RECORDS OF SOME RARE DEEP-SEA ANGLERFISHES OBTAINED FROM THE WATERS OF HOKKAIDO

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As far as we are aware, the deep-sea anglerfishes have not been formally recorded from the waters around Hokkaido until recent times except for a short statement about the occurrence of a species *Ceratias holboelli KRÖYER* by Dr. Matsubara in his "Fish Morphology and Hierarchy, Part II." published in 1955 as follows "As far as Japanese waters are concerned off Toda, Suruga Bay and in Sagami Bay (Imai, '41, '42), but the author has a picture of a fish of this species which was caught in Hokkaido and was preserved in the Hokkaido Fisheries Research Station in Yoichi" (p. 1357). It is to be regretted that the said specimen has already been lost from the station for some time and it is not available for subsequent studies.

However, during recent years, five specimens of deep-sea anglerfishes were obtained from the Pacific coast of Hokkaido. Two of them, a female of the species *Cryptopsaras couesi GILL*, with a parasitic male and a female of the species *Ceratias holboelli KRÖYER* were reported on briefly by Ueno ('66) and Ueno & Abe ('67). In addition to this, it is worth mentioning that one of these specimens, a pelagic type caulophrynid deep-sea anglerfish recently caught off Kushiro is the first record of this fish from Japanese waters as well as being the first record of this fish from the North Pacific Ocean. We would like to give here, therefore, the detailed descriptions of these five specimens of deep-sea anglerfishes. All specimens treated is this report are deposited in the Fisheries Museum, Faculty of Fisheries, Hokkaido University.

Before going further, we wish to express here our heart felt thanks to Mr. M. Sakurai, a previous director of the Kushiro Fisheries Research Station, for his courtesy in aiding this study. Thanks are also due to Mr. T. Sakamoto of the same station for his cooperation in keeping a live caulophrynid specimen in a small aquarium and in taking photographs of this fish which appear in this paper. Acknowledgement is made to the partial financial support of this study through a grant from the Japan Society for the Promotion of Science as a part of Japan-U.S.A. Cooperative Science Programs.

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I. First record of *Caulophryne jordani* GOODE & BEAN from the North Pacific Ocean

New Japanese name: Hirenaga-Chōchin-Ankō

An immature female specimen of caulophrynid deep-sea anglerfish was taken in living conditions by the small sized trawl-net for shrimp fishing (Ebi-keta-ami) of a small commercial fishing boat "No. 3 Shichisei Maru" (about 10 metric tons) from a depth of about 500 m off Kushiro at 42°40'N and 144°40'E between 8.00 A.M. and 12.00 A.M. on April 26, 1967. The specimen was taken the Kushiro Fisheries Research Station and she lived for two days in a small aquarium (PLATE I, A~C).

This specimen 135 mm long, is very peculiar in having long filamentous dorsal and anal fin rays, which indicat it is apparently a member of the family Caulophrynidae. The family Caulophrynidae consists of only a single genus *Caulophryne*. Bertelsen ('51) in his monograph on the ceratioid fishes states that all previously known 6 species of this genus and *Ceratocaulophryne regani* ROULE

