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Some Morphological Features and Body Size of Early Stage Short-finned Squid  
(Illex illecebrosus) in the Northwest Atlantic

by

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ABSTRACT

Some morphological changes with growth and body size of early stage short-finned squid (Illex illecebrosus, Family Ommastrephidae) in the Northwest Atlantic were described based on 565 individuals of larvae and juveniles collected during the Japan/Canada/U.S.A. joint survey aboard the R/V KAIYO MARU during January - March 1982. The head width was the easiest for length measurement in early life stages, and the relationship between dorsal mantle length (DML in mm) and head width (HW in mm) was expressed by a equation,  $DML = 1.57 \times HW^{1.35}$ . The rostrum-like tentacle length relative to body size varied to a large extent from specimen to specimen. The chromatophores on the dorsal surface of head also varied considerably in position, size and shape in formalin-fixed specimens. However, most of the individuals had six chromatophores in their earliest stage; additional two chromatophores appeared at the length of roughly 3.2 mm DML; and most of individuals larger than 4.6 mm had eight chromatophores. The changeovers from Rhynchoteuthion to transition stages and from transition to juvenile stages occur at the lengths about 5 mm and 7 mm DML, respectively.

INTRODUCTION

The short-finned squid, Illex illecebrosus (LeSueur), is widely distributed in the Northwest Atlantic. This squid is one of the important species to the domestic fisheries of both Canada and the U.S.A. and is also important for the foreign fleets from Japan, U.S.S.R., Cuba and

so on. The fisheries for this species have developed since the early 1970's with a peak catch of 180,000 metric tons in 1979 (NAFO, 1981), but the catch decreased remarkably in recent years due to the poor recruitment especially in Canadian waters.

A considerable amount of biological information on this species is obtained (Balck et al., 1978; Coelho and Rosenberg, 1984; Dawe et al., 1981; Dawe and Drew, 1981; Dawe et al., 1984; Durward et al., 1979 and 1980; Froerman, 1984; Japan Fisheries Agency, 1982; Mohn, 1982; Roper and Lu, 1979; Squires, 1967; and Trites, 1983). However, most of the information is concerned the animals in young and adult stages. Those on spawning and larval squids are still insufficient.

For the purpose of getting information on short-finned squid in the spawning and larval periods, a Japan/Canada/U.S.A. joint survey was conducted using a research vessel KAIYO MARU during January - March 1982. In the present paper, some morphological features and body size of early stage short-finned squid are described based on the specimens collected during the joint survey.

#### MATERIALS AND METHODS

The Japan/Canada/U.S.A. joint squid survey was conducted aboard the 2,540 gross ton Japanese R/V KAIYO MARU. This survey was composed of two cruises, the first from 16 January to 5 February 1982 and the second from 11 February to 5 March 1982. A total of 91 bongo net (Model 1971, 0.5 mm mesh) tows were made in the areas off Canada and U.S.A. (Fig. 1). Details on the methods and operations of the survey are described in the cruise report (Japan Fisheries Agency, 1982).

The collected samples were preserved in 5 % formalin solution. The catch in one net of every tow (bongo net is composed of two same sized nets) is deposited in Far Seas Fisheries Research Laboratory, Japan and the catch by other net is shared between Canadian and American scientists. Materials used in this report are ones in Far Seas Fisheries Research Laboratory.

Rhynchoteuthion type larvae and juvenile squids were sorted from the bongo net samples, and were identified to species according to Roper and Lu (1979) based primarily on the suckers on the tip of rostrumlike tentacle; no presence of photophores on the eye and liver, and the shape of liver. A total of 565 individuals were identified as Illex illecebrosus. The classification of stages was also based on Roper and Lu (op. cit.), viz. Rhynchoteuthion having complete rostrumlike tentacle, transition having a split at the base of rostrumlike tentacle (though this stage included into Rhynchoteuthion in a wider term) and juvenile having splitted tentacles.

The method of measuring the head width (HW) and dorsal mantle length (DML) are shown in Fig. 2. As the degree of protuberance of eye varied from specimen to specimen, the head width between eyes, a ordinary method for measuring, was thought to be unapt for measuring. The width backward the eyes was measured. The mantles of specimens used frequently transformed into thickset shape, and so-called "Pre-rhynchoteuthion" (Hayashi and Iizuka, 1953), which the head and arms are pulled into the mantle, often occurred. Consequently, DMLs of only 93 individuals (16 % of total specimens used) could be measured. On the other hand, because the posterior part of head behind eyes is tough and scarcely transformed even in the specimens of Prerhynchoteuthion type, HWs of 549 in 565 individuals used could be measured (Table 1). The measurement of the rostrumlike tentacle length was difficult because of the bending, extrusion and contraction of rostrumlike tentacle. The reliability of values measured might be low.

