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Spatial Distribution and Abundance of Phyllosoma Larvae in the Kumano- and Enshu-Nada Seas North of the Kuroshio Current*

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Abstract

Distribution and abundance of phyllosoma larvae were examined in the Kumano- and Enshu-nada seas along the Pacific coast of central Japan during September to October 1983 and 1984. Ten species of phyllosoma larvae, belonging to *Ibacus, Parribacus, Scyllarides, Scyllarus* and *Panulirus*, were obtained. *Scyllarus bicuspidatus* larvae were found abundantly and were predominant, accounting for more than 90% of the collected larvae. *Panulirus japonicus* was not caught, though six specimens of *P. ornatus* and *P. versicolor* were collected. The present study indicates that phyllosoma larvae of *S. bicuspidatus*, which were released by the adults inhabiting the near-shore of the Kumano- and Enshu-nada seas and were composed of the fourth to final stages in the zooplankton samples, are retained within these, while suggesting that *Panulirus japonicus* larvae are possibly flushed out into the Kuroshio Current.

As opposed to scyllarid (slipper) lobsters, several palinurid (spiny) lobsters are of very high economic value in Japan. The main species are: *Panulirus japonicus*, predominant in the southern to central portions of the Japanese waters; *P. longipes*, in the Bonin Island waters; and *P. penicillatus*, in the Ryukyu Island waters (KURATA and SHIMIDU, 1973; NONAKA, 1982; SHOKITA *et al.*, 1982). In particular, *P. japonicus* has been harvested at over one thousand tons annually in Japan (NONAKA, 1982).

The occurrence of phyllosoma larvae in Japanese waters has been investigated and early-stage phyllosomas of *P. japonicus* have been obtained. Unfortunately, late-stage phyllosomas have only rarely been found (HARADA, 1957; MURANO, 1967; NAKAMURA, 1975; SAISHO *et al.*, 1983). To date, very little is known about the ecology and recruitment mechanism of any scyllarid and palinurid lobster larvae in Japan. In western Australian waters, however, the recruitment mechanism for *P. cygnus* has been clarified greatly (PHILLIPS *et al.*, 1979; PHILLIPS, 1981). SEKIGUCHI (1985) presented a hypothesis concerning the larval recruitment processes of *P. japonicus*, which has a long larval period of about eight months (INOUE, 1981). He proposed that phyllosoma larvae of *P. japonicus*, released in the near-shores, are flushed out into the Kuroshio Current and further into the Countercurrent south of the Kuroshio Current. After passing a planktonic life for four to six months, they again enter the Kuroshio Current and metamorphose into the puerulus stage with strong swimming power and are then recruited into near-shore Japanese waters north of the Kuroshio Current as adults. This hypothesis not withstanding, there is still considerable controversy surrounding the larval recruitment mechanisms of the Japanese scyllarid and palinurid lobsters (see review by SEKIGUCHI, 1985).

Purposes of this study are, firstly, to identify phyllosoma larvae to confirm the occurrence or absence of *P. japonicus* larvae in the coastal region north of the Kuroshio Current, and secondly to examine the spatial distribution of the scyllarid and palinurid larvae.

Materials and Methods

Investigations were conducted in 1983 and 1984. The investigation in 1983 was generally concentrated in the waters comparatively close to coasts of the Kumano- and Enshu-nada seas