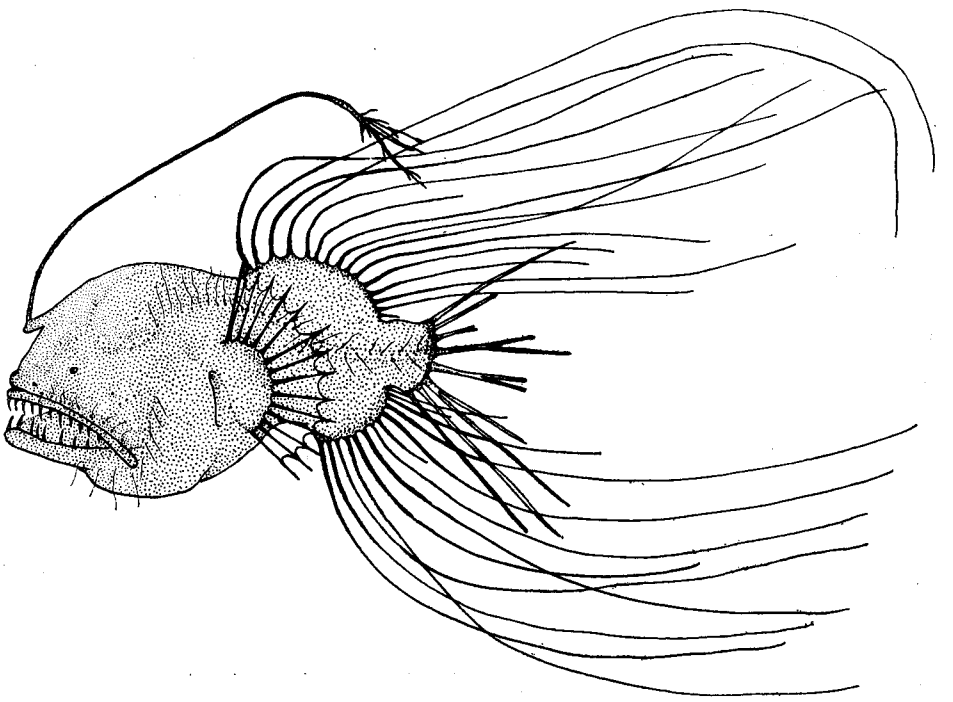

Fig. 1. Lateral view of an immature female specimen of *Caulophryne jordani* GOODE & BEAN, 135 mm in total length, taken from off Kushiro, on April 26, 1967 (F-1639)

& *ANGEL* be considered as the same species since all differences found in those caulophrynid specimens may be due to individual variation and differences in age. He therefore, treated these species as synonyms of *Caulophryne jordani GOODE & BEAN*. However, Bertelsen divided this species into three subspecies mainly based upon the length of dorsal and anal fin rays and also on the form of the illicium. Of these three subspecies the present specimen is most similar to *Caulophryne jordani pelagica REGAN & TREWAVAS*, but there are also some differences. We therefore, provisionally identified the present specimen only as *Caulophryne jordani* in this paper since the details of the specific and subspecific division of these caulophrynid fishes still remains inclear.

The measurements and counts of body parts and proportions of body parts to the standard length of the present specimens were given in Table 1.

Body short, oval, rather massive anteriorly and compressed posteriorly. Head large, broad, its length about a half of the standard length without the caudal fin, and with an elongated illicium on the back above the eye. The length of the illicium is about 90% of the total length, its stem slender and the terminal part of its main portion having some small tubercles. The tip of the illicium has some filaments of which four preximal ones much shorter than the middle two have some branches (Fig. 2). Eyes extremely small and inconspicuous. Mouth very large, nearly horizontal, and the length of the upper jaw is about 45% of the standard length. The tip of the lower jaw is strongly pointed, the length of the lower jaw is about a half of the standard length.

Teeth are present on jaws, vomer and palatines, they are all strong caninelike in form, and sharply pointed. The upper jaw has 10 teeth on the right side, but 12 on the left side. On the other hand, the lower jaw has 8 teeth on the right side and 11 on the left side. There are 3 teeth on the vomer. The palatine has 2 teeth on the anterior and 3 on the posterior parts on each side.

Gill-opening narrow, placed below and in front of the pectoral fin base. There are 4 gill-arches, the first one is attuched to the second one and is without filaments. The second, third and forth ones have well developed gill-filaments, but the last one is attached to the gill-cavity. Gill-rakers are absent from all gill-arches.

Dorsal and anal fins are opposite each other asymmetrically, but the origin of the dorsal fin is somewhat closer to the anterior that of the anal fin. Fin rays of both the dorsal and anal fins are greatly prolonged, filamentous, the longest one being about 1.5 times the total length. However, some of them were torn off on the way. The pectoral fins are large, very broad, and located just below the origin of the dorsal fin. All rays of the pectoral fins are unbranched and of nearly equal length. The caudal fin is long, and tapering. The tips of the rays are not filamentous, but the middle four rays are branched. Ventral fins are entirely absent

Table 1. Measurements and counts of body parts and proportions to the standard length of *Caulophryne jordani* (an immature specimen), taken from off Kushiro, on April 26, 1967 (F–1639)

