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SIPHONOPHORES AND THEIR COMMENSALS IN THE INDIAN OCEAN*

RUBY DANIEL
Zoological Survey of India, Calcutta

ABSTRACT

During the course of a detailed study of the siphonophores of the Indian Ocean, the juveniles and later stages of two species of Phronimid and one species of Hyperid Amphipoda were found within the mesoglea of the nectophores, bracts and nectosac of fourteen species of siphonophores at 37 stations. In this paper the species associated, their exact location within the siphonophores, size attained within the mesoglea and in the nectosac and their latitudinal records are presented.

The association of *Nomeus* with the siphonophore *Physalia* is also recorded. The association between the siphonophores and other animals described earlier from the Indian and other Oceans by Totton (1960) and Chang - Tai Shih (1969) are also briefly discussed.

INTRODUCTION

DURING the course of a detailed study of the siphonophores of the Indian Ocean, 56 examples of fourteen species of Siphonophora from 44 stations were found to harbour 70 juveniles and adults of Amphipoda (species of the genera *Phronima, Hyperia* and *Euprimno*). Since nothing is known about the relationship between the Siphonophora and Phronimidae (Chang-Tai Shih, 1969) it was considered worthwhile to study in detail the species associated, exact location, size attained and their latitudinal-longitudinal records. These observations, together with records of association of *Nomeus* with *Physalia* in the Indian Ocean are presented here.

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MATERIAL

Station No.	Position Lat.	Position Long. E.	Date	Siphonophore (host)	Locality in host	No. of ex.	Name of Amphipod
1	2	3	4	5	6	7	8
AB 54	18° 24′N	90° 45′	7–4–63	*A. okeni*	1 bract	1	*Phronima* sp.
AB336	02° 01′N	65° 03′	26–5–64	*A. okeni*	1 bract	2	,,
Ar 52	00° 05′N	62° 19′	18–3–62	*L. hotspur*	1 ant.necto	1	,,
Ar 71	00° 30′S	79° 02′	2–9–62	*C. leuckarti*	1 bract	1	,,
CO 49	10° 00′N	75° 39′	17–10–63	*A. eschscholtzi*	1 gono.	1	,,
Dm2/86/62	07° 41′S	105° 01′	17–8–62	*B. bassensis*	1 eudoxid	1	,,
					1 post.necto	1	,,
Dm/2/94/62	17° 45′S	105° 06′	20–8–62	*D. bojani*	1 ant.necto	1	,,
Dm1/10/63	26° 00′S	110° 00′	1–4–63	*D. dispar*	1 bract	1	,,

