Spawn, larvae, juveniles

Eggs and larvae are found at sea in water of oceanic salinity, during autumn. Post-larvae are commonest at harbour and river mouths (Dakin, 1938) but have been found up to 60 miles (96 km) offshore in depths of 53 fm (97 m) (Racek, 1959).

In N.S.W. post-larvae enter the estuaries in late autumn and leave as juveniles during the period January to March (Racek, 1959).

2.22 Adults

Maturing juveniles are found within depths of 1 to 25 fm (2 to 50 m) and adults are found at depths of 50 to 90 fm (92 to 165 m) (Racek, 1959).

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.11 Sexuality

P. plebejus is heterosexual. The males have a petasma on the 1st pleopods and the females have a thelycum between the bases of the 5th pereiopods. Females appear to be larger than males of the same age.

3.12 Maturity

P. plebejus reaches maturity at 10 to 12 months. At maturity the mean total length of males is 145 mm. The mean length of females at maturity is 176 mm (Racek, 1959).

3.13 Mating

Mating apparently occurs in waters deeper than 100 m (Racek, 1959).

3.14 Fertilization

Fertilization is internal (Racek, 1959).

3.15 Gonads

Water of oceanic salinity is required for the full development of gonads (Dakin, 1938).

3.16 Spawning

Spawning occurs during the period March to June (Racek, 1959). Dakin (1938, 1940) found larvae during the period January to June and during August but the identity of these larvae is doubtful.

Spawning grounds are 3 to 22 miles (5 to 35 km) offshore in depths of 50 to 200 m.

Spawning is most frequent in the middle of the night and it seems likely that prawns leave the substrate to spawn (Racek, 1959). There also appears to be a lunar rhythm in breeding (Racek, 1959).

3.17 Spawn

Eggs attributed to P. plebejus have a blue hue and are 0.28 mm in diamater. They were taken 10 to 14 m above the bottom in depths over 100 m (Racek, 1959).

3.2 Pre-adult phase

3.22 Larval phase

Dakin (1938) described protozoea and mysis stages which he thought were P. plebejus. It appears that these larvae are not those of P. plebejus but are those of a Sicyonia species (Kirkegaard, unpublished data).

A protozoeal stage of P. plebejus and a mysis stage from the same series of larvae were described by Dakin (1940).

3.23 Adolescent phase

The post-larvae and juveniles of P. plebejus were described by Dakin (1938).

3.3 Adult phase

3.31 Longevity

Dakin (1938) suggested that king prawns spend 12 months in estuaries as juveniles and reach sexual maturity in the open sea at 18 months. Racek (1959) suggested that king prawns become sexually mature at 12 to 14 months. In recent years catches of king prawns of 25 cm and longer in 200 m off Queensland indicate that this species lives at least 2 years and may enter a 3rd year.

3.34 Predators

Racek (1959) considered Urolophus testaceus, Aptychotrema rostrata, Cnidoglanis macrocephalus, Squatina tergocellata, Paristiopterus labiosus, Neoplatycephalus macrodon and various cetaceans as predators of P. plebejus.

3.35 Parasites, diseases, injuries and abnormalities

- Parasites and diseases

P. plebejus sometimes has a bopyrid parasite (unidentified) in the branchial region. (Kirkegaard and Walker, unpublished data.)

- Injuries and abnormalities

Specimens have been found with the dorsal carinae interrupted just behind the rostrum. P. maccullochi (Schmitt, 1926) is a specimen of this type. Other specimens with this deformity have been recorded by Racek (Dall, 1957).