Items	Measurements and counts	Proportions to the standard length
Total length	135 (mm)	
Standard length	92	
Greatest depth of body	48	51(%)
Length of head	45	49
Depth of caudal peduncle	14	15
Length of snout	20	22
Length of upper jaw	41	45
Length of lower jaw	44	48
Width of interorbital space	27	29
Diameter of eye	2	2
Total length of illicium	112	122
Stem length of illicium	21	23
Width of gill-slit	15	16
Length of 1st dorsal fin ray	140	152
〃 2nd 〃	210	228
〃 3rd 〃	180	196
〃 4th 〃	200	218
〃 5th 〃	150	163
〃 6th 〃	(40)	—
〃 7th 〃	180	196
〃 8th 〃	140	152
〃 9th 〃	160	174
〃 10th 〃	120	130
〃 11th 〃	(70)	—
〃 12th 〃	(60)	—
〃 13th 〃	110	120
〃 14th 〃	(80)	—
〃 15th 〃	70	72
Length of 1st anal fin ray	140	152
〃 2nd 〃	140	152
〃 3rd 〃	150	163
〃 4th 〃	160	174
〃 5th 〃	(80)	—
〃 6th 〃	140	152
〃 7th 〃	140	152
〃 8th 〃	(18)	—
〃 9th 〃	150	163
〃 10th 〃	160	174
〃 11th 〃	(70)	—
〃 12th 〃	(20)	—
〃 13th 〃	(40)	—
Length of the longest caudal fin ray	40	43
Length of the longest pectoral fin ray	20	22
Number of dorsal fin rays	15	
〃 anal fin rays	13	
〃 pectoral fin rays (L:R)	15 : 15	
〃 caudal fin rays	2+4+2	
〃 teeth on upper jaw (L:R)	12 : 10	
〃 teeth on lower jaw (L:R)	8 : 11	
〃 teeth on vomer	3	
〃 teeth on palatines (L:R)	2+3 : 2+3	
〃 branchiostegal rays	6	
〃 vertebrae	19(9+10)	

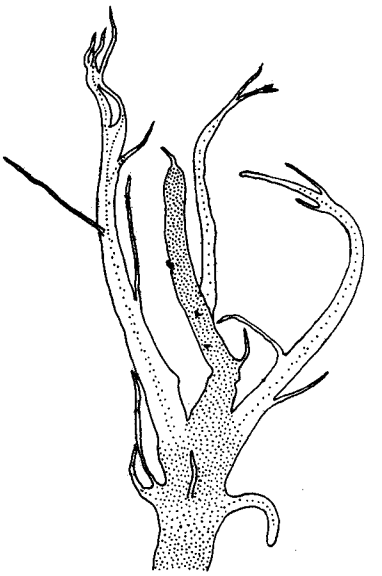

Fig. 2. A magnified figure of terminal portion of the illicium of *Caulophryne jordani* GOODE & BEAN

from the present specimen.

Laterial pores are about 34 in number, each one with a long hair-like cutaneous flap the longest one of which is about 15% of the body length. Similar flaps are present on the side of the head and the jaws. There are about 5 on the preopercular margin, 9 on each side of the upper jaw and 4 on each side of the lower jaw. Vertebrae are 19 number according to an X-ray. Nine are abdominal and other 10 are caudal vertebrae. The X-ray photograph agrees quite well in the arrangement of vertebrae and other osteological characteristics with Bertelsen's figure of the lateral view of the skeleton based on a 9.5mm long larval female specimen of this species (Bertelsen, '51, p. 32, fig, 8~B). The skin of the body is entirely naked. Head and body are blackish and most of the fin rays are black but with some pale segmentous bands (see Table 2).

All known specimens of *Caulophryne jordani* and its synonyms have previously been recorded from the North-West and North-East Atlantic, Gulf of Panama, Tasman Sea, North Indian Ocean, Indo-Malayan Seas, Eastern Pacific and South China Sea (a free-living male), so the present specimen apparently is the first record of this species from the North Pacific Ocean. We would like here to propose a new Japanese name for this species, "Hirenaga-Chyōchin-Ankō"* based upon the distinct characteritic of the adult females in having conspicuously elongated filamentous dorsal and anal fin rays.

* This Japanese name means a long-fined deep-sea anglerfish.

Table 2. Arrangements and intervals of blackish and pale bands on the dorsal and anal fins of *Caulophryne jordani* examined. The measurements were made only for several unbroken rays. The figures within the parenthesis indicates widths of pale bands, all of them indicated in millimetre.

