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Larvae of decapod Crustacea of Hokkaido.
3. Pandalidae

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Larvae of decapod Crustacea of Hokkaido

3. Pandalidae

Hiroshi KURATA

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Decapod of Pandalidae in Hokkaido is classified p.24 as 2 groups and 9 species as followa (Nishimura, 1939; Urita, 1934, 1941 a, b; Urita, 1942, Yokoya, 1930 and Yokoya, 1934).

Pandalus borealis Krøyer (HOKKOKU AKAEBI)

P. goniurus Stimpson (BENISUJI EBI)*

P. hypsinotus Brandt (YAMATOEBI, TRABAEBI)

P. meridionalis Balss (SUNAEBI)

P. kessleri Czerniavski (HOKKAIEBI)

Pandalopsis japonica Balss (MOROTOKE EBI)

P. lamelligera (Brandt) (KITAAKAEBI)*

P. coccinata Urita (HIGOROMOEBI)

P. mitsukurii Rathbum (MITSUKURIEBI)

Some commercially important species belong to this species. P. borealis and P. hypsinotus consist of a remarkable resource in fishing industry, being caught at the whole coast in Hokkaido. P. coccinata and P. kessleri are valuable resource at the east coast of Hokkaido. Hokkaido Regional Research Laboratory has recently reported the investigation of this family in Hokkaido. However only one report on larvae of P. kessleri is available (Kurata, 1955). In Europe and Canadian Pacific coast,

*The matured species at Japanese coast, south of Aba Bay, Karafuto, have not been collected.

some researches on Pandalidae have been progressed since long time before. General characteristics of this family are as follows (Lebour, 1939). Caridea, carapace at all stage; 1st antennal base hollow (sometimes indistinguishable at stage I); 2nd antennal epipod, single bat-shaped segment, 1 hair and 1 sub-hair (sometimes no sub-hair). Rostrum developed, 5th pereiopod undeveloped at the early stage and no exopod, all walking legs (pereiopods) not oar-shaped; rostrum toothed at the later stage, 1st pereiopod single dactyl or small hook. The 2nd pereiopod hook at the later stage.

The hatching from eggs of P. borealis, hypsinotus and coccinata in the laboratory has recently reported. Also it became possible to separate larvae of three species from plankton. This report presents the morphological observation of larvae stage of these 3 species from eggs or planktons. It may contribute to give the index where research on life cycle of larvae is intended. The larvae sample from egg at the stage I, P. hypsinotus and P. borealis are donated from L. Hayashi, Muroran Station, Hokkaido Regional Fisheries Laboratory, and P. hypsinotus from K. Abe, Kushiro Station. The author expressed sincere thanks to their courtesy.

Fam. Pandalidae (TABARAEBI Family)

The characteristics of 3 species of larvae are coincident with a description by Lebour (1939), except P. coccinata, which development proceeds in eggs until the late stage. There are other characters observed in larvae from Hokkaido species. Rostrum is distinct from stage I and toothed in late stage (with an exception of P. coccinata, in which rostrum is toothed from stage I). Antennular penducles on either side widely separated at base and concave on the outer margins. Eyes slender, pear-shaped. Anal spine in late stage. Rostrum well developed. Leg 5 never prematurely developed. No exopod on leg 4 and 5. Leg 1 simple or with rodimentary chela. Leg 2 chelates in later stage (with an exception of P. coccinata, leg 2 distinctly chelates from stage I). Leg 3-5 ending in simple dactyls. Pleopod 1 smaller than pleopod 2.

It makes possible easily to separate this larvae from plankton by the remarkable character in 1st antenna. This character shows apparent difference with the larvae of other family (Kurata, 1963).

Fig.1

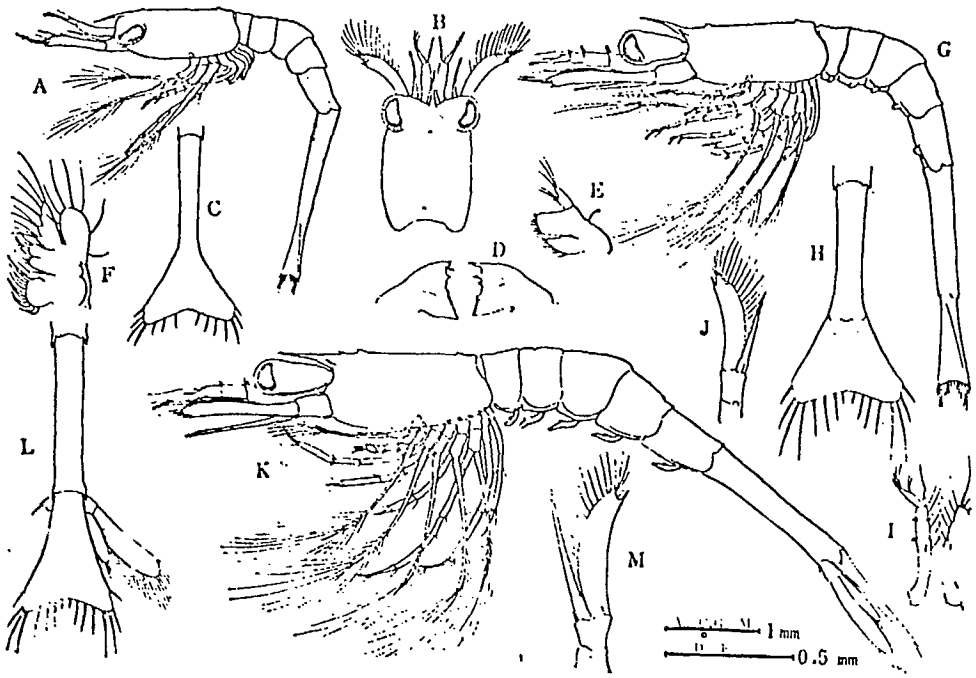

Fig. 1. *Pandalus borealis*: Stages I-III.

