

A New Species of Enoploteuthid Squid, *Abraliopsis (Watasenia) felis*, from the California Current

BY

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(Plates 9 and 10; 1 Map)

INTRODUCTION

IN AN EXAMINATION of the extensive collection of pelagic cephalopods at the Scripps Institution of Oceanography a number of specimens of apparently undescribed species was found. One group of these specimens was so numerous and the series so complete that we have decided to describe it separately from the rest of the collection. A further reason for describing this species now is that it was discovered in a study of the distribution and abundance of the larval squid of the California Current that this species ranked first in abundance (OKUTANI & MCGOWAN, in press). Including larvae, juveniles and adults, we have examined about 1850 individuals of this new species.

ACKNOWLEDGMENTS

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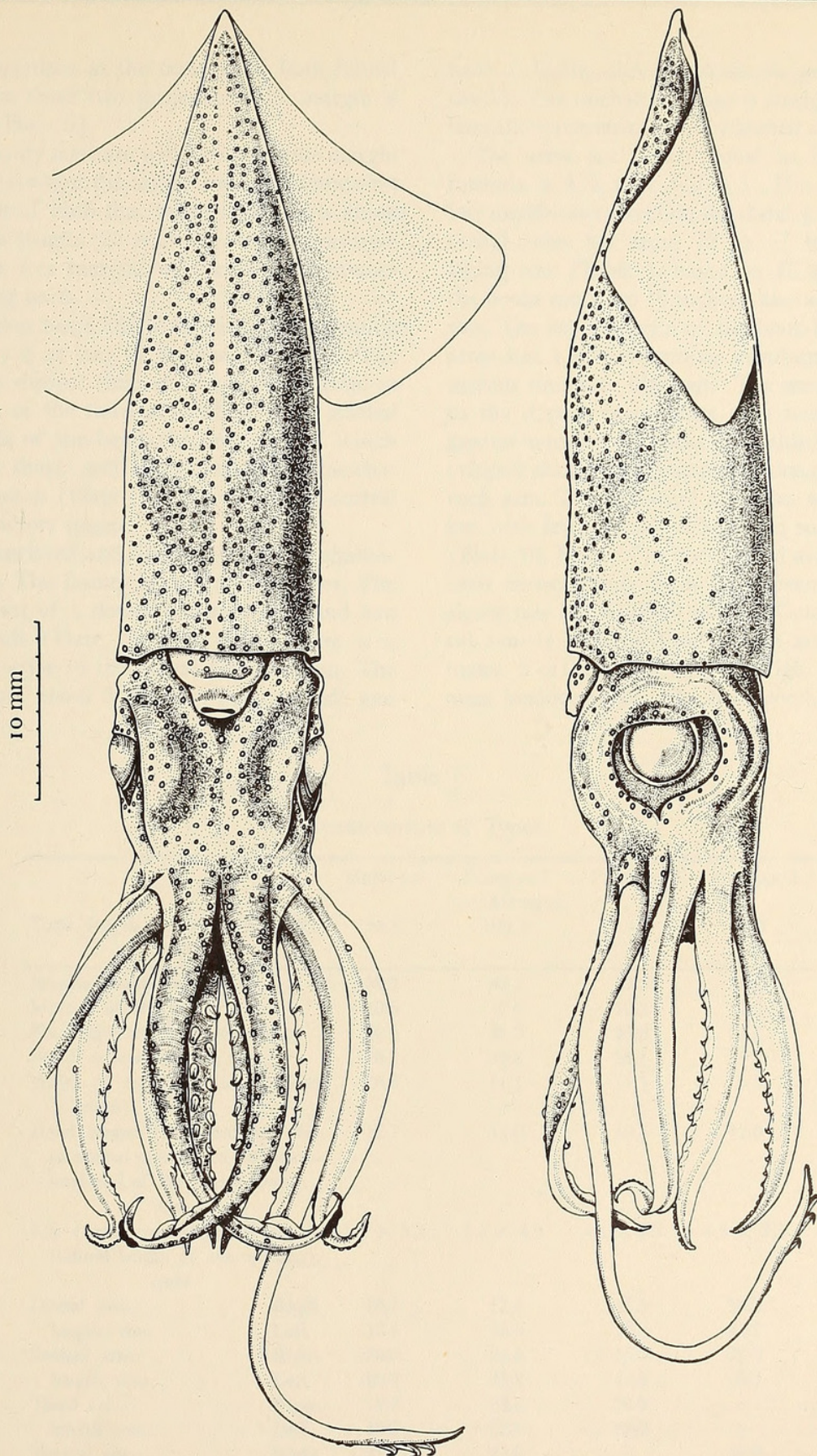
Abraliopsis (Watasenia) felis MCGOWAN & OKUTANI,
spec. nov.