Dorsal fin :	
1st ray	65+(1)+100+(2)+118+(1)
2nd ray	32+(1)+54+(1)+73+(1)+114+(2)+185+(1)
3rd ray	27+(1)+58+(1)+78+(2)+150+(2)+176+(2)
4th ray	38+(1)+57+(1)+82+(1)+142+(3)+180+(2)
9th ray	10+(1)+27+(1)+65+(1)+93+(1)+145+(3)
Anal fin :	
1st ray	35+(1)+75+(2)
2nd ray	22+(1)+50+(1)+97+(1)
3rd ray	? +40+(1)+80+(1)+140+(1)
7th ray	42+(1)+76+(2)+100+(1)

II. A female specimen of *Cryptopsaras couesi GILL* with a well developed parasitic male on her body taken from the Pacific coast of Hokkaido

Japanese name: Mitsukuri-Enaga-Chōchin-Ankō

A female specimen of *Cryptopsaras couesi*, 401 mm long, was taken from a depth about 450 m, by a trawl-net of a commercial fishing boat on December 15, southeast of Daikoku Island which is in the mouth of Akkeshi Bay. This specimen had a well developed parasitic male on the lower part of the right side of the head (PLATE II, B).

As mentioned above, this specimen was reported on briefly by one of the authors of this paper, Ueno ('66), and Ueno & Abe ('67) as being the first occurrence of this species in the waters of Hokkaido. It also bears the largest parasitic male on record. It sheuld also be noted that this specimen was caught farther north than any other specimen of this species, caught to date in the Pacific.

The measurements and counts of body parts and proportions of body parts to the standard length of both female and male specimens examined are given in Table 3.

Female specimen (Sp. No. F–1652): The standard length is 272 mm. The body is in good condition except for the illicium which was torn off from the base, presumably by accident when this specimen was handled on deck. No other important damage was found on the specimen.

Body oval, compressed, and the deepest at the vertical through the pectoral fin base. The depth of the body is about 50% of the standard length. Head

Table 3. Measurements and counts of body parts and proportions to the standardlength of a female and attached parasitic male of *Cryptopsaras couesi*, taken from the Pacific coast of Hokkaido, on December 15, 1966 (F–1652)

Items	♀		♂	
Total length	401 (mm)		87 (mm)	
Standard length	272		74	
Greatest depth of body	135	50 (%)	20	27 (%)
Length of head	138	51	39	53
Depth of caudal peduncle	30	11	7	9.5
Length of snout	45	16	14	19
Diameter of eye	4	1.5	2	3
Length of upper jaw	50	18	7	9.5
Width of mouth cleft	36	13	6	8
Width of gill-slit	22	8	2.5	3
Total length of illicium	?	?	—	—
Length of median caruncle	16	6	—	—
Length of left caruncle	11	4	—	—
Length of right caruncle	12	4.5	—	—
Length of dorsal fin base	35	13	6	8
Length of anal fin base	27	10	6	8
Length of pectoral fin base	17	6	3	4
Length of the longest dorsal fin ray	36	13	6	8
Length of the longest anal fin ray	47	17	9	12
Length of the longest pectoral fin ray	15	6	5	7
Length of the longest caudal fin ray	129	48	17	23
Distance from tip of snout to base of illicium	43	16	—	—
Distance from tip of snout to origin of dorsal fin	189	69	57	77
Number of dorsal fin rays	4		4	
〃 anal fin rays	4		4	
〃 pectoral fin rays (L:R)	16:15		16:16	
〃 caudal fin rays	2+4+2		2+4+2	
〃 branchiostegal rays	6		?	

large, occipital region flat transversely. Dorsal profile of head gently rounded. Eye very small and rather obsolate. Mouth large, almost vertical. There is a distinct symphysial knob at the tip of lower jaw.

Teeth are present on jaws and vomer, and those on jaws are all depressible. Teeth on upper jaw are smaller than those on lower jaw, and are arranged in a narrow band, but those on the lower jaw are larger and sharper, and arranged in one or two irregular rows. Vomer with 3 small teeth on its left wing, but with 4 similar ones on the right wing. No teeth on the platines.

Gills are 4 in number and gill-rakers are reduced to small tubercles. The gill-opening lies just behind the pectoral fin base and its vertical diameter is a little larger than the pectoral fin base.

There are 3 caruncles in front of the dorsal fin in a transverse row across the back. The middle one is the largest and most massive in form. The other two are

club-like, paired, and with pale areas of lens-like tissue at their tips. The one on the right side is somewhat larger than the one on the left side. A short tube-like tentacle lies just in front of the middle caruncle, and a minute pore opens at the tip of the tube.