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Station No.	Position Lat.	Position Long E.	Date	Siphonophore (host)	Locality in host	No. of ex.	Name of Amphipod
1	2	3	4	5	6	7	8
Dm2/67/63	15° 30′S	110° 00′	13–5–63	*E. mitra*	1 bract	1	,,
Dm2/69/63	12° 30′S	110° 00′	14–5–63	*D. dispar*	1 bract	2	,,
Dm2/71/63	09° 27′S	109° 51′	15–5–63	*D. bojani*	1 ant.necto	1	,,
Dm2/73/63	09° 00′S	105° 00′	25–5–63	*A. tetragona*	1 bract	1	,,
					1 post.necto	1	*E.macropus*
Dm5/152/63	18° 36′S	107° 36′	8–9–63	*L. fowleri*	1 ant.necto	1	*P. pacifica*
Dm5/156/63	11° 23′S	104° 50′	10–9–63	*A. eschscholtzi*	1 bract	1	*Phronima* sp.
Dm1/26/64	21° 52′S	113° 50′	1–2–64	*E. mitra*	1 bract	2	,,
Dm3/129/64	09° 33′S	110° 00′	13–5–64	*D. dispar*	1 bract	1	,,
Dm1/53/65	01° 33′S	76° 03′	9–5–65	*D. dispar*	1 bract	1	,,
Di 5267	06° 44′N	57° 59′	15–3–64	*S. chuni*	1 post.necto	1	,,
Di 5275	01° 02′N	57° 59′	19–3–64	*D. bojani*	1 cudoxid	1	,,
Di 5292	04° 56′S	58° 04′	24–3–64	*H. rubrum*	2 necto.	2	,,
Di 5383	09° 85′N	67° 23′	21–5–64	*A. okeni*	1 necto	2	,,
Di 5400	14° 01′N	56° 30′	28–5–64	*A. okeni*	3 bract; 2 necto.	5	,,
Di 5400	14° 01′N	56° 30′	28–5–64	*A. elegans*	2 necto	2	,,
Di 5408	04° 20′N	57° 58′	31–5–64	*A. elegans*	1 necto.	1	,,
Di 5408	04° 20′N	57° 58′	31–5–64	*A. okeni*	1 bract	1	*H. galba*
Di 5412	02° 02′N	56° 63′	2–6–64	*E. mitra*	1 gono	1	*Phronima*
Di 5437	00° 56′N	59° 56′	15–6–64	*D. disper*	1 ant. necto (nectosac)	2	*H. galba*
Di 5450	00° 03′N	67° 25′	19–6–64	*A. eschscholtzi*	1 bract	2	*Phronima* sp.
Di 5474	12° 36′S	67° 18′	26–6–64	*E. mitra*	1 bract	3	,,
Di 5497	06° 40′S	57° 56′	16–7–64	*E. mitra*	1 bract	2	,,
Di 5519	04° 24′S	40° 35′	26–7–64	*E. mitra*	1 bract	3	,,
Di 5541	03° 46′S	52° 22′	17–8–64	*E. mitra*	1 bract	2	,,
Ga4/195/62	12° 34′S	109° 57′	26–8–62	*D. dispar*	1 bract	1	,,
Ga1/4/63	29° 00′S	110° 00′	20–1–63	*B. bassensis*	1 bract	1	,,
Gi 144	—	—	11–1–63	*A.eschscholtzi*	1 gono	1	,,
Ka 14	00° 57′S	78° 03′	11–12–63	*A.okeni*	1 bract	2	,,
Ka 19	05° 04′N	77° 46′	16–12–63	*A.eschscholtzi*	1 bract	1	,,
Ko 20	21° 35′S	100° 1′	25–1–64	*A. okeni*	1 bract	1	*P. collett*
UmI –2	06° 04′N	77° 44′	18–12–62	*A.okeni*	1 bract	1	*Pharonima* sp.
UmI –12	07° 15′S	78° 13′	30–12–62	*A.eschscholtzi*	1 ant. necto	1	,,
Va 2012	09° 00′N	72° 00′	6–11–63	*A. okeni*	1 bract	2	,,
Vi 4642	13° 32′S	67° 50′	18–2–60	*E. mitra*	1 bract	1	,,
Vi 5212	05° 11′S	91° 17′	2–9–62	*A.eschscholtzi*	1 bract	1	,,
Vi 5249	05° 05′N	77° 07′	1–10–62	*E. mitra*	1 bract	1	,,
Vi 5269	12° 02′S	76° 59′	15–10–62	*E. mitra*	1 bract	1	,,
				A. haeckeli	1 bract	2	,,
Vi 5321	13° 27′S	54° 53′	14–12–64	*D. bojani*	1 ant. necto	1	,,
				A. tetragona	1 ant. necto	1	,,

Ships: 'AB–Anton Bruun'; Ar – 'Argo-Lusiad'; Co – 'Cochin'; Dm–'Diamantina'; Di–'Discovery'; Ga – 'Gascoyne'; Gi – 'Gilchrist'; Ka – 'Kago Shima'; Ko – 'Koyo Maru'; Um - 'Umitaka Maru'; Va – 'Varuna'; Vi – 'Vityaz'.

ant.necto – anterior nectophore; necto – nectophore; post. necto – posterior nectophore; gono- gonophore

OBSERVATIONS AND REMARKS

This study has revealed that 0.053% of siphonophores collected in the Indian Ocean were utilised by the hyperian amphipods for depositing their eggs and larvae for development. Among the siphonophores the Cystonectaedid not harbour the larval stages of these amphipods, since without nectophores and bracts these lack the necessary mesoglea. The Physonectae and Calycophorae on the other hand, with well developed mesoglea in the nectophores, bracts and gonophores were preferred by these amphipods. Among the Physonectae, *Agalma okeni* Eschscholtz, which occurred in abundance in the Indian Ocean was preferred. The amphipods