A-F, stage I; A, lateral view; B, carapace and anterior parts (dorsal view); C, telson (dorsal view); D, mandibles (anterior view); E, maxillule; F, maxilla.

G-J, stage II; G, lateral view; H, telson (dorsal view); I, antennules (ventral view); J, antenna (ventral view).

K-M, stage III; K, lateral view; L, telson and uropod (dorsal view); M, antenna (ventral view).

Pandalus borealis Krøyer

Body limbs slander, large. Abdomen is 3 times as long as carapace excluding rostrum. Carapace not exceed over the top of 1st antennal base segment. A pair of dorsal wen locates just behind and near end of eyes. The

end of 1st abdominal segment 1 seta, behind which several tiny spines locate (indistinguishable in later stage). Eye and antennal setae distinguishable after stage II. The end of telson wide, 6th pair of marginal seta shorter than that of 5th in earlier stage, but longer in later stage. The 2nd antennula scale top segments (stage I - III). Epipod end short setae and lacks hair. The growth of maxillapede slow. The 1st mandibles 1 hair (stage I - III). Exopods on 1 - 3 pereiopods.

Stage I (Fig.1, A-F). Length 6.0 mm. 6 from egg. Eye un-move. Rostrum needle-shaped and smooth. Ends of telson apart. The length including 6th pleopod 2 times of the width. Marginal setae 7+ 7. The longest pair (4th) 1/2 of telson. The 1st antennal base single segment. One sensory spine. The 2nd antennal scale tip 4 segments, and one rigid hair; epipod length 2/3 of scale, and short setae at top. Epipods of 1st-3rd maxillapede 4,5,5 segments. Exopod swiming spines 7, 12, 16. Basipodite apart, no segment; uropod not-apart. Single subleg on 1st maxillapede distinct.

Stage II (Fig. 1, G-J). Length 6.5 mm. 3 from plankton. Eye move with stalk. Rostrum smooth, not exceed the front edge of eye. Telson partly apart after 6th abdominal somite, the length 5/6 of the width and 5/7 of

6th abdominal somite, marginal setae 8+8. The 1st antennal base 3 segments, 2 sensory spines. The 2nd antennal scale 3 segments at tip. Epipod length 5/6 of scale. The 1st-3rd maxilla swimming spines 7, 16, 18. p.26 The 1st-3rd pereiopods have segments, exopods functional 16, 16, 9, spines (ocasionally 3rd leg exopod lacks spine). The 4th and 5th pereiopod segments indistinguishable. Pleopods slightly nipple-shaped. Uropod end apart.

Stage III (Fig.1, K-M). Length 7.8 - 8.6 mm. 11 from plankton. One seta on rostrum base. Telson completely apart, fan-shaped, length 1-1/4 times of the width, and 2/3 of the 6th abdominal somite. Uropods apart, segments, shorter than telson; epipod little longer than 1/2 of exopod, several hairs. Anal spinal distinct. The 2nd antennal scale segment, epipod same length as scale. Swimming spines on maxillapod and walking legs exopods, Fig.2

7, 16, 18-19, 17-18, 17-18, 11-12. The 4th and 5th pereiopod no segment. The 2nd pereiopod hook-shaped. Subpod on the 2nd maxillapede. A pair of gill rodiment on 1st-5th pereiopod.

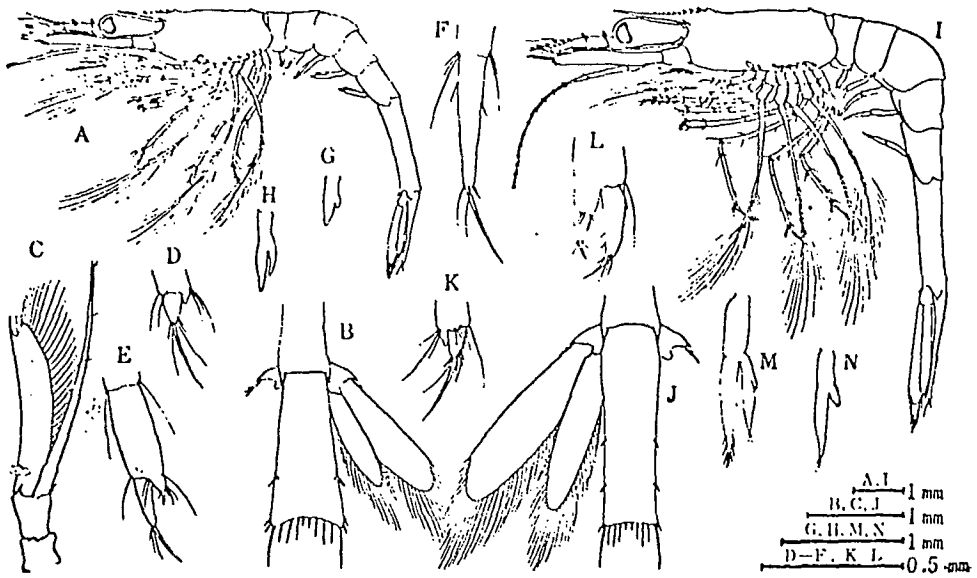

Fig. 2. *Pandalus borealis*: stages IV and V.