Four marginal rays (two upper and two lower) of the caudal fin are simple with terminal enlargements on their tips. However, the two middle rays are branched and inner branches of these middle rays have exceedingly long filamentous tentacles, but without such terminal swellings at their tips as were illustrated in Tanaka's original figure *Paraceratias mitsukurii* (=*Cryptopsaras couesi*) and also Bertelsen ('51) figure *Cryptopsaras couesi*.

The ovaries are not matured, and the eggs are very small, scarcelly visible without lens.

The body is coal black and the skin is densely covered with minute prickles which are embeded under the skin, which make the skin somewhat rought to the touch.

Parasitic male (attached to F-1652): A single specimen (87 mm in total and 74 mm in standard length) was attached to the female specimen mentioned above on the lower part of the right side of her head facing in the same direction as the host. Both jaws of the left side of the male are completely used with the female's akin. There is a narrow slit between the jaws on its right side (Fig. 3). The present parasitic male is without any evidence of illicium or caruncles on the back of body, but dorsal, anal, pectoral and caudal fins are present.

Body slender, gradualy tapering into the caudal peduncle. Head long, dorsal profile gently convex. The depth of the caudal peduncle is about 32% of the deepest part of body measured vertically, passing through the pectoral fin base. Body jetblack, not lighter than the female in pigmentation. Easily visible but small bean-like shaped testes were observed as a result of dissection of the body cavity. The longitudinal diameter of the left testis is about 4 mm. The color of the testes are dark milk-white in formalin solution.

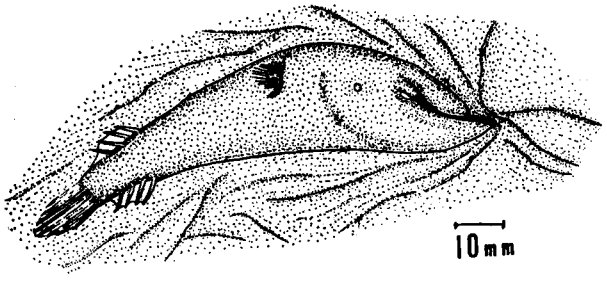

Fig. 3. A parasitic male (87 mm long) of *Cryptopsaras couesi* GILL attached to a female specimen (401 mm long, F-1652) taken from off the Pacific coast of Hokkaido

The dwarf parasitic male of this species, was first reported by Barbour ('41) as a result of a reexamination of Tanaka's *Paraceratias mitsukurii* which is regarded as a synonym of this species. In the original figure of this type specimen (440 mm long) given by Tanaka ('08), this imperfect male looked like only a small club-like appendage below the left pectoral fin a little to the left of the mid-line of the belly. Tanaka, however, did not mention about this appendage in his description on this specimen. He must not have known at that time that this was a dwarf parasitic male. But that one was extremely degenerated. The whole caudal region including the caudal peduncle was wanting. The total length of this male measured about 12 mm nevertheless the caudal region was lost. The next record was be given by Abe & Nakamura ('54). They reported an adult female of this species with a supposedly parasitic male which was caught along the Pacific coast of northern Japan between Hachinohe and Kesen-numa. The parasitic male (about 15 mm in total and about 12 mm in standard length) was fused at the anterior end to the right side of the female (435 mm in total and 270 mm in standard length) below the pectoral base near the mid-ventral line. Later, Okada ('61) gave additional descriptions and figures of this parasitic male based upon a reexamination of this specimen. According to Okada, this second parasitic male measured 16 mm in total length and had less pigmentation than the female. After this, Fast ('57) and Shoemaker ('58) reported on females with two and three parasitic males respectively. Fast's female specimen (213 mm in standard length) was captured near Monterey Bay, California and was bearing two about equal sized parasitic males (27.6 mm and 27.1 mm long) on her belly. On the other hand, Shoemaker's female specimen (176 mm in standard length) was collected from near Mobile Bay in the Gulf of Mexico with one large and two small males on her belly. The largest one measured 37 mm in standard length. Therefore, the present parasitic male is undobutedly the largest specimen among all know males of this species.

According to Bertelsen ('51) *Ceratias carunclatus GÜNTHER*, *Paraceratias mitsukurii TANAKA*, *Cryptosaras normani REGAN & TREWAVAS*, etc. are synonyms of *Crptopsaras couesi GILL*. Therefore, all specimens from Japanese waters recorded under these synonyms belong to the same species. In Japanese waters, this species has previously been recorded from south of Tokyo as *Ceratias carunculatus* (Günther, 1887), from Sagami Bay as *Paraceratias mitsukurii* (Tanaka, '08; '11), from Suruga Bay as *Cryptopsaras normani* (Imai, '42), from off Tsuchizaki, Akita Pref. (Oshima, '42), off Toda, Suruga Bay Kuronuma, '41; Imai, '42), off Sanriku, in a limited area of the Pacific coast of northern Japan (Abe & Nakamura, '54; Okada, '61) as *Cryptopsaras couesi*.