(Plates 9 and 10)

Synonyms: None.

Diagnosis: An *Abraliopsis* with a double row of tentacular hooks, the ventral row of which consists of 3 or occasionally 4 large hooks and the dorsal row of 3 or occasionally 4 small hooks. The fixing apparatus on the carpus is compact and consists of 4 suckers and 7 knobs. The right ventral arm and occasionally both the right and left ventral arm of the male is hectocotylized. The hectocotylus consists of two semilunar membranes on the lateral edges of the arm just proximal to the 3 large photophores of the arm tip. These membranes are offset from one another, the inner one being more proximal than the outer. The ventral surface of the mantle with many small photophores arranged randomly but with a narrow median bare area running the entire length of the mantle. The body is elongate and fusiform with the width being less than $\frac{1}{3}$, but more than $\frac{1}{4}$ the length.

Description: The body is muscular and firm. The mantle shape is fusiform and somewhat elongated. Based on measurements of 94 adult specimens, the width is less than $\frac{1}{3}$ of the dorsal mantle length but more than $\frac{1}{4}$ of the dorsal mantle length. The broadest part of the mantle is at the free margin which flares out slightly. The dorsal margin of the mantle is triangularly lobed and projects slightly at the mid-point. On the ventral side there are



Abraliopsis (Watasenia) felis McGOWAN & OKUTANI, n. sp.

Holotype, Male

slight angular projections at the position of both funnel cartilages. Between these two projections the margin is slightly concave (Plate 9).

The fins are broadly sagittate with the posterior margin being slightly concave and the anterior margin somewhat convex. The width of both fins, taken together, is about 86% of the mantle length (22 adult specimens measured, see Table 1). The free margins of the fins are thinner than the remaining parts.

The head is rather large and is as wide as the mantle and approximately $\frac{1}{3}$ as long as the mantle length. The eye opening has a distinct sinus on the anterior edge at about the position of the third arm. There are 3 nuchal folds on either side of the head, the ventral 2 of which are semi-lunar in shape and the dorsal one somewhat squared and elongated (Plate 10, Figure 1). The central fold bears an "olfactory organ."

The neck is constricted and distinct and has a shallow funnel excavation. The funnel is conical and short. The funnel organs consist of a dorsal V-shaped pad and two ventral oblong pads (Plate 10, Figure 3). There is a transverse fold anterior to the dorsal funnel organ. The funnel cartilages are about 3 times as long as wide and

have a slightly curved but simple groove (Plate 10, Figure 1). The nuchal cartilage is straight, spatulate and bilaterally symmetrical. It is widened a little on both ends.

The arms are nearly equal in length with an arm formula 4, 3, 2, 1 or 4, 2, 3, 1. The dorsal arms have a low membranous keel on the distal $\frac{4}{5}$. The oral face of the dorsal arms has from 12 to 17 hooks arranged in a zigzag row (Table 1, based on 12 specimens). Distal to the hooks are 10 to 18 suckers, also alternating in a zigzag row. The outer margin of the hook-bearing face of these arms has a low swimming membrane supported by numerous muscular filaments. The second arms are similar to the dorsals except that they tend to have a slightly greater number of hooks. The third arms have well-developed aboral keels extending along the entire length of each arm. The armature is similar to that of the second but with fewer distal suckers and somewhat fewer hooks (Plate 10, Figure 7). The ventral arms have aboral keels their entire length. They have from 7 to 14 hooks in a zigzag row but no distal suckers. Generally the right ventral arm is hectocotylized but in an examination of 39 males, 2 of them had both the right and the left ventral arms hectocotylized. The hectocotylus is a pair of semi-