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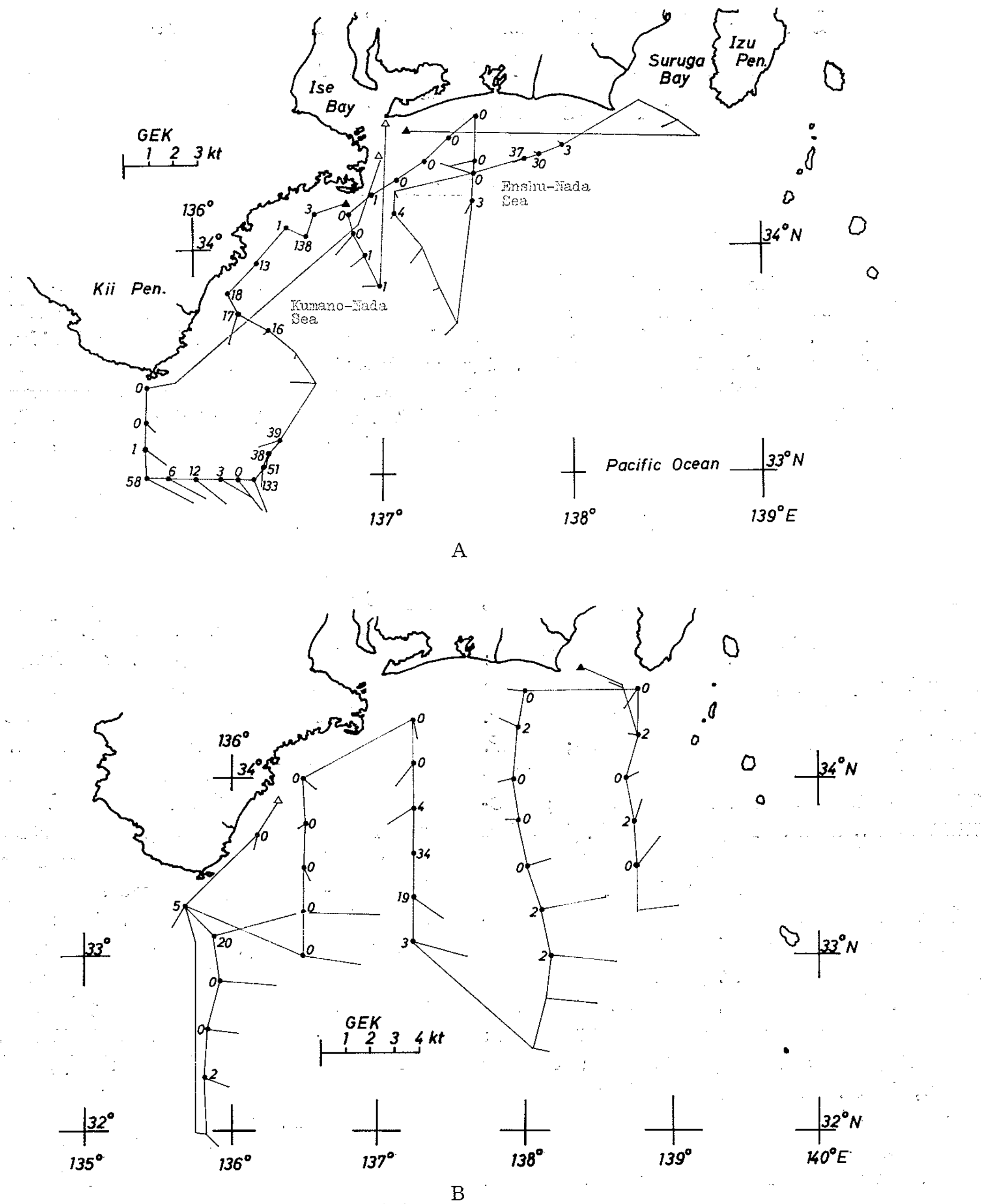

Fig. 1. Surface current velocity measured with GEK in the Kumano- and Enshu-nada seas. Numericals: individual numbers of *Porpita pacifica* per ten minutes tow; solid circles: sampling positions by "Maruchi" net at night; open triangles: starting positions of cruising by T/V Seisui-Maru; solid triangles: ending positions of cruising by the vessel; solid lines: cruising tracks of the vessel; A- in the 83-R-10 cruise (Sept. 25-Oct. 1 1983), B- in the 84-R-7 cruise (Sept. 13-21 1984)

(32°59.04′N to 34°27.38′N; 135°45.11′E to 137° 57.63′E) (Fig. 1a), while in 1984 it covered the off-shore portion of these seas in addition to the Kuroshio Current (32°20.00′N to 34°45.44′N; 135°44.75′E to 138°45.40′E) (Fig. 1b). The investigations were made for seven days in 1983 (Sept. 25–Oct. 1 1983; 83-R-10 cruise) and for nine days in 1984 (Sept. 13–21 1984; 84-R-7 cruise) aboard the training vessel Seisui-Maru of Mie University.

Zooplanktons were sampled from 36 stations in 1983 and from 29 stations in 1984, by night-time horizontal surface hauls of a large "Maru-chi" net (1.3 meter in diameter, 1.0 mm mesh-openings). Surface nets were towed from booms, one on either side of the ship for ten minutes at two knots. Previous studies have confirmed the effectiveness of nighttime horizontal surface towes to collect phyllosoma larvae (NONAKA and WAKABAYASHI, 1973; PHILLIPS *et al.*, 1978). Zooplankton samples collected were immediately fixed in 10% formalin seawater. Phyllosoma larvae were sorted from the samples and identified to the generic level, and where possible to the species level, in the laboratory. Phyllosoma larvae of a scyllarid lobster *Scyllarus bicuspidatus* were classified into eight stages according to morphological features as described by PHILLIPS *et al.* (1981).