III. Three adult female specimens of *Ceratias holboelli* KRÖYER were captured from off Kushiro, Hokkaido

Japanese name: Biwa-Ankō

As already mentioned, *Ceratias holboelli* and nominally been recorded from the waters of Hokkaido by Matsubara ('55) based on a photograph. However, three large adult female specimens were recently caught off Kushiro. This at least comfirms fact that, this species is distributed in the depths of the Pacific coast of Hokkaido. All specimens obtained, however, without parasitic males. Unfortunately we lock information about the date of capture of the largest specimen (650 mm long), but it is certain that this specimen was taken during 1954 or a while before. The intermediate size specimen (450 mm long) was captured in the middle of April, 1957, from a depth of about 200 m. The smallest specimen (292 mm long) was taken on June 9, 1966, by a trawl from a depth of about 450 m.

Table 4. Measurements and counts of body parts and proportions to the standard length of three specimens of *Ceratias holboelli*, taken from off Kushiro, Hokkaido

Itemes	F-1640		F-1641		F-1653	
Total length	450 (mm)		650 (mm)		292 (mm)	
Standard length	330		420		242	
Greatest depth of body	145	44(%)	160	38(%)	97	40(%)
Length of head	130	40	150	36	108	45
Depth of caudal peduncle	30	9	37	9	20	8
Length of snout	62	19	50	12	37	15
Length of upper jaw	57	17	95	23	48	20
Width of interorbital space	40	12	45	11	22	9
Diameter of eye	4	1.2	8	2	4	1.5
Length of the longest dorsal fin ray	54	16	75	18	30	12
Length of the longest anal fin ray	52	15	75	18	46	19
Length of the longest pectoral fin ray	18	6	25	6	12	5
Length of the longest caudal fin ray	107	32	230	55	50	21
Length of dorsal fin base	39	12	90	21	31	13
Length of anal fin base	35	11	75	18	26	11
Length of pectoral fin base	18	6	22	6	15	7
Width of mouth-cleft	45	14	60	14	32	13
Width of gill-slit	35	11	47	11	16	7
Total length of illicium	226	64	194	46	170	70
Stem length of illicium	71	22	85	20	30	12
Distance from tip of snout to base of illicium	60	18	95	22	43	18
Distance from tip of snout to origin of dorsal fin	250	76	300	72	161	67
Number of dorsal fin rays	4		4		4	
〃 anal fin rays	4		4		4	
〃 pectoral fin rays (L:R)	18:18		18:18		16:17	
〃 caudal fin rays	2+4+2		2+4+2		2+4+2	
〃 branchiostegal rays	6		6		6	

The measurements and counts of body parts and proportion of body parts to the standard length of these three specimens are given in Table 4.

The general appearance and the form of the illicium of our specimens resemble those of *Manaclias uranoscopus* MURRAY described by Imai ('42) based on his specimen from Suruga Bay rather than those of *Manaclias sessilis* Imai ('41) based on a specimen from Sagami Bay even if those two species are regarded as identical and junior synonyms of *Ceratias holboelli* KRÖYER by Bertelsen ('51). However, the length of the illicium varys among these three specimens. In the smallest specimen, the total length of the illicium is about 70% of the standard length, but in the larger two specimens it is 64% and 46% respectively (see Table 4).

Body rather slender, and wholy compressed. The body is deepest vertically at the pectoral fin base. The depth is about 40% of standard length. The general appearance of the body form is like a lute. Head large, the upper profile of the snout slightly concave. Eye extremely small, obsolete. Illicium long, slender and consisting of two parts; basal and stem. There is a small oval esca at the tip of the stem with a transparent part. Mouth cleft nearly vertical, the upper jaw proturding over the lower jaw, but the symphysial knob distinct, and pointed obliquly downward.

Teeth on both jaws are depresible, those on the upper jaw are much smaller than those on the lower jaw, and arranged in several irregular rows anteriorly. Teeth on lower jaw are enlarged, canine-like, sharply pointed, and arranged in indefinite double rows anteriorly and an irregular single row in the posterior portion.