A-H, stage IV; A, lateral view; B, telson and uropod (dorsal view); C, antenna (ventral view); D-F, tips of legs 1-3; G, H, pleopods 1 and 2.

I-N, stage V; I, lateral view; J, telson and uropod(dorsal view); K, L, tips of legs 1 and 2; M, N, pleopods 1 and 2.

Stage IV (Fig.2, A-H). 9.3 -12.0 mm. 14 from plankton. On rostrum base 4-5 setae. Telson fan-shaped, length 2 times of the width, 2/3 of 6th abdominal somite; 1st-3rd marginal setae shorten, 1st pair concave on the outer margin. Sensory spines on 1st antenna 5. The 2nd antennal scale no segment, epipod 1-1/4 times of the scale. On maxillapede and exopods of walking legs, swimming spines 8, 19-20, 20-21,23-24, 23-24, 18. Left

and right leg of 2nd preiopod different length. Left longer than right. Pleopods no segment, no inner seta.

Stage V (Fig. 2, I-N). Length 12.0 - 14.0 mm. 21 separated from plankton. Rostrum dosal teeth 9-12+ 0, ventral side smooth. Two telsons parallel, the length 3 - 3-1/3 times of the width, and 3.4 of 6th abdominal somite. The 2nd antennal stalk 2 times longer than the scale, 9-13 ring segment. The 2nd walking leg different length, ischium, merus, carpus, left longer than right; propodus, right longer. One seta at the top of 3rd-5th preiopods (large size specimen has another seta at the center part of merus). Pleopods spines, none or imcomplete.

Stage VI (Fig. 3, A-F). Length 14.4 - 16.9 mm. 41 separated from plankton. Rostrum 12-14+1 dosal teeth, ventral side smooth or 3-5 setae. Telson thin at end, the length 3-1/3 times of the end width, marginal setae 8+8. Ischium of 3-5 preiopod 3-4, one seta ; merus 3-5 2-4, 2-4 1-2 setae. The 2nd antennal stalk length 2- $2\frac{1}{2}$ times of the scale, 13-20 ring segments. The top

Fig. 3

end of pleopods distinctly apart. One subleg on maxilla 3- preiopods 3.

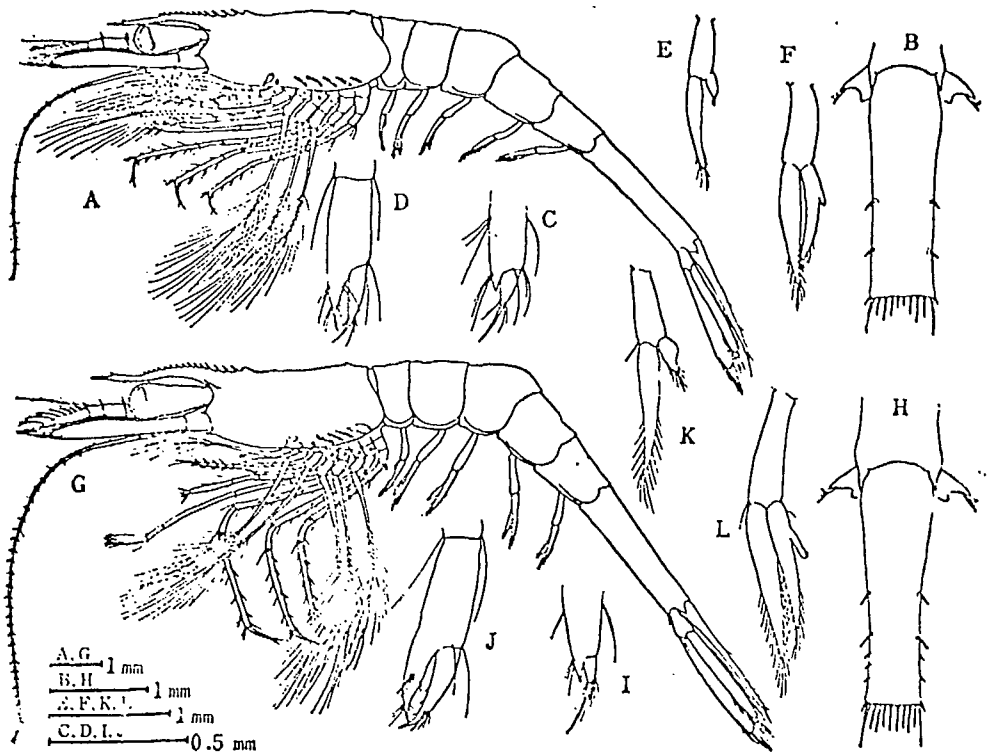

Fig. 3. *Pandalus borealis*: stages VI and VII.

A-F, stage VI; A, lateral view; B, telson (dorsal view); C, D, tips of legs 1 and 2; E, F, pleopods 1 and 2.

G-L, stage VII; G, lateral view; H, telson (dorsal view); I, J, tips of legs 1 and 2; K, L, pleopods 1 and 2.