Table 1

Measurements of Types

		Holotype	Paratype 1 (= Allotype)	Paratype 2	Paratype 3
Total length (including tentacle)		84.8	105.5	—	80.0
	mm				
Mantle length, mm		36.7	41.7	33.5	39.2
Mantle width, mm		10.6	12.4	10.2	11.8
Fin length at attachment, mm		20.5	25.0	16.0	21.6
Width across the fins, mm		26.2	33.8	26.1	29.8
Width of the head (inter-ocular length), mm		10.6	11.1	11.5	9.5
Head length (from anterior end of nuchal cartilage to the proximal end of the dorsal arms), mm		12.7	11.0	10.1	12.0
Eye (transverse length \times longitudinal length of eye opening), mm		5.5 \times 5.5	5.9 \times 4.5	4.1 \times 3.3	4.3 \times 3.5
Dorsal arm:	Right	18.9	17.8	12.5	18.0
length, mm	Left	18.1	18.5	13.0	16.0
Second arm:	Right	20.9	21.8	15.8	21.0
length, mm	Left	20.2	21.8	14.2	20.2
Third arm:	Right	19.2	22.8	16.6	—
length, mm	Left	19.3	22.4	15.0	—
Ventral arm:	Right	21.5	27.0	—	24.0
length, mm	Left	21.8	27.0	—	21.0
Tentacle:	Right	37.0	42.7	—	34.1
length, mm	Left	32.2	41.0	—	—

lunar membranes offset from one another with the inner membrane being somewhat more distal than the outer (Plate 10, Figures 6, 6a, 6b). Between these crests is a deep groove.

The tentacle is as long as the mantle and has a gradually tapered stem which is flattened on the oral surface. The club (or manus) is not expanded and occupies $\frac{1}{6}$ to $\frac{1}{7}$ of the tentacle length. There is no membrane on the outer side of the club. The armature of the proximal portion of the club consists primarily of hooks arranged in two rows. In the ventral row there are 3 or occasionally 4 large hooks and muscular pads are sometimes present between these. The dorsal row consists of 3 and occasionally 4 small hooks which are usually about half the size of the large hooks (Plate 10, Figures 5a and 5b). There are very small suckers and sometimes pads between these hooks. The distal part of the club has 13 transverse rows of 4 suckers each. The horny rings of these suckers have 5 to 6 rather blunt teeth on the margin (Plate 10, Figure 5a). The carpus bears a fixing apparatus which consists of 4 suckers arranged in a quadrate and 6 to 7 small papillae or knobs (Plate 10, Figure 5).

The mantle has many photophores, particularly on its ventral surface. These range in size from 150μ to 250μ . There is an almost random arrangement of these, but a narrow longitudinal strip without photophores exists on the mid-ventrum. The funnel has about 60 photophores, particularly on the ventral side, but also on the dorsum. The ventral surface of the head also has photophores on its integument, but these are arranged in no consistent order except about 28 surrounding the periphery of the eyes (Plate 9). The eyeball has 2 large (600μ) and 3 small (400μ) photophores along the ventral periphery. The third arms have a row of 9 to 11 photophores on the ventral surface. The ventral arms bear 3 rows of photophores of which the dorsal-most consists of 5 small ones on the keel. The other 2 rows are along both edges of the aboral surface (Plate 9). Very near the distal tip of the ventral arms are 3 very large ellipsoid luminous organs about 0.8mm in length (Plate

10, Figure 6). Distal to these are 4 small photophores. These large luminous organs are a characteristic feature of the genus.

The buccal membrane has 8 supporting muscles and its inner surface is heavily papillated (Plate 10, Figure 2).

The radula is quite delicate and has 7 unicuspid rha-chidian teeth in a row and no accessory plates (Plate 10, Figure 4). The gladius is penniform with a maximum width about $\frac{1}{8}$ of the length. The rhachis has a sharp keel which appears as a dark streak on the dorsum of the mantle. The spermatophores are about 5.5mm in length and 0.16mm wide. The sperm cord is thick and occupies about $\frac{2}{3}$ of the length. The distal portion of this is opaque and without structure, posterior to this it coils $2\frac{1}{2}$ to 3 times and continues to a striated portion (Plate 10, Figure 8).

Types:

Holotype (male): Station 87.90 of CalCOFI Cruise 25 ($31^{\circ}59'N$, $122^{\circ}24'W$), May 1951.