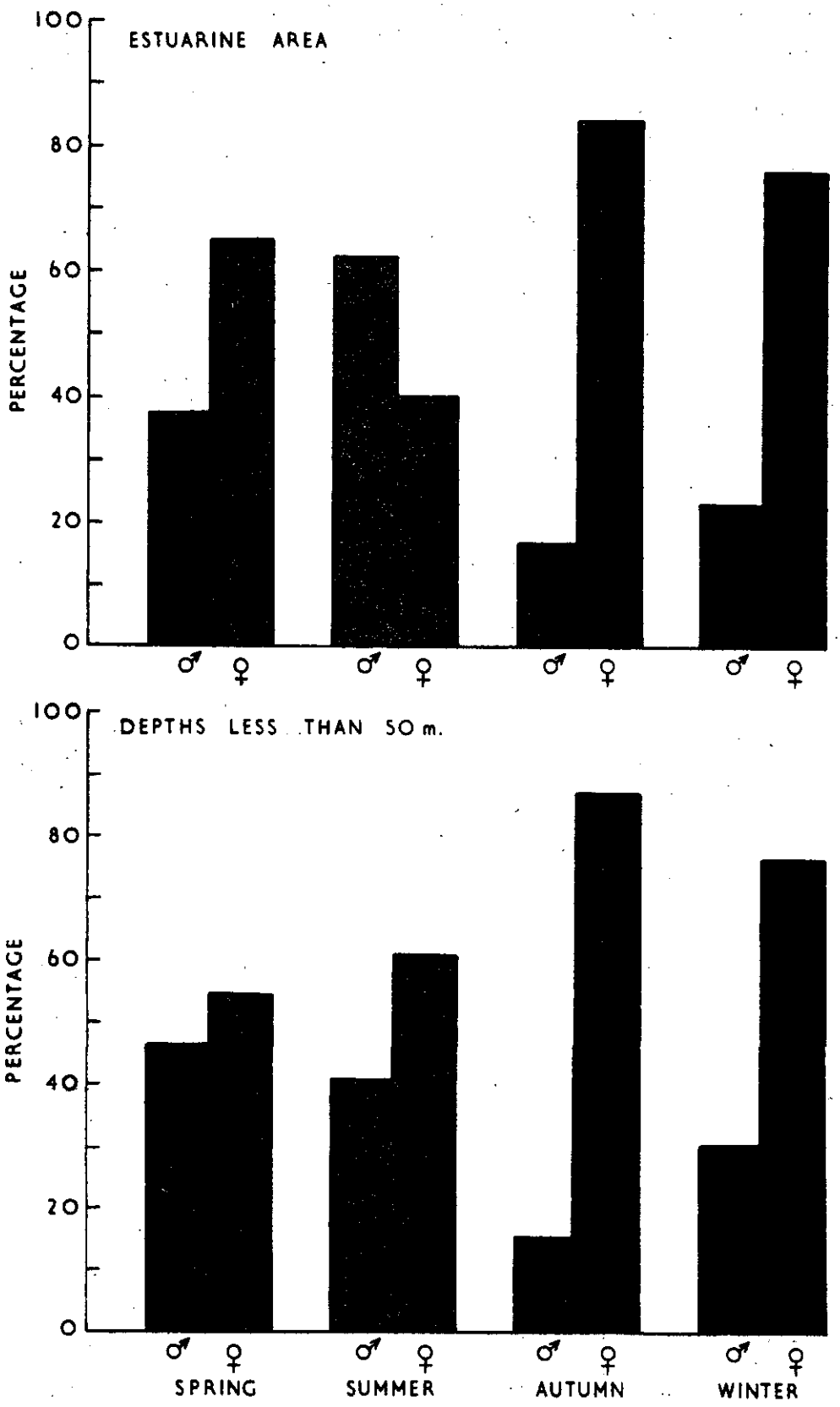

Fig. 4.- Sex ratio of Penaeus plebejus, central and north coast of New South Wales (Racek, 1959).

3.4 Nutrition

3.41 Feeding

It has been suggested that P. plebejus forms feeding schools during dark moon phases (Racek, 1959).

3.42 Food

The stomachs of adult P. plebejus captured in the wild often contain ctenoid fish scales. Aquarium observations confirm that these prawns can capture small fish (Racek, 1959).

3.5 Behaviour

3.51 Migrations and local movements

See Sections 2.21, 2.22, and 3.53.

3.52 Schooling

Shortly before the last quarter of the moon, adolescent prawns assemble in large schools on the seaward part of estuaries. These assemblages increase towards the new moon and presage migrations from the estuaries which take place during the new moon period (Racek, 1959).

3.53 Responses to stimuli

Racek (1959) classified P. plebejus as a "consistent" species. Adults of consistent species have a small, defined, habitat preference and do not form schools except during their mating and spawning period. Consistent prawns also travel against prevailing winds which cause turbidity.

During floods P. plebejus move out of the inner littoral areas and do not return until water conditions have stabilized again.

During light moon phases the prawns swim up to 10 m off the bottom, but the reason for this is not fully understood.

Diurnal abundance varies with a peak between 2000 h and 2100 h with a small peak at noon.

4 POPULATION

4.1 Structure

4.11 Sex ratio

The sex ratio varies from season to season, as shown in Figure 4 (Racek, 1959).

4.3 Natality and recruitment

4.32 Factors affecting reproduction

P. plebejus does not breed in inshore waters, probably because of low salinity (Morris and Bennett, 1952).

4.6 The population in the community and the ecosystem

- Physical features of the biotope of the community.

The salinity range of P. plebejus is from brackish lakes to the open sea (Dakin, 1938). Fishermen suggest that this species prefers a relatively soft bottom but Racek (1959) disagrees with this in the case of large adults.

- Species composition of the community

In rivers and brackish lakes in New South Wales, P. plebejus is associated with Metapenaeus bennettae. In Queensland and northern N.S.W., Penaeus esculentus is associated with P. plebejus in estuaries. In Queensland, Penaeus merguiensis and M. macleayi are found with P. plebejus, and Trachypenaeus spp. and Parapenaeopsis cornuta also occur with P. plebejus in Moreton Bay (Kirkegaard and Walker, unpublished data).