Stage VII (Fig. 3, G-L). Length 14.7 - 19.8 mm. 23 separated from plankton. On rostrum 12-14+1 dorsal teeth, 5-6 ventral setae. Telson thin at end, the length 5-6 times of the end width, marginal setae >8+8, (increment of side setae between setae 1-3, 4-8 in both sides, 6+6 setae at the end; inner pair of the last seta is

longer than 3 pairs of setae in both sides. The 2nd antennal filament 3 times longer than the scale, 30-33 ring segments. Maxillapede small wen-shaped. Exopods of walking leg have hairs and functional. Pereiopod 2 carpus 1 ring segment. The preiopod 3-5 ischium 1, merus 4-8, 4-6, 3; carpus 1 seta. The maxillapede 3 gill rodiment, pereiopod 4 subleg rodiment.

No larvae is collected after stage VII. As the result of observation on larvae before ecdysis, it was found that after ecdysis mandibles and molars became apart widely, sublegs grew and that three pairs of caudal filament degenerated. These characters are usually seen at the grown-up stage. The stage VII may be the last stage of larvae.

Discussion. The development of this species at the stage 1-4 coincides with the record by Berkeley(1931). The larvae in British Columbia has no wen at dorsal somite, and ventral surface is smooth except at the front margin seta. The 2nd antennal scale has no segment at the tips. Lebour (1939) divided the larvae of Pndalus into 2 groups; (a) pereiopods are non-functional in stage I and the 2nd antennal scale has segments; (b) pereiopods are functional after stage I and 2nd antennal scale has

no segment. He defined P. borealis as the middle of these two groups. However this species in the Hokkaido coast belongs to group(a) as described above.

Fig. 4 p.28

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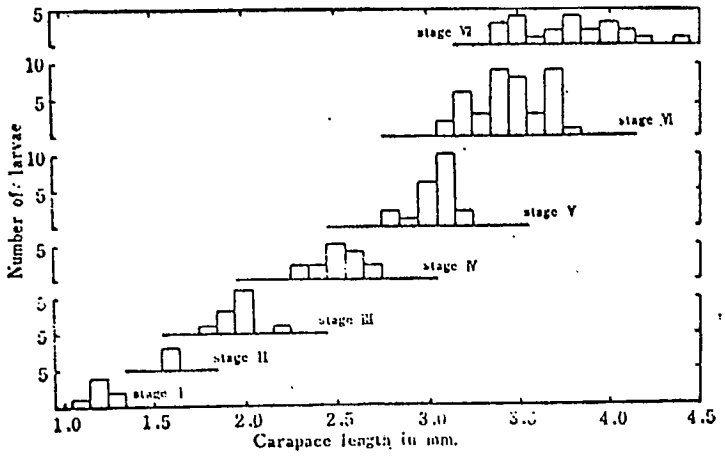

Fig. 4. *Pandalus borealis*: frequency distributions of carapace length (excluding rostrum) of the larvae. Stage I from eggs, stages II–VII from plankton.

The development after stage V is slightly different from the description by Berkeley. The larvae of this species in British Columbia has pleopods with segment and rostrum without dorsal seta in stage V. In stage VI rostrum with setae has separated and pleopods have epi-spinal. These characteristics are the same as those in Hokkaido. However the species in B.C., ischium and merus on 3rd maxillapede joint, and sublegs grow on the

maxillapod 2 in stage V. The species in Hokkaido has distinct segments on ischium and merus in stage VII, whereas sublegs in the 2nd maxilla is distinguishable since the stage III. B.C. species at 6th stage has gill rodiment at the 3rd maxilla, which coincides with the specimen in Hokkaido at stage VII. The stage VI is the last stage of larvae by Berkeley, but one of the VII stage could be separated at Hokkaido (the successive growth at each stage has not been achived by the author). It was easy to separate the larvae of the stage I - IV from plankton, but the separation at stage V - VII was performed practically as follows. From the sample developed further beyond the larvae at stage IV, the specimen without dorsal teeth on rostrum and without inner setae on pleopods were defined as the stage V. The specimen with outer setae 8+8 at telson were defined as the stage VII. The rest of them were classified as the stage VI. As the results of this classification, there observed inter-mixing at the stage VI (rostrum and pleopods) and VII (marginal setae on telson).

In the larvae at stage VI and VII, the frequency distribution of carapace length showed no normal pattern (Fig.4). It is doubtful that all individuals pass the

the stage VII. Some individuals presumably skip the stage VI over, and others pass twice at the stage VI or VII. This irregularity is frequently observed in other species of decapod (Johonson and Lewis, 1942; Broad, 1957, a, b; Rees, 1959; Kurata, 1960; Boyds and Johnson, 1963). This phenomenon is unavoidable for the larvae of decapod with ecdysis. It is unreasonable to difine a constant "normal pattern" independent to its ecological condition, Broad (1957 a) suggested that the rapidity of formation is goverened by a function independent to the frequency of ecdysis. The metamorphosis of larvae is not effected unless ecdysis. The form of larvae at some stage is defined as the form before ecdysis at the stage. If ecdysis time becomes earlier or later by some reasons independent to the formation (Fraser, 1936), the frequency of ecdysis after hatching effects metamorphosis among the same individual.

Table 1

p.29

Table 1. Materials examined of *Pandalus borealis* larvae.