The shape, size and position of each chromatophore on the dorsal surface of head varied to a large extent from specimen to specimen. Each chromatophore was labeled with alphabet as shown in Fig. 3, and their appearances were recorded.

## RESULTS

### Morphological features

Using untransformed individuals, the relationship between head width and dorsal mantle length was plotted in Fig. 4, and the equation obtained is as follows,

$$DML = 1.57 \times HW^{1.35}$$

$$r = 0.97$$

where, the unit of length is mm, and  $r$  is the correlation coefficient in the logarithmic linear equation.

The relationship between head width and rostrumlike tentacle length is examined. As shown in Fig. 5, the relative length of rostrumlike tentacle varied to a large extent from 1.4 times to a half of the HW.

The results on the observations of chromatophores on the dorsal surface of head are shown in Table 2. Irrespective of body size and stage, most of the specimens had at least six chromatophores of A to F. It is reported that a five-day-old larva in vitro had six chromatophores on the dorsal surface of head (Durward et al., 1980), and these ones seem to be corresponded with A to F. These six chromatophores were estimated to be retained on head from the hatching at least to juvenile stage smaller than 3.6 mm HW (8.8 mm DML). Two chromatophores of G and H were generally small compared with other six ones, and shrank often into thin wedge shape. These two chromatophores were not found in smaller specimens, and appeared in more than half of the specimens larger than 1.7 mm HW (3.2 mm DML).

#### Body size by stage

The size compositions by stage are shown in Fig. 6. Although a sufficient number of specimens is not available in juvenile stage, the lengths by stage are summarized as Table 3. The changeovers from Rhynchoteuthion to transition and from transition to juvenile occur at about 2.4 mm HW (5 mm DML) and about 3.0 mm HW (7 mm DML), respectively.

#### DISCUSSION

Roper and Lu (1979) described the larvae and juveniles of Illex illecebrosus based on specimens from the western North Atlantic. However, the larvae of a closely-related species, Illex oxygonius which is found in coastal waters from New Jersey to Florida, is not yet described taxonomically. As far as larvae used in this study are concerned, there is no indication that more than one species of larvae are mixed. As those specimens were taken from the offshore waters far eastward of the known range of I. oxygonius, the larvae used are regarded as Illex illecebrosus.

In case of squid species, the mantle length is used exclusively as a basic length. The mantle was however vulnerable and frequently transformed in the specimens used, and mantle length was unmeasurable in 84 % of specimens. Head width is therefore more practical for length measurement at least in formalin-fixed specimens in the larval and early juvenile stages of this species. The relative length of rostrumlike tentacle, such as the tentacular index (Sato, 1983), is often used for identification (Yamamoto and Okutani, 1975), but the individual value varied to a large extent in the case of Illex illecebrosus. The chromatophores on the dorsal surface of head were very prominent themselves. However, the shape and position varied in formalin-fixed specimens, and a few chromatophores were disappeared or lacked in some specimens. This character should be used with caution for identification.

Durward et al. (1980) found that newly hatched larvae of this species were about 1 mm in mantle length, and the size ranges and changeover sizes in Rhynchoteuthion and transition stages were reported in this paper. In consequence, the body size in the period from the hatch to the beginning of juvenile was observed. The changeover size from juvenile to young stages is still remained to be investigated.

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Table 1. Number of specimens measured the dorsal mantle length (DML) and/or head width (HW).

Length measured	Rhyncho-teuthion	Transition	Juvenile	Total
DML	47	39	7	93
HW	428	110	11	549
Both DML and HW	46	39	7	92
Both unmeasurable	15	-	-	15
Total specimens	444	110	11	565

Table 2. The results on the observations of chromatophores on the dorsal surface of head.

Stage	Length class (HW in mm)	Number of specimens used	Number of specimens lacking in the respective chromatophores*							
			A	B	C	D	F	E	G & H	G or H
Rhyncho-teuthion	1.0-1.2	3	-	-	-	-	-	3	-	-
	1.2-1.4	21	-	-	-	-	-	20	-	1
	1.4-1.6	74	-	-	1	-	59	8	7	
	1.6-1.8	94	2	-	-	-	1	41	9	44
	1.8-2.0	80	2	-	-	-	1	14	2	61
	2.0-2.2	66	5	-	-	-	-	6	-	56
	2.2-2.4	39	2	-	-	-	-	-	-	37
2.4-2.6	5	1	-	-	-	-	-	-	4	
Transition	2.0-2.2	10	1	-	-	-	-	1	-	8
	2.2-2.4	25	3	-	-	-	-	-	-	22
	2.4-2.6	34	4	-	-	-	-	-	1	29
	2.6-2.8	24	1	-	-	-	-	-	-	23
	2.8-3.0	11	2	-	-	-	-	-	-	9
	3.0-3.2	1	-	-	-	-	-	-	-	1
	3.2-3.4	2	-	-	-	-	-	-	-	2
Juvenile	2.8-3.0	2	-	-	-	-	-	-	-	2
	3.0-3.2	5	-	-	-	-	-	-	-	5
	3.2-3.4	1	-	-	-	-	-	-	-	1
	3.4-3.6	2	-	-	-	-	-	-	-	2
Total		499	23	-	1	2	144	20	314	

\* the position and symbolic name of each chromatophore are shown in Fig. 2

\*\* none of the eight chromatophores are lacked

Table 3. The lengths (mm) by stage. DMLs are calculated from HWs by the regression curve between HW and DML.