Paratype No. 1 (female): ($32^{\circ}39.3'N$, $117^{\circ}37.2'W$), August, 1953.

Paratype No. 2 (male): ($32^{\circ}49'N$, $117^{\circ}43'W$), August 1953.

Paratype No. 3 (male): St. 93.90 of CalCOFI Cruise 5704 ($30^{\circ}49.5'N$, $121^{\circ}32'W$), April 1957.

Deposition of Types:

Holotype: U. S. National Museum, one male, USNM 678792

Paratype 1: U. S. National Museum, one female, USNM 678793

Paratype 2: California Acad. Sci. Dept. Invert. Zool., one male, CAL Acad. Invert. Type Coll. No. 310

Paratype 3: Scripps Institution of Oceanography, Marine Invertebrate Collections, one male.

DISCUSSION

There are at least 3 other species of the genus in the North Pacific. As is frequently the case with oceanic invertebrates, which are difficult to collect, many of the

Explanation of Plate 10

Abraliopsis (Watasenia) felis McGOWAN & OKUTANI, n. sp.

Figure 1: Latero-ventral view of the cephalic part (Paratype No. 3, male) showing funnel cartilage, olfactory lobe, nuchal folds and the funnel adductors. The photophores on the eyeball are shown by removing a part of the eye lid. The photophores on the integument are not drawn.

Figure 2: Buccal membrane (Paratype No. 3). Vento-anterior view.

Figure 3: Funnel organ (Paratype No. 3). The funnel is cut open.

Figure 4: Three transverse rows of the radula (Paratype No. 3).

Figure 5: Club and carpus of the tentacle (Holotype).

Figure 5a: A large sucker of the tentacle (Paratype No. 3).

Figure 5b: A large hook of the tentacle (Paratype No. 3).