The surface current velocity was measured by GEK. Water temperature data is taken from the Prompt Report of the Oceanographic Conditions published by the Hydrographic Department, Maritime Safety Agency (1983–1984). In addition, the numbers of a chondrophorid medusa, *Porpita pacifica*, were counted at each sampling station to confirm the extention of the Kuroshio Current into the Kumano- and Enshu-nada seas.

Results and Discussion

1. The Kuroshio path during the investigation

The Kuroshio path fluctuated from June to October of both years as indicated in Fig. 2. According to the classification of the Kuroshio path by NITANI (1969), the Kuroshio was mainly in the "B" type from June to October 1983, while in 1984 the Kuroshio path fluctuated considerably, changing from the "B" type in early June, next to the "C" or "D" type and finally to "N" type path in September. The investigations were made from September to October when the Kuroshio path was of the "B" type in 1983 and of the "N" type in 1984.

Due to the "B" type Kuroshio path in 1983, a strong south-westerly current appeared in the Kumano- nada sea (Fig. 1a). Though a westerly current appeared in the Enshu-nada seas, this current was not followed by the southwesterly current in the Kumanonada seas. The "N" type Kuroshio path in 1984 produced an anti-clockwise circulation in the Enshu-nada seas, though the Kumano-nada sea showed irregular-directed and weak current (Fig. 1b). Distribution of water temperature in relation to the Kuroshio

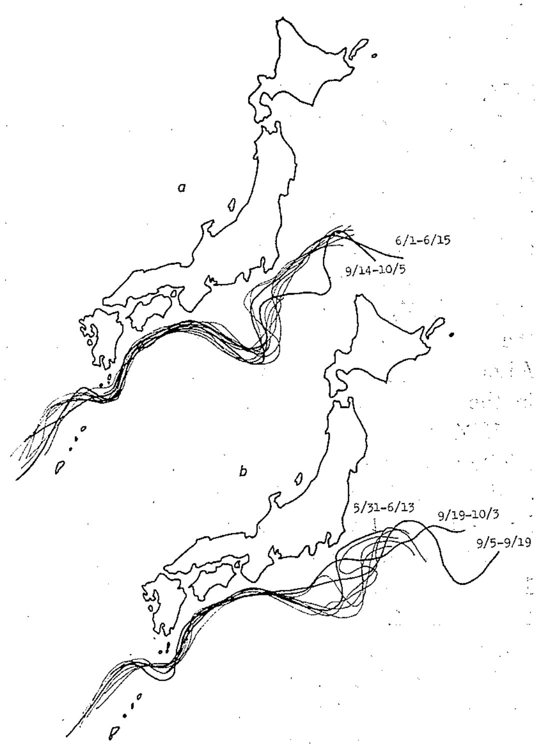

Fig. 2. Semi-monthly fluctuation of the Kuroshio path from June to October.
a: 1983, b: 1984. Data supplied from the Prompt Report of the Oceanographic Conditions published by the Hydrographic Department of the Maritime Safety Agency (1983–1984). The Kuroshio path is based on the GEK data.

path is shown in Fig. 3a, b. A distinct cold water mass appeared in the off-shore portion of the Enshu-nada sea when the Kuroshio was in the "B" type in 1983. Features of the water temperature pattern in 1983 (Fig. 3a) indicate that the Enshu-nada sea was influenced by the Kuroshio Current which had intruded from the east. Furthermore, the chondrophorid mesusa, *Porpita pacifica*, which always floats on the surface and may be used as an indicator species of Kuroshio water, densely appeared in the waters close to the Kumano- and Enshu-nada seas coasts, in addition to the Kuroshio Current (*i.e.*, 32°59.04′N to 33°06.21′N; 135°45.14′E to 136°23.38′E) off the southern tip of the Kii Peninsula in 1983, while in 1984 it appeared in small numbers in these seas (Fig. 1a, b).