Date	Locality	Distance from shore (Sea miles)	Depth (m.)	Surface temp. (°C)	Method	Number of captured larvae	Larval stages
Feb. 21, 1963	Japan Sea (Ishikari Bay)	7.0	650	7.7	130cm.*net, surface	1	II
Mar. 8, 1963	do	7.0	87	6.9	do	12	II&III
Mar. 28, 1963	do	10-13	55-70	6.4-6.6	do	27	IV&IV
Apr. 28, 1963	do	7.0	48	8.0	do	26	IV-VI
May 12, 1962	Okhotsk (Off Esashi)	10	88	6.4	do	3	VII
June 18, 1962	Pacific (Off Kushiro)	4.5	40	--	130cm.*net, 10m. layer	37	VI&VII
June 20, 1963	do	2-3	20-50	--	do	6	VI&VII

* Diameter of mouth of the plankton net used.

Collection data. It is noted that the number of larvae at the earlier stage counts small as described in this text. No larvae of the stage I was collected. It may be the reason of out-of season when collected. Another reason should be considered as transitition of larvae. As the collection of plankton does not cover the area where the imagos are found, the distribution area of larvae is not concluded. Data in Table I show that larvae live near coast and shallow sea bed. The matured species live at the depth of 250 - 400 m at Japan Sea (Kojima and Nakano, 1961), 200 - 300 m at Kushiro Off-shore (Sakurai et al., 1962). Based on the plankton collection data Berkeley reported the larvae of this species disappear from the area of hatching (another word the area of maturity) after the stage III. Data of the author also suggest that larvae propably move towards the nearer shore after that stage.

Pandalus hypsinotus Brandt

Body and limbs stout. Abdomen about $2\frac{1}{2}$ times as long as carapace excluding rostrum. One wen at the behind of eye and end of dorsal segment. Ventral surface smooth, 1 seta on 1st segment. One pair of seta on eyes and on

antenna after stage II. Telson concave at the end; marginal setae, 6th same length or longer than 5th. Somite at the tip of 2nd antennal scale (stage I and II). Maxillapede no marginal hair. Exopod on 1st and 2nd pereiopod.

Stage I (Fig.5, A-F). Length 5.4 - 6.2 mm. Somite length 1.8 - 2.1 mm. 8 from eggs. Eye unmove. Rostrum needle-shaped, smooth. Telson unseparated, length including 6th somite 1-3/4 times longer than the width. Marginal setae, 7+7, longest 4th pair $\frac{1}{2}$ of telson width. The 1st antennal base single segment, outer sensory spine 1. Tip of 2nd antennal scale 4 segments, epipod bat-shaped, longer than scale, 2 short hairs. Maxillapede no sublegs, 2nd maxillule gill rodiment not spread at the end. 1st-3rd maxilla epipod 4, 5, 5 segments; exopod swimming hairs 8, 14, 17-18. Walking legs segmented. 2nd pereiopod hook. Exopods at 1st, 2nd pereiopod no hair, shorter than epipods. Pleopods and uropods un-separated.

Stage II (Fig. 5, G-M). Length 7.0 - 7.2 mm. Somite length 2.4 - 2.5 mm. 5 from plankton. Eyes with stalk move. Rostrum smooth. Eye and antenna 1 pair of setae distinct. Telson incompletely separated, length same as the width, about 4/5 length of 6th abdominal

somite, marginal setae 8+ 8. 1st antenna base 3 segments, outer sensory spines 4. Tip of 2nd antennal scale 2 segments, tip of exopod 5-6 segments. The 2nd antennal gill rodiment spread wide at the end. The 1st-3rd maxillapod 8, 14-15, 18 swimming hairs. Exopods of 1st and 2nd walking legs functional 16-17, 14-15 hairs; 2nd walking leg hook. Pleopods, pereiopods unseparated. The 1st and 2nd maxillapede 1 subleg; 1 gill rodiment at 1st-5th pereiopod distinct.