Length		Rhyncho- teuthion	Transition	Juvenile
Range	HW	1.0 - 2.6	2.0 - 3.4	Over 2.8
	DML	1.6 - 5.7	4.0 - 8.2	Over 6.3
Mean length	HW	1.8	2.5	-
	DML	3.5	5.4	-
Critical length*	HW	2.4	3.0	
	DML	about 5	about 7	

\* the length at which the numbers of individuals in both stages are nearly equal

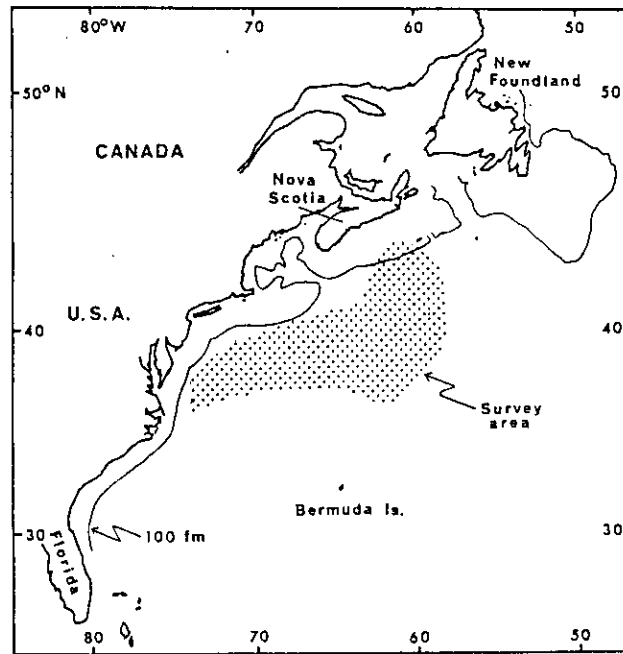


Fig. 1. The map showing the survey area of Japan/Canada/U.S.A. joint squid survey by R/V KAIYO MARU, January - March 1982.



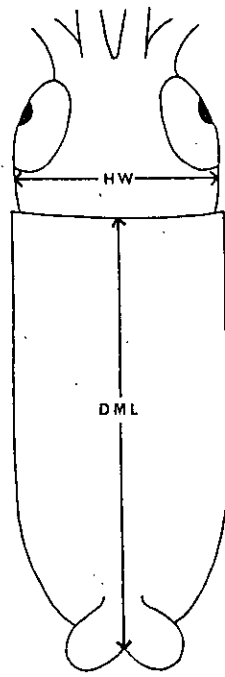


Fig. 2. The measurements of dorsal mantle length (DML) and head width (HW).

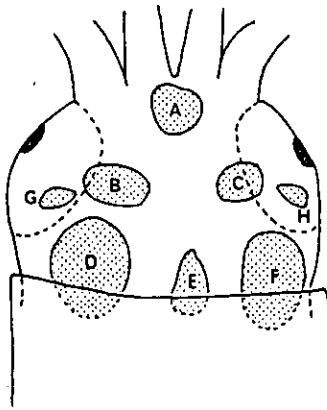


Fig. 3. The schematic figures showing the chromatophores on the dorsal surface of head.