2. Abundance of phyllosoma larvae

There was a sharp contrast in the abundance of phyllosoma larvae caught between 1983 and 1984. A total of 365 individuals was caught in 1983, while in 1984 they totaled 15 individuals. Two explanations are possible in this case: (1) if the number of the larvae released by all the berried female in 1983 and 1984 did not differ greatly, it is suggested that most of the larvae were flushed out into the Kuroshio Current in 1984, while they were retained within the Kumano- and Enshu-nada seas in 1983. Alternatively, (2) sampling was concentrated in the waters close to the coasts in 1983, while in 1984 the off-shore portion of these seas in addition to the Kuroshio Current was covered as described in the previous section. Phyllosoma larvae may have occurred mainly in the waters close to the coasts and thus the investigation in 1983 would be more likely to catch the larvae than in 1984.

Scyllarid and palinurid lobsters have a planktonic larval life ranging from one month to nearly one year (PHILLIPS and SASTRY, 1980). Therefore, the current pattern in the Kumano- and Enshu-nada seas determines whether phyllosoma larvae released by the berried lobsters inhabiting the near-shores are retained within these seas, or are flushed out into the Kuroshio Current. Fluctuations of the Kuroshio path of from a half-month to a few months considerably influence the surface current pattern in these seas

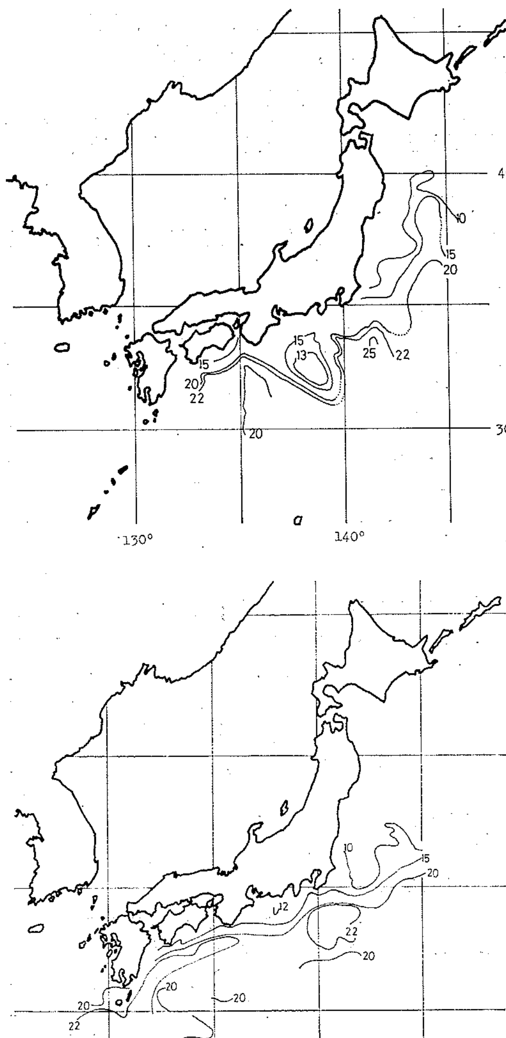

Fig. 3. Water temperature distribution at 100m depth. a: from Sept. 14 to Oct. 5 1983, b: from Sept. 19 to Oct. 3 1984. Data from the Prompt Report of the Oceanographic Conditions published by the Hydrographic Department of the Maritime Safety Agency (1983–1984).

(KOBAYASHI *et al.*, 1984). According to Kobayashi's (1985) study concerning the oceanographic conditions of these seas in relation to the Kuroshio meander, floating particles released into these seas tended to be flushed out into the Kuroshio Current more during the periods of the Kuroshio meander than during the periods of the "N" type of Kuroshio path. This suggests that the phyllosoma larvae were more abundant in 1984 under the "N" type Kuroshio path than in 1983 under the "B" type path. The phyllosoma larvae collected, however, were much more abundant in 1983. From this, the author believes that the large difference in phyllosoma numbers between 1983 and 1984 can be attributed to differences in sampling positions between years. Further support comes from KIDACHI and ITO (1979) who worked on the fluctuation of zooplankton wet weights in these seas in relation to the Kuroshio meander. The weights apparently increased during periods of the Kuroshio meander when compared with those from the "N" type of Kuroshio path. They suggested that this increase in weight is connected with the extention of coastal water caused by the Kuroshio meander.