There is a pair of stalked caruncles on the mid-like of the back in front of the dorsal fin. Those caruncles, almost equal in size, pear-like, sharp, and with a minute pore at each tip. Dorsal and anal fins are well back, nearly opposite, and fin rays are thick and strong. Pectoral fin small, originating in about the middle of the side of the body.

Gill-opening slit-like, lie just behind the pectoral fin base, and its vertical diameter is equal to the width of the pectoral fin base. The middle four rays of the caudal fin are branched. The skin of the body is jet-black, covered by minute embeded prickles, so the skin is some what rough to the touch. The above descriptions are mainly based on the smallest specimen.

Ceratias holboelli has hitherto been recorded in Japanese waters formally only from Suruga Bay and Sagami Bay under the name of *Mancalias sessilis* and *Mancalias uranoscopus* by Imai ('41; '42).

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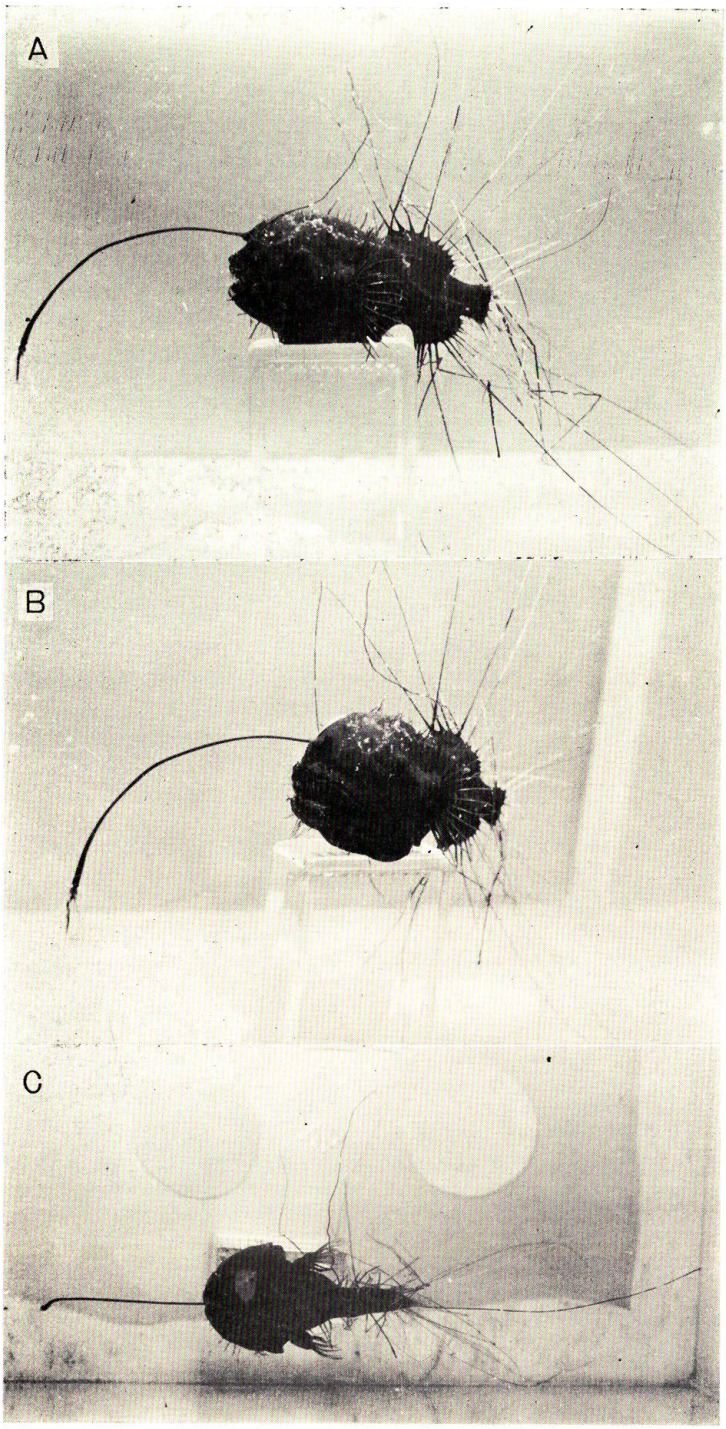
Explanation of Plates