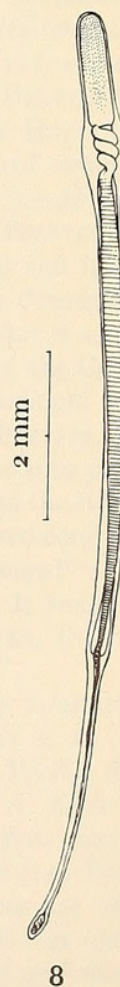
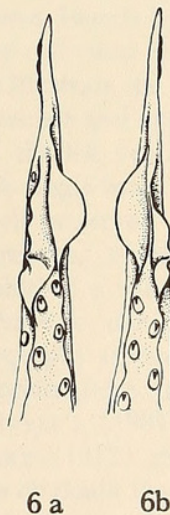
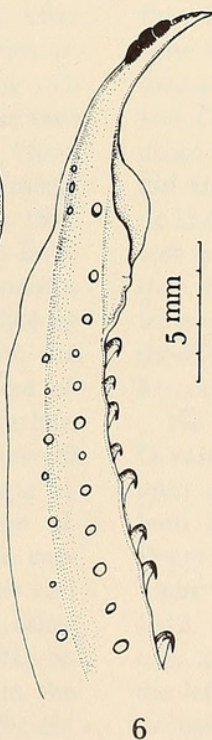
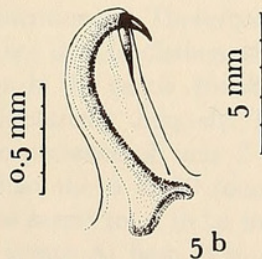
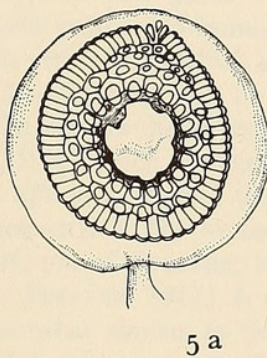
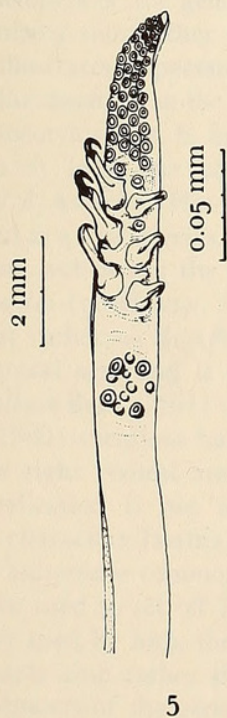
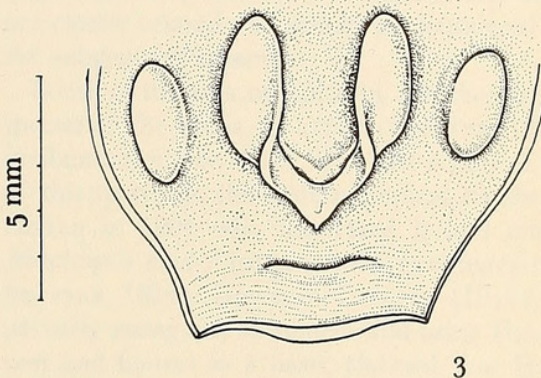
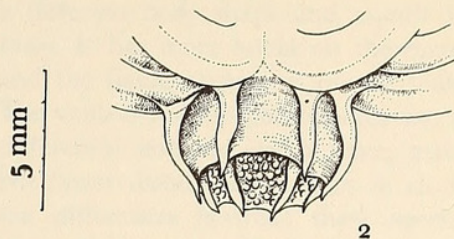
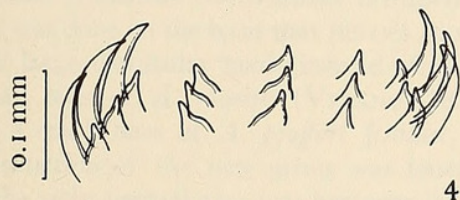
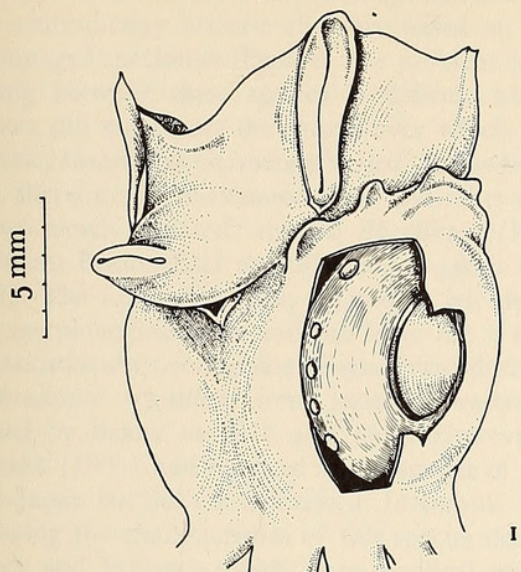
Figure 6: Right ventral arm of the male (Paratype No. 2).

Figure 6a: The distal tip of the right hectocotylized arm (Holotype).

Figure 6b: The distal tip of the left hectocotylized arm (Holotype).

Figure 7: Left third lateral arm (Holotype).

Figure 8: A spermatophore taken from the spermatophore sac (Paratype No. 3).



descriptions and reports of these species are confusing and contradictory because they are based on immature or damaged specimens. Further, the problem of discriminating between these species is difficult because the authors did not report the ranges over which important meristic, taxonomic characters varied. It has been necessary, therefore, to re-examine these and other characters of two closely "related" species, *Abraliopsis* (*Watasenia*) *scintillans* BERRY, 1911 and *Abraliopsis affinis* (PFEFFER, 1912). The former is closely related to our new species in a morphological sense and the latter has a contiguous and occasionally overlapping geographical distribution.