3. Identification of collected phyllosoma larvae

To determine the spatial distribution of phyllosoma larvae of *Panulirus japonicus*, which is commercially fished in nearshore waters of the Kumano- and Enshu-nada seas, the present investigation was undertaken from September to October, shortly after the main hatching and releasing from July to August (INOUE, 1981). However, as referred below, phyllosoma larvae of scyllarid lobsters were predominant among the collected larvae.

Late and gilled (final) phyllosoma stages of the scyllarid and palinurid lobsters were identified in the samples:

83-R-10 cruise	84-R-7 cruise
Scyllarus bicuspidatus (338 inds.)	*Scyllarus bicuspidatus* (2)
cultrifer (1)	sp. a (7)
kitanoviriosus (3)	
martensii (1)	*Panulirus ornatus* (2)
sp. a (13)	
Panulirus ornatus (3)	
versicolor (1)	

Five specimens of early-stage phyllosoma larvae belonging to *Ibacus*, *Parribacus*, and *Scyllarides* were also caught in the present investigation. These speciments were difficult to identify to species level and only ten species of phyllosoma larvae were identified. Descriptions of the phyllosoma larvae were given in a previous paper (SEKIGUCHI, 1986) that included keys to the genera and species of scyllarid and palinurid lobsters in Japan. Phyllosoma larvae of *Thenus* (Scyllaridae), *Linuparus*, *Puerulus*, *Palinustus* and *Justitia* (Palinuridae) were not sampled in the present investigation, though those of *Linuparus* and *Justitia* have already been reported from Japanese waters (SAISHO *et al.*, 1983; AOYAMA *et al.*, 1985).

Among the ten species of phoyllosoma larvae collected in the present investigation, the larvae of *Scyllarus bicuspidatus* were predominant, occupying more than 90% of the collected larvae. As spawning period of scyllarid lobsters generally extends from May to early August in Japanese waters (SAISHO, 1964), this indicates that adults of *S. bicuspidatus* were also predominant in the near-shores of the Kumano- and Enshu-nada seas. Taxonomy of *Scyllarus* adults in Japanese waters has tentatively been reviewed by HARADA (1962, 1965), but their abundance and regional occurrence have not yet been investigated in detail until now. Though it is believed that *S. cultrifer* is predominant among *Scyllarus* species in Japan (MIYAKE, 1982), it is probable that *S. bicuspidatus* has erroneously been identified as *S. cultrifer* as HARADA (1965) suggested. In the near future it will be difficult to clarify the ecology of the small-sized *Scyllarus* adults as they generally lack economic value in Japan, as opposed to large-sized *Panulirus* adults. Thus, studies on taxonomical and distributional features of *Scyllarus* larvae could give valuable information concerning those of the adults.

Only six specimens of *Panulirus ornatus* and *P. versicolor* phyllosoma larvae were taken in the present investigation. Curiously, phyllosoma larvae of *P. japonicus*, which mainly releases their larvae from July to August and lives densely in near-shore waters of the Kumano- and Enshu-nada seas (INOUE, 1981; NONAKA, 1982), could not be collected. The reasons why *Panulirus* larvae appeared in small numbers in these seas are not immediately apparent.

Two specimens of nisto larvae belonging to the *Scyllarus* were obtained in the 84-R-7 cruise: sampling position was 33°55.67′N; 136°

24.34′E on Sept. 27 1984. Unfortunately, it is still difficult to identify these specimens to species.

4. Spatial distribution of phyllosoma larvae of *Scyllarus bicuspidatus*

All the phyllosoma larvae of *S. bicuspidatus* were in the fourth to eighth (final and/or gilled) stages of development based on PHILLIPS *et al.* (1981). Frequency distributions of body lengths for collected larvae are illustrated for each phyllosoma stage in Fig. 4 which indicates that body lengths at each stage do not overlap with each other. Stage composition of the *S. bicuspidatus* larvae collected in 1983 is shown in Fig. 5, the seventh to eighth stages were predominant while the first to third stages were lacking.

Spatial distribution, abundance, and stage composition of phyllosoma larvae of *S. bicuspi-*

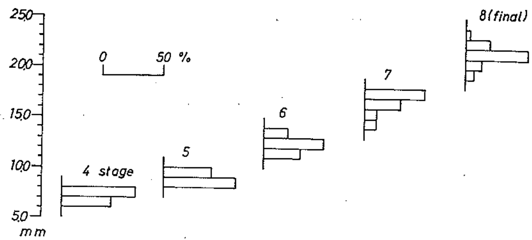

Fig. 4. Frequency distribution of body lengths of each phyllosoma stage of *Scyllarus bicuspidatus*. The 338 specimens collected in 1983 were examined.