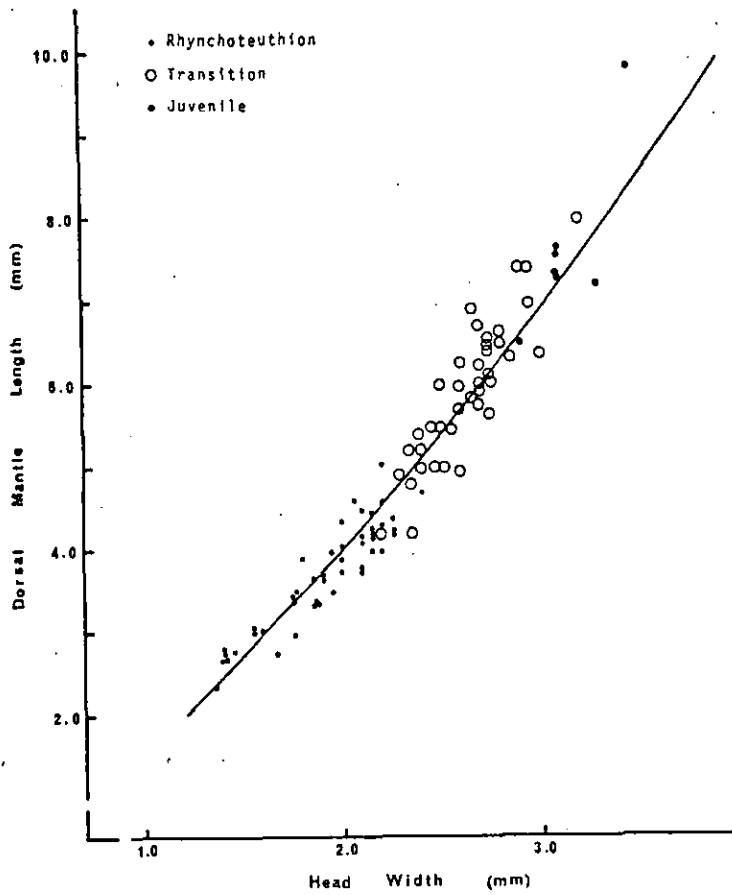


Fig. 4. The relation between head width and dorsal mantle length in the early stages. The regression curve is shown in the figure.

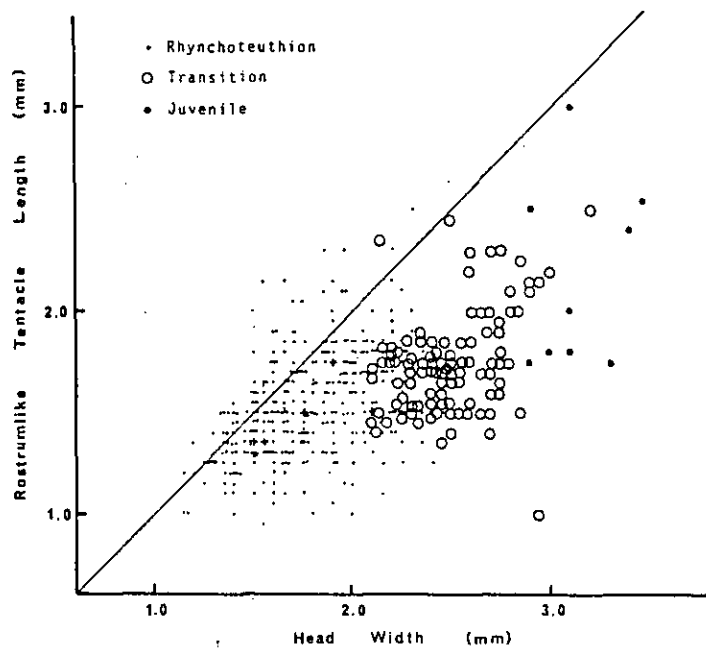


Fig. 5. The relation between head width and rostrumlike tentacle length in the early stages. The line of  $y = x$  is shown in the figure.

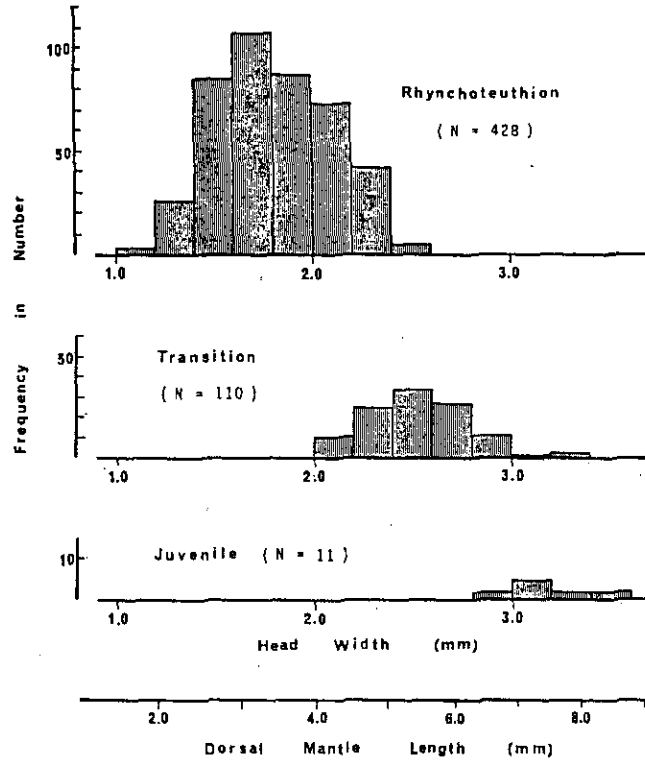


Fig. 6. The size compositions by stage. N denotes the number of specimens used.