PLATE I

Photographs of living of *Caulophryne jordani* GOODE & BEAN in a small aquarium

A : Lateral view
B : Antero-lateral view
C : Above view



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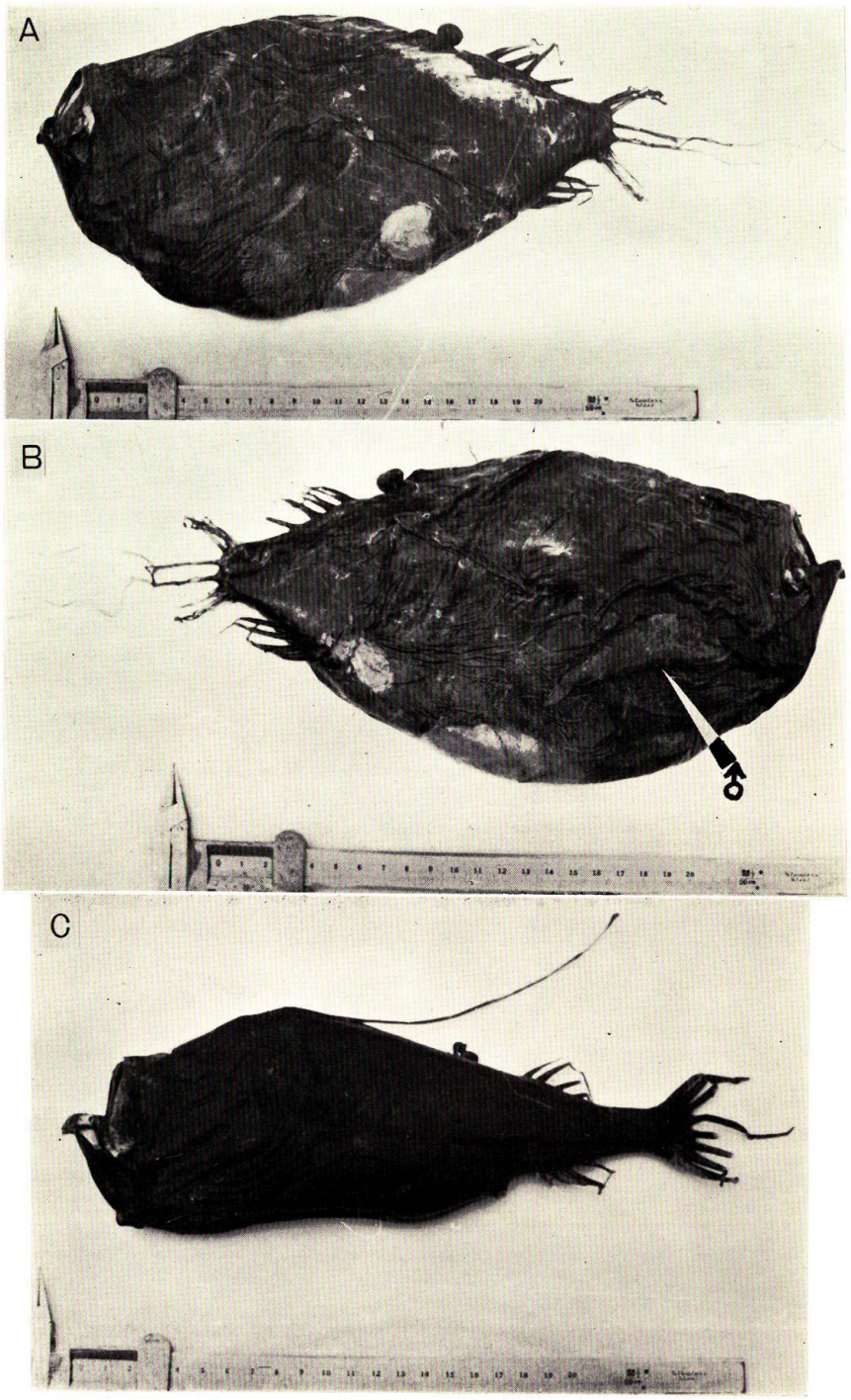

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PLATE II

Photographs of the lateral view of *Cryptopsaras couesi GILL* (401 mm long, F–1652) and *Ceratias holboelli KRÖYER* (292 mm long, F–1653), taken from off the Pacific coast of Hokkaido

A : Left side of a female specimen of *Cryptopsaras couesi*

B : A parasitic male attached to the right side of the above female specimen of *Cryptopsaras couesi*

C : A female specimen of *Ceratias holboelli*