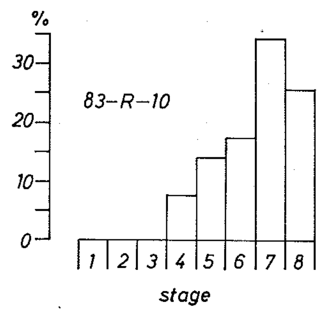

Fig. 5. Stage composition of phyllosoma larvae of *Scyllarus bicuspidatus*.

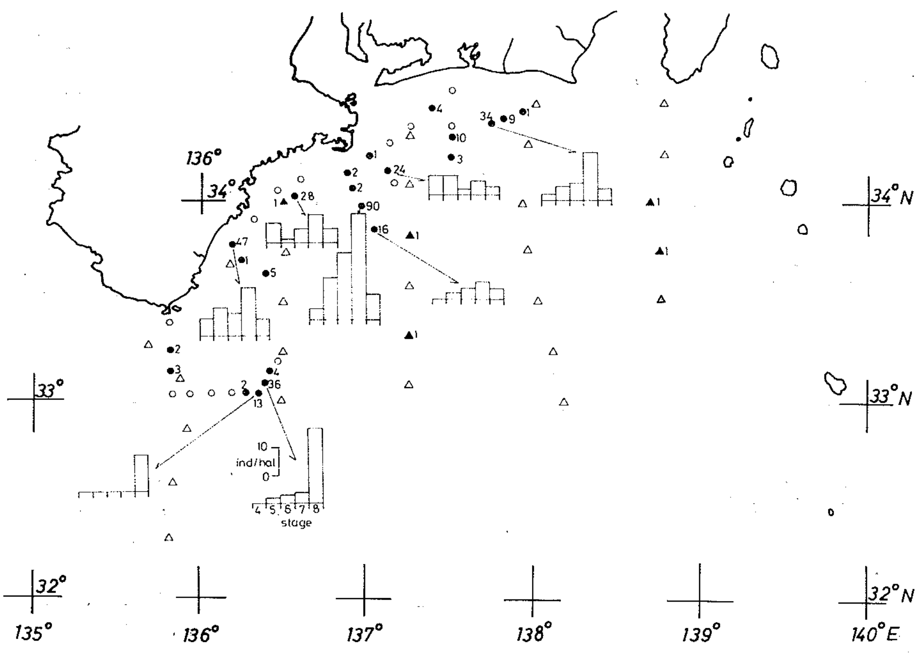

Fig. 6. Spatial distribution, abundance and stage composition of phyllosoma larvae of *Scyllarus bicuspidatus* in the Kumano- and Enshu-nada seas.
Numericals: individual numbers per ten minutes tow; circles: sampling positions of the 83-R-10 cruise; triangles: those of the 84-R-7 cruise. Open and solid marks show absence and occurrence of larvae, respectively.

datus are shown in Fig. 6. Larvae were mainly found in the waters close to coasts of the Kumano- and Enshu-nada seas with the highest density of 90 inds. per tow for ten minutes. Distinctly different from the larval population collected within the Kumano- and Enshu-nada seas, the larvae which were caught in the Kuroshio Current close to the southern tip of the Kii Peninsula consisted mainly of final stage specimens (Fig. 6). Two explanations are possible concerning the larval population of *S. bicuspidatus* which were collected within the Kumano- and Enshu-nada seas. Firstly, the larvae were released by the adults inhabiting near-shore waters and most were retained therein. Secondly, the larvae were released elsewhere and then later transported into these seas through the Kuroshio Current. If larvae of *S. bicuspidatus* originated from waters other than these seas, it is difficult to understand then why phyllosoma stages of the larvae collected within these seas were younger than those in the Kuroshio Current as indicated in Fig. 6. A chondrophorid medusa *Porpita pacifica* which is used as an indicator of the Kuroshio water on the surface was collected abundantly within these seas (Fig. 2a). However, these medusae always live on the sea surface, while the phyllosoma larvae clearly show diel vertical migration (PHILLIPS *et al.*, 1981). Such behavioral differences would result in greatly different spatial distributional patterns for each species (*e.g.* SEKIGUCHI, 1984).