Abraliopsis scintillans from Japanese waters was described by BERRY in 1911 and 1912. However, earlier WATASE (1905) had reported a new species of the genus from Japan but did not describe it. ISHIKAWA (1913) in reviewing the characteristics of this species decided that Berry's and Watase's squids were identical and created the new genus *Watasenia* (= *Watasea* ISHIKAWA, 1913) for it. This was done on the basis that Berry's *A. scintillans* had only 2 large tentacular hooks instead of the 3 large and 3 small ones of *A. morisii* (VERANY, 1837) or 5 large and 5 small ones of *A. pfefferi* JOUBIN, 1896. A further distinction of the new genus was based on the fact that the right ventral arm was hectocotylized with 2 small semi-lunar membranes near the tip. This, according to ISHIKAWA, set it off from *A. morisii* and presumably other members of the genus because CHUN (1910) after synonymizing most other species of the genus with *A. morisii* illustrates a spectacularly enlarged swimming web (or "Schutzsaum") on the left ventral arm which he calls the hectocotylus (plt. 6, fig. 1 and plt. 10, fig. 1). However, in at least one of the species he synonymized (namely *A. hoylei* of HOYLE, 1904, which PFEFFER, 1912 described as a new species, *A. affinis*, see below) this large swimming web is not the hectocotylus. The hectocotylus of *A. hoylei* (of HOYLE, 1904, not of PFEFFER, 1884 or 1912 but rather = *A. affinis* PFEFFER, 1912) is on the right ventral arm and is somewhat similar to those of *A. scintillans* BERRY, 1911 and *A. felis*, spec. nov. Further, VOSS (1960) mentions having a specimen of *A. morisii* with the right ventral arm hectocotylized. The type of hectocotylization is not mentioned. Therefore one of the two characters ISHIKAWA uses to distinguish his new genus *Watasenia* is common in the genus *Abraliopsis* and cannot be used to set off *Watasenia* uniquely. The other character used by him, the presence of only 2 hooks on the tentacle club rather than the 6 to 10 found in the other members of the genus seems to us to be insufficient for the creation of a new genus. At best, *Watasenia* can be considered only a subgenus of *Abraliopsis* JOUBIN, 1896. We so consider it here.

The differences between *Abraliopsis scintillans* and *A. felis* are listed in Table 1. It is evident that *A. felis* has a different body shape and mantle length to fin width ratio. It has more hooks on the manus of the tentacles and the fixing apparatus of the tentacle carpus differs. The ventral mantle photophores are arranged somewhat differently and the arms have, generally, more hooks but fewer distal suckers than in *A. scintillans*. Most of the differences between these species are quantitative rather than qualitative; however, they are consistent and significant and may be used for a rather easy visual separation of specimens. It is obvious that the two species are closely related and should be considered members of the subgenus *Watasenia*.

South of the area occupied by *Abraliopsis felis* a second species of the genus, *A. affinis* (PFEFFER, 1912), is found in abundance (see Map). The first report of the presence of this species in the eastern tropical Pacific was that of HOYLE in 1904 who illustrated it and identified it as *Abraliopsis hoylei* JOUBIN, 1896 (= *Enoploteuthis hoylei* PFEFFER, 1884). However, PFEFFER (1912), without apparently seeing any specimens and using HOYLE's description and figures as a basis, claimed that HOYLE's specimens were not the *A. hoylei* that he had described in 1884, but rather a new species, *Abralia* (= *Abraliopsis*) *affinis*, which he proceeded to describe. PFEFFER further re-described his *A. hoylei* in more detail and it is clear that HOYLE's specimens do not fit this description. In spite of this, ROBSON (1948) reports that 8 specimens (one male) were collected in the vicinity of the Galapagos and Cocos Islands by the Arcturus Expedition. ROBSON chose to call these specimens *A. hoylei* PFEFFER. But he did not illustrate the specimens, gave no counts of meristic characters and apparently has confused the swimming web of the left ventral arm with the hectocotylus. Further, his single male specimen was "damaged" and "not very well preserved" (*op. cit.*, p. 118). It would seem, therefore, that *Abraliopsis affinis* (PFEFFER, 1912) must be considered a valid species.

We have in our collection at Scripps Institution of Oceanography several hundred specimens of an *Abraliopsis* species from the eastern tropical Pacific that fit both HOYLE's (1904) illustrations of "*A. hoylei*" and PFEFFER's (1912) description of *A. affinis* very well. There is no doubt that they are the *A. affinis* of PFEFFER, 1912, but because his original descriptions are incomplete, additional details need to be added. For example, the left ventral arm is as HOYLE shows it and resembles strongly the left ventral arm of *A. morisii* as figured by CHUN (1910); that is, with a greatly enlarged swimming web. CHUN called this swimming web "the hectocotylus." While this is a good secondary sexual characteristic, being



1968. "A new species of enoploteuthid squid, *Abraliopsis* (Watasenia) *felis*, from the California Current." *The veliger* 11, 72–79.

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