Fig.5 p.30

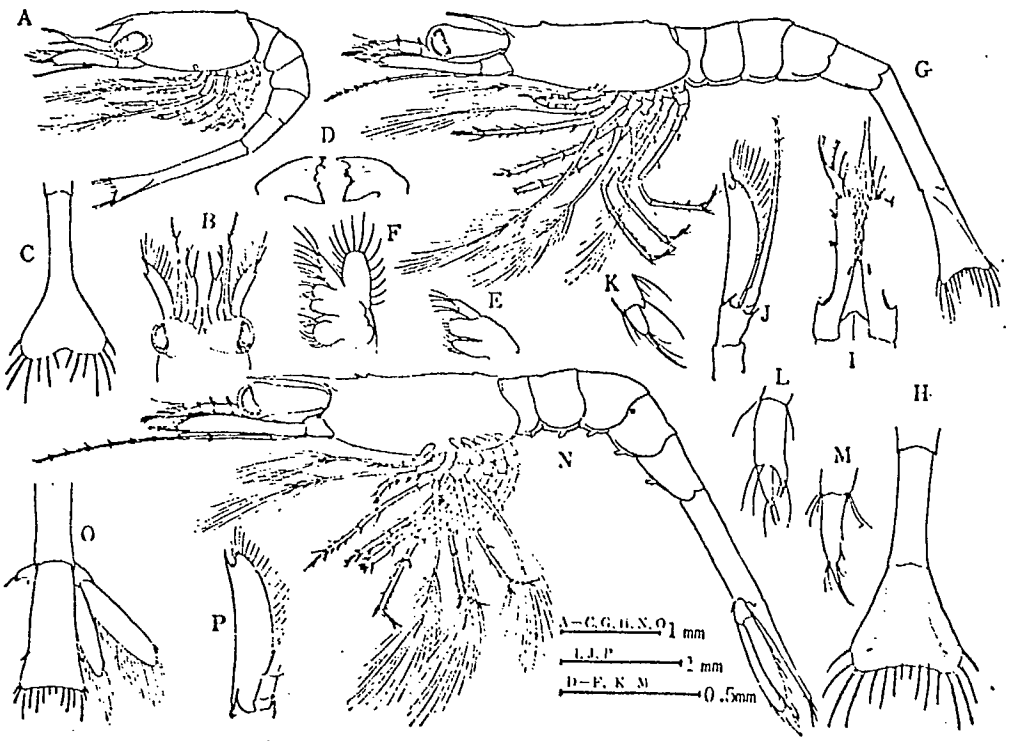

Fig. 5. *Pandalus hypsinotus*: stages I–III.

A–F, stage I; A, lateral view; B, carapace and anterior parts (dorsal view); C, telson (dorsal view); D, mandibles (anterior view); E, maxillule; F, maxilla.

G–M, stage II; G, lateral view; H, telson (dorsal view); I, antennules (ventral view); J, antenna (ventral view); K–N, tips of legs 1–3.

N–P, stage III; N, lateral view; O, telson and uropod(dorsal view); P, antennal scale (ventral view.).

Stage III (Fig. 5, N-P). Length 7.8 - 8.3 mm. Somite length 2.9 - 3.2 mm. 10 from plankton. Rostrum base (dorsal side) 1 tooth. Anal spinal distinct. Telson separated, fan-shaped, length about 2 times longer than the width, shorter than 6th abdominal somite; marginal setae shorten, 1st pair locates $\frac{1}{4}$ anterior side. Uropod separated and segmented, many rigid hairs on exopod and epipod. Antennal scale 2 lacks segment, epipod 2 times longer than scale, 9-10 segments. Swimming hair on maxillapede and walking legs, 8, 16, 18, 17-18, 14-15. Pereiopod 2 different length at left and right, carpus left> right, propodus right> left. Pleopod slightly nipple-shaped, unseparated.

Stage IV (Fig. 6, A-E). Length 10.4 - 10.7 mm. Somite length 3.7 - 3.8 mm. 52 from plankton. Rostrum slightly exceed over the front edge of eye, 10-11+ 0, dorsal tooth (4 - 5 setae are on dorsal side, close together, the seta at carapace base smaller and locate apart), 2-3 tiny setae on ventral side. The sides of telson parallel, length about 3 times of the width, longer than 6th abdominal somite, marginal setae 1st and 2nd pair apart at upper-outer side. The 1st antennal spine 2 segments, outer sensory spines 5. The 2nd antennal filament 13-14

segments. The 1st maxilla exopod base 1 hair outer. 1st walking leg hook. 3rd pereiopod carpus 1 seta on tip, 3rd-5th pereiopod merus 1 seta on tip. Pleopods unseparated, un-segmented. 3rd maxillapede has one subleg on 3rd preiopod; this subleg rudiment distinct.

Stage V (Fig. 6, F-G). Length 11.4 mm. Carapace length 4.1 - 4.3 mm. 4 from plankton. Rostrum 18+1 dorsal teeth, 5 ventral teeth. Telson end sharp, length 4-1/3 times of the end width; marginal setae 8+8. 1st antennal inner filament 3 segments, outer sensory spines 6; 1st maxillapod exopod base 2 hairs on outer margin. The 2nd walking leg carpus no segment. Merus and carpus of preiopod 3 and 4, setae 2 and 1. 5th preiopod merus 1 seta. Pleopods no segment, no inner wen.

No developed larvae beyond that stage was separated. The stage V may not be the last stage of larvae being observed on pleopods form. Another stage is probably required to complete metamorphosis.

Fig. 6 p.31

Discussion: Berkeley (1931) described briefly on larvae of stage I hatched from egg. He could separate specimen from plankton, being considered as larvae