As estimated from the surface current pattern of these seas (Fig. 2a) and from the *S. bicuspidatus* larvae found mainly in the waters close to the coasts (Fig. 6), most of the larvae were not dispersed into the off-shore portion of these seas. Nevertheless, high densities of larvae were sometimes found within the Kuroshio Current close to the southern tip of the Kii Peninsula (Fig. 6). This suggests that larvae of *S. bicuspidatus* are, in part, flushed out into the Kuroshio Current. Conversely, this may indicate that the larvae could not be flushed out into the Kuroshio Current until after entering the later developmental stages.

As mentioned above, larvae of *S. bicuspidatus*, which were composed of the fourth to eight (final) stages, were found abundantly within the Kumano- and Enshu-nada seas, while those of *P. japonicus* were lacking. The results stated above support the idea that larvae of *S. bicuspidatus* are retained within these seas throughout their phyllosoma stages while those of *P. japonicus* are flushed out into the Kuroshio Current as discussed by SEKIGUCHI (1985). It is possible, though demanding much time and energy, to examine this hypothesis. Sampling by a large plankton net must cover the whole area of the Kumano- and Enshu-nada seas throughout the year. The author is now planning to start such a study in near future.

Acknowledgements

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References

AOYAMA, M., T. SASAKI and M. NONAKA (1984) On a new form of palinurid phyllosoma. Aquaculture, **32**, 54-58. (in Japanese)

HARADA, E. (1957) Ecological observations on the Japanese spiny lobster, *Panulirus japonica* (Von Siebold), in its larval and adult life. Publ. Seto Mar. Biol. Lab., **6**, 99-120.

HARADA, E. (1962) On the genus *Scyllarus* (Crustacea Decapoda: Reptantia) from Japan. Publ. Seto Mar. Biol. Lab., **10**, 109-132.

HARADA, E. (1965) Zoogeographical aspects of Palinura found in the Kii District. Nanki Seibutsu, **7**, 35-42. (in Japanese)

INOUE, M. (1978) Studies on the cultured phyllosoma larvae of the Japanese spiny lobster *Panulirus japonicus*. 1. Morphology of the phyllosoma. Bull. Japan. Soc. Sci. Fish., **44**, 457-475. (in Japanese)

INOUE, M. (1981) Studies on the cultured phyllosoma larvae of the Japanese spiny lobster, *Panulirus japonicus* (V. Siebold). Special Rep. Kanagawa Pref. Fish. Exp. Stn., **1**, 1-91. (in Japanese)

KIDACHI, T. and H. ITO (1979) Distribution and structure of macroplankton communities in the Kuroshio and coastal region, south of Honshu, during spring season. Bull. Tokai Reg. Fish. Res. Lab., **97**, 1-119. (in Japanese)

KOBAYASHI, M. (1985) Studies on the currents of the Kuroshio region of importance to the transport of pelagic eggs and larvae. Ph. D Thesis, University of Tokyo, 166 pp. (in Japanese)

KOBAYASHI, M., T. SUGIMOTO and T. HIRANO (1984) Surface current patterns in the Kumano-nada and the Enshu-nada seas for different types of the Kuroshio paths based on GEK data -1. Bull. Japan. Soc. Fish. Oceanogr., **46**, 18-26. (in Japanese)

KURATA, Y. and T. SHIMIDU (1973) Fisheries biology of palinurid lobsters in the Bonin islands. *In*, Report on Fisheries Development in the Bonin islands, ed. Tokyo Metoropolitan Fish. Exp. Stn., 1-19. (in Japanese)

MURANO, M. (1967) Preliminary notes on the ecological study of the phyllosoma larvae of the Japanese spiny lobster. Inform. Bull. Plankton Soc. Japan, Commemoration Number of Dr. Y. MATSUE, 129-137.

MIYAKE, S. (1982) Japanese Crustacean Decapoda and Stomatopods in Color, Vol. 1. Macrura, Anomura and Stomatopoda, Hoikusha Publ. Co. Ltd., Osaka, 261 pp.