5 EXPLOITATION

5.1 Fishing equipment

5.11 Gears

Boats in the P. plebejus fishery generally tow otter trawls. Beam trawls are sometimes used by boats under 30 ft (9 m) in length. Regulations govern sizes and meshes of trawls in Queensland and New South Wales (see 6.12). A few prawns are taken by amateurs and for bait by a variety of small hand nets. A dip net is commonest of these.

5.12 Boats

There are three classes of boats in the Australian prawn fishery.

1. In estuaries, boats generally under 30 ft (9 m) in length, with a shallow draught, powered by a small inboard motor, are used for short trips. Very few have any provision for storing prawns, and prawns are cooked soon after capture.

2. Boats 30 to 70 ft (9 to 21 m) long are used for trips of 1 to 5 days. Prawns are stored on ice or in a freezing brine in insulated boxes on deck. Prawns are sold uncooked for processing or cooked for the local market.

3. Boats 50 to 70 ft (15 to 21 m) which have refrigerated fish holds, and which may carry processing crew on fishing trips, usually make extended cruises for several days or weeks.

Trawling rig used by Australian prawn trawlers is unusual. It has been described by Wright (1966).

5.2 Fishing areas

5.21 General geographic distribution

Commercial grounds are fairly continuous along the east coast of Australia on the continental shelf between 25° and 38°S.

5.23 Depth ranges

Juvenile king prawns are caught from 4 m and less in estuarine fisheries; adults of maximum size are caught to 250 m in the offshore grounds.

5.3 Fishing seasons

5.31 General pattern of seasons

Because P. plebejus is fished from the time it leaves the nursery grounds, the fishing seasons cover most of the year.

5.32 Dates of beginning, peak, and end of season

The estuarine fishery commences in November and finishes about March (Racek, 1959) and overlaps with the middle grounds fishery which commences in February and is worked until May in the south and until July in the north. This fishery grades into the deepwater fishery (beyond 160 m) which extends throughout the winter months. The fishery reverts to juveniles in the north in late September.

The peak in offshore catches occurs in the period April to July.

5.4 Fishing operations and results

5.43 Catches

Individual 24 h catch rates of adults in the Queensland fishery (using otter trawls) of more than 500 lb (230 kg) are common (Grant, 1965). The catch rate on juveniles is much less.

Production figures of prawns by species are not available for New South Wales but in Queensland king prawns make up over 65% of the total landings (see Table 3).

TABLE 3

ANNUAL CATCH OF P. PLEBEJUS IN QUEENSLAND

Year	Catch (kg)	Source
1964	1,613,516	Aust. Fish. Newsl. (1965)
1965	1,871,190	Aust. Fish. Newsl. (1966)
1966	1,744,428	Aust. Fish. Newsl. (1967)

6 PROTECTION AND MANAGEMENT

6.1 Regulatory (legislative) measures

6.11 Limitation or reduction of total catch

- Limitation on the efficiency of fishing units

In Queensland, maximum headrope length of otter trawls is 8 fm (16 m) in estuaries and 20 fm (37 m) in ocean waters. In New South Wales, maximum headrope length is 8 fm (16 m).

- Limitation of effort

In Queensland, Moreton Bay waters are closed to professional fishing at weekends, for the sake of amateur anglers.

- Limitation on the number of fishing units, fishermen

None.

- Limitation on total catches (quota)

None.

6.12 Protections of portions of the population

Various closures operate to protect juvenile prawns.

- Closed areas

In Queensland, trawling within one mile of the shore is prohibited. This regulation was established to protect juvenile king prawns.

In Queensland and New South Wales, portions of various estuaries and inlets are closed to prawn fishing.

- Closed seasons

Apart from portions of various estuaries and large bays which are closed from time to time for periods which usually coincide with the presence of prawns in these areas, the most extensive closure is the closure of all Queensland waters south of 25°S. during daylight between October 1 and February 1.

- Limitations on size or efficiency of gear or craft

Regulations provide for minimum mesh sizes in all States.

Minimum mesh size supposedly allows escape of juveniles, but its success is as yet unproved. In Queensland, minimum mesh sizes are 1 inch (2.5 cm) in estuaries and $1\frac{1}{2}$ inches (3.8 cm) in ocean waters. In New South Wales, minimum mesh sizes are $1\frac{1}{4}$ inches (3.2 cm) in estuaries and $1\frac{1}{2}$ inches (3.8 cm) in ocean waters.

6.2 Control or alteration of physical features of the environment

6.23 Control of erosion and silting

There is no deliberate interference with the physical environment of P. plebejus although land reclamation and various civil engineering works do affect the habitats of juveniles and young adults.

6.3 Control or alteration of the chemical features of the environment

6.31 Water pollution control

There is no deliberate interference with the chemical environment but industrial activity and sewage disposal often affect the habitats of juveniles and young adults.

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