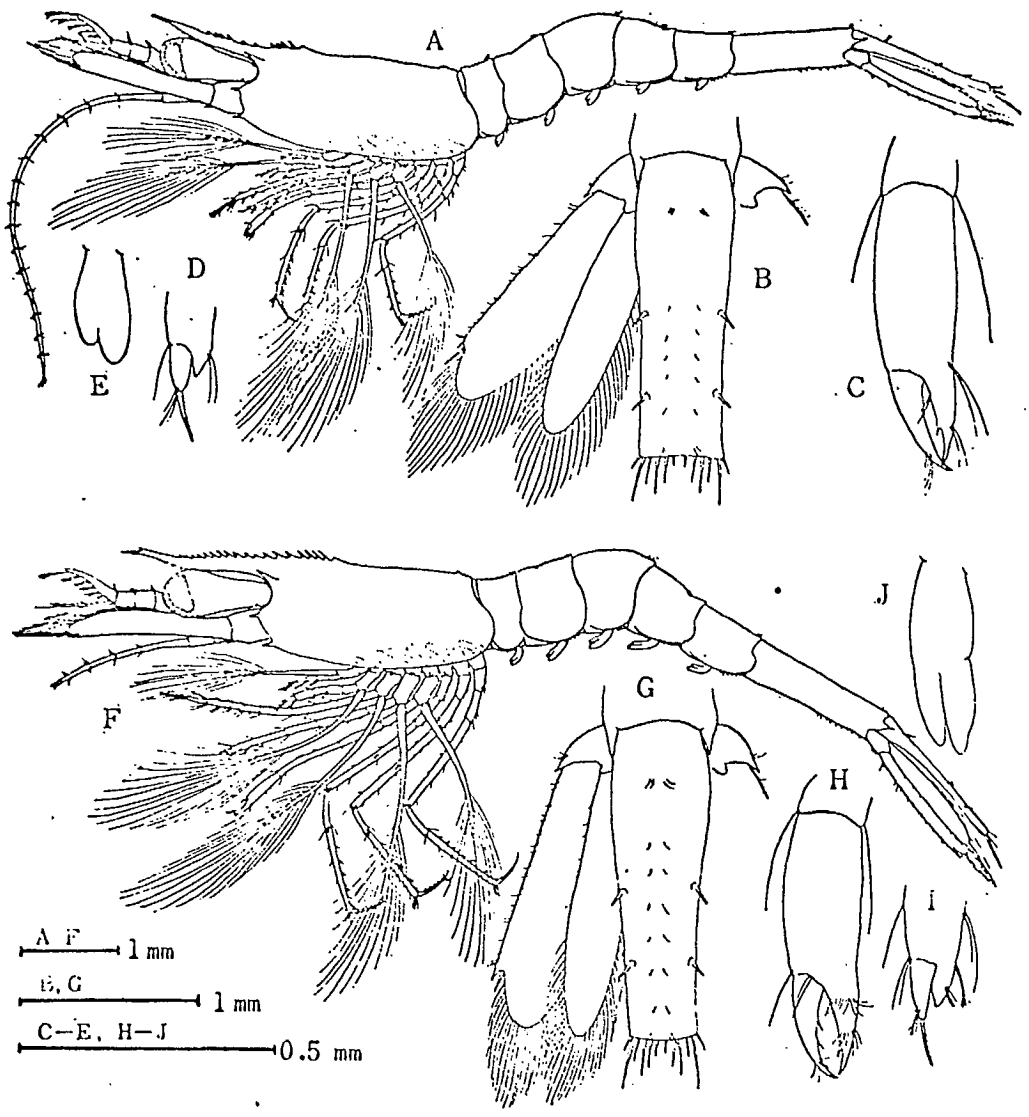

Fig. 6. *Pandalus hypsinotus*: stages IV and V.

A–E, stage IV; A, lateral view; B, telson and uropod (dorsal view); C, D, tips of legs 1 and 2; E, second pleopod.

F–J, stage V; E, lateral view; G, telson and uropod (dorsal view); H, I, tips of legs 1 and 2; J, second pleopod.

in stage II or III, and stated that characteristics resemble one of P. danae. However larvae of P. danae in Hokkaido differes from the report by Berkeley as follows; (1) Telson joints to 6th abdominal somite at stage I. (2) Segment tip of 2nd antennal scale in early stage. (3) Segments on 1st and 2nd maxillapede sublegs are distinguishable since stage I. (4) Ischium and merus at 3rd maxillapede do not adhere together in stage V.

Lebour (1939) classified this species to group II of Pandalus as Berkeley's observation (1931). The larvae of this species in Hokkaido is favorably classified to group I. of Pnadalus, by the facts that 2nd antennal scale has segment and that walking legs, especially exopods, are not functional in stage I. p.32

Table 2

Table 2. Materials examined of *Pandalus hypsinotus* larvae

Date	Locality	Distance from shore (sea miles)	Depth (m.)	Surface temp. (°C)	Method	Number of captured larvae	Larval stages
Mar. 9, 1963	Japan Sea (Ishikari Bay)	4.0	46	6.3	130cm.*net, surface	1	II
Apr. 27, 1963	do	3-7	34-51	8.1-8.7	do	12	II-IV
Apr. 28, 1963	do	7.0	48	8.0	do	2	III
June 8, 1963	Pacific (Off Kushiro)	4.0	38	6.8	130cm.*net, 10m. layer	3	III&IV
June 18, 1962	do	4.5	40	—	do	4	IV&V
June 19, 1963	do	2-4	5-20	—	130cm.*net, 3-5m. layer	49	IV&V

* Diameter of mouth of the plankton net used

Collection data: The collection of larvae of this species took place at shallow sea near shore (Table 2). The depth of matured population is shallower than that of P. borealis, 250 - 350 m in Japan Sea (Kojima and Nakano, 1961), 150 - 250 m in Kushiro Off-shore. Larvae may move towards shore after hatching.

As based on collection data in Kushiro offshore, P. borealis and P. hypsinotus are collected at the same place but not at the same time. Only one species is usually collected whereas number of collection is large. In case of small collection, it sometimes happens to being collected mixing together. Both species live in group apart from each other.

Pandalopsis coccinata Urita

Large size. Abdominal surface smooth, length 2 times longer than carapace excluding rostrum. Rostrum mandibles from stage I. Dorsal side of carapace, thoracic somite sooth except end setae. Telson mearly circular with a large number of marginal setae. The 2nd antenna, mandibles maxilla and pereiopods the same form of adult since stage I.