NAKAMURA, K. (1975) Notes on morphology of the *Panulirus* phyllosoma larvae collected in the coast of Tokushima Pref., southern Japan. Saibai Giken, **4**, 1-8. (in Japanese)

NITANI, H. (1969) On the variability of the Kuroshio in recent several years. Bull, Japan. Soc. Fish. Oceanogr., **14**, 13-18. (in Japanese)

NONAKA, M. (1982) Characteristics of local stocks of Japanese spiny lobster. Bull. Shizuoka Pref. Fish. Exp. Stn., **16**, 31-42. (in Japanese)

NONAKA, M. and C. WAKABAYASHI (1973) On the distribution of phyllosoma larvae in waters adjacent to the Nansei islands, in June-July of 1970. Bull. Shizuoka Pref. Fish. Exp. Stn., **6**, 15-18. (in Japanese)

PHILLIPS, B.F. (1981) The circulation in the southern Indian and the planktonic life of the western rock lobster. Ann. Rev. Oceanogr. Mar. Biol., **19**, 11-39.

PHILLIPS, B. F. and A. N. SASTRY (1980) Larval ecology. *In*, The Biology and Management of Lobsters, Vol. 2. Ecology and Management, ed. J.S. COBB and B.F. PHILLIPS, Academic Press, New York, 11-58.

PHILLIPS, B.F., D.W. RIMMER and D.D. REID (1978) Ecological investigations of the late-stage phyllosoma and puerulus larvae of the western rock lobster *Panulirus longipes cygnus*. Mar. Biol., **45**, 347-357.

PHILLIPS, B.F., P.A. BROWN, D.W. RIMMER and D.D. REID (1979) Distribution and dispersal of the phyllosoma larvae of the western rock lobster, *Panulirus cygnus*, in the south-eastern Indian Ocean. Aust. J. Mar. Freshwat. Res., **30**, 773-784.

PHILLIPS, B.F., P.A. BROWN, D.W. RIMMER and S.J. BRAINE (1981) Description, distribution and abundance of late larval stages of the scyllaridae (slipper lobsters) in the south-eastern Indian Ocean. Aust. J. Mar. Freshwat. Res., **32**, 417-437.

SAISHO, T. (1964) Notes on the first stage phyllosoma of scyllarid lobster, *Scyllarus bicuspidatus*. Mem. Fac. Fish. Kagoshima Univ., **13**, 1-4.

SAISHO, T., G. KAWAMURA and A. YOTSUMIYA (1983) Studies concerning palinurid larval settlement. Grant-in-Aid Rep., 56560210, 1-23. (in Japanese)

SEKIGUCHI, H. (1984) Distributional ecology of marine planktonic copepods. Bull. Plankton Soc. Japan. 30th Anniversary Volume, 40-43. (in Japanese)

SEKIGUCHI, H. (1985) Larval recruitment processes of the Japanese spiny lobster *Panulirus japonicus* (Decapoda, Palinuridae): a perspective. Bull. Japan. Ass. Benthol., **28**, 24-35. (in Japanese)

SEKIGUCHI, H. (1986) Identification of phyllosoma larvae of scyllarid and palinurid lobsters in the Japanese waters. Bull. Japan. Soc. Sci. Fish., **52** (in press).

SHOKITA, S., S. NISHIJIMA, T. WATANABE, N. OHSHIRO and T. TOMA (1983) Biology of the spiny lobsters, *Panulirus penicillatus* (Oliver), from Senkaku isles, the Ryukyu islands. *In*, Investigation Report of Fishing Grounds surrounding Senkaku isles, ed. Okinawa Pref. Fish. Exp. Stn., 57-74. (in Japanese)

Spatial Distribution and Abundance of Phyllosoma Larvae in the Kumano- and Enshu-Nada

熊野・遠州灘のフィロゾーマ幼生の出現数と水平分布

関　口　秀　夫*

要旨: 1983年と1984年の9月から10月にかけて，熊野・遠州灘全域においてフィロゾーマ幼生の分布を調査した。5属10種類（*Ibacus*, *Parribacus*, *Scyllarides*, *Scyllarus* と *Panulirus*）の幼生が採集された。フタバヒメセミエビ（*Scyllarus bicuspidatus*）の幼生が多数採集され，採集された全フィロゾーマ幼生の90%以上を占めた。イセエビ（*Panulirus japonicus*）の幼生は採集されず，ニシキエビ（*P. ornatus*）とゴシキエビ（*P. versicolor*）の幼生がわずか6個体出現した。熊野・遠州灘の浅海水域の親個体群に由来し，調査時に第4期から最終期までに達していたフィロゾーマ幼生が熊野・遠州灘に多数出現したので，フタバヒメセミエビは幼生の全期間を通じてこれらの水域に出現し，一方イセエビのフィロゾーマ幼生はこれらの水域にとどまることなく黒潮水域へ運び出されることを，本研究は示唆している。

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