Stage I (Fig. 7, A-L). Length 15.5 mm. Carapace 6.2 mm. 3 from eggs. Eyes joint partly with dorsal front margin. Rostrum extends to tip of 1st antennal base, 13 setae (4 on dorsal somite), 3 abdominal setae. Telson clearly separated, slightly longer than the width, width nearly the same as 6th abdominal somite; center of poterior margin in hollow, marginal setae 55-56; 1st antennal base single segment, inner spines feather-shaped, outer sensory spines 1; 2nd antennal pendules is same length as body, about 105 segments. Mandibles and molars separate widely, subleg 3 segments. Ischium and merus on 3rd maxillapod-2nd pereiopod remained. The 2nd preiopod hook, same length at left and right, extend up towards middle part of 2nd antennal scale. One segment on carpus. Pleopods separated. One subleg on 1st maxillapod - 3rd preiopod, one segmental gill on 3rd maxillapod - 4th preiopod, one large rodimental gill on 3rd maxillapod - 5th preiopod.

Discussion: The larvae of P. kessleri are observed by the development of shell on abdominal somite since stage I, telson separated, preiopod segmented and

functional; rudiment of exopod on leg 2 and 2, pleopods separated, 1st maxillapod - 4th legs sublegs. It hatched in the form closely related to adult form. Larvae of P. coccinata just after hatching resemble matured form than P. kessleri. A remarkable development is observed on mandibles and maxillapede. These sublegs are undeveloped form in stage I of P. kessleri, and exopod on 3rd leg has hair and functional.

Fig. 7 p.33

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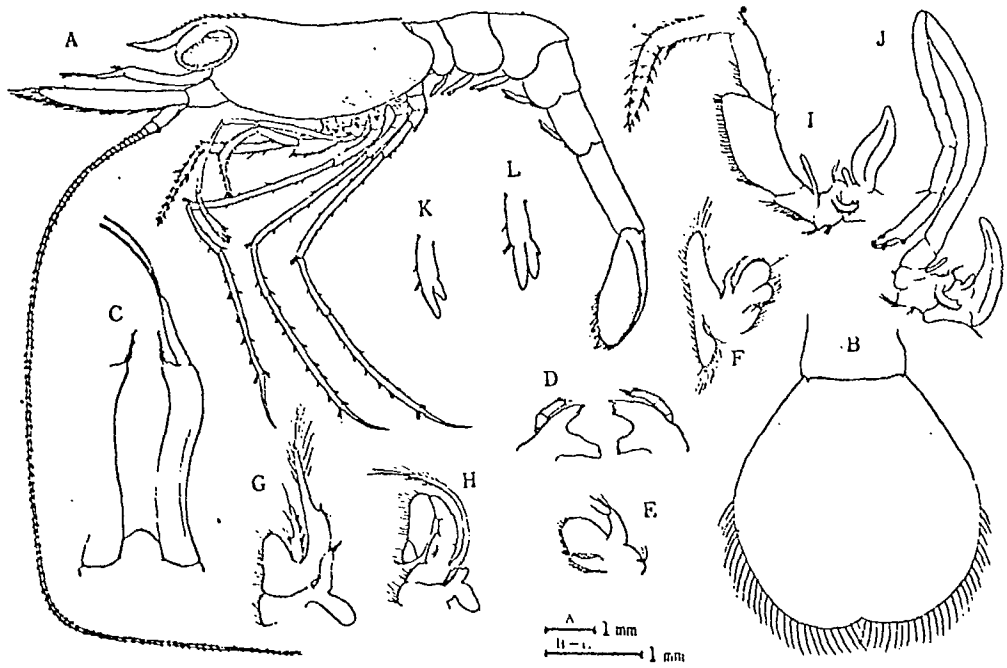

Fig. 7. *Pandalopsis coccinata*: stage I.
A, lateral view; B, telson(dorsal view); C, antennals(ventral view); D, mandibles (anterior view); E, maxillule; F, maxilla; G, H, first and second maxillipedes; I, J, legs 1 and 2; K, L, pleopods 1 and 2

An undeveloped part common to both species are 1st antenna and telson. The 1st antenna remained undeveloped in spite of earlier development of other sublegs. These sublegs are different from other posterior sublegs in function, and it is interested that it has the same function of sublegs on head of primitive Arthropoda (Snodgrass, 1952), and that it receives directly nerve branch from supra-oesophageal ganglion (Calman, 1909).

The morphological condition after hatching is considered to relate with size of eggs. Eggs of P. coccinata are generally 3.6 x 2.7 mm, whereas eggs of P. kessleri are 2.6 x 2.0 mm. Eggs of P. hypsinotus and P. borealis, which hatch under more undeveloped state, are smaller, 1.3 x 1.1 mm and 1.2 x 0.9 mm respectively (Kurata, 1957 a, b). The difference of egg size may affect to the formation before hatching but also to larvae size.

In larvae of P. coccinata exopods on 3rd maxillapod, preiopod and pleopod are rudimental and nonfunctional. It makes them unable to swim in the water nor to floate upto water surface. It is supposed that

larvae live at the sea bed or hide themselves in any shelter. This life cycle of larvae of this species consists of a main reason of collection data being unavailable when plankton was collected, if the matured species live aboundant in Kushiro offshore, and supply a commercially important resource for fish industry.

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