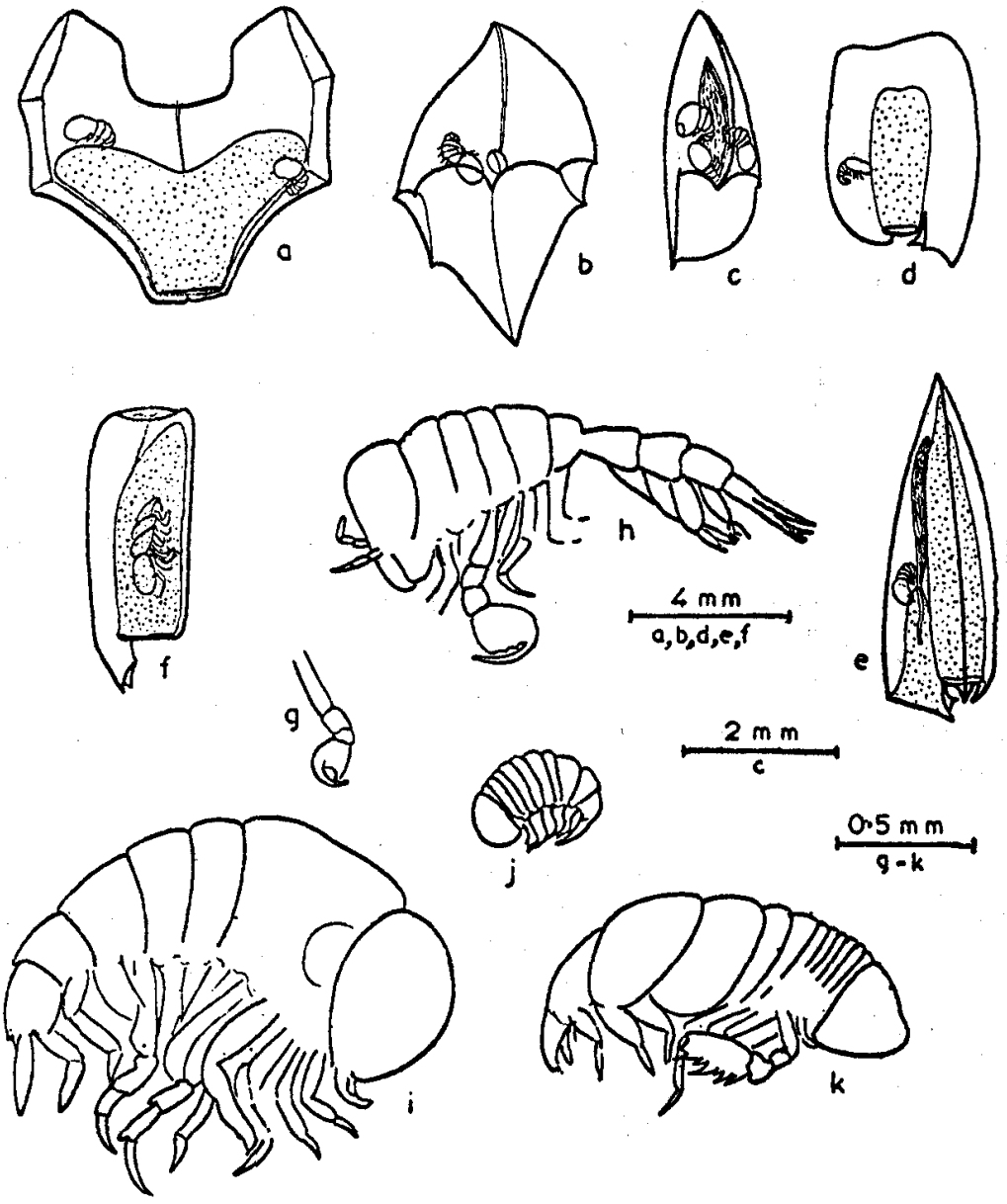

Fig. 1. a. *Agalma okeni*, nectophore with 2 amphipod juveniles; b. *A. okeni*, bract with amphipod juvenile and egg; c. *Eudoxoides mitra*, bract with amphipod juveniles (Stn. Di-5519); d. *Bassia bassensis*, posterior nectophore with a juvenile; e. *Diphyes bojani*, anterior nectophore with a juvenile; f. *Sulculeolaria chuni*, posterior nectophore with *Euprimno* sp.; g. ?*Phronima pacifica*; h. *Phronima colletti*; i. *Hyperia galba*; j. *Hyperia* sp. within *A. okeni* bract (Stn. Di 5408); and k. *Euprimno macropus* found within *S. chuni*.

occurred at 9 stations within 3 nectophores and 11 bracts of this species (Figs. 1a, b). *Agalma elegans* (Sars) and *Halistemma rubrum* (Vogt) also harboured these amphipod

larvae within their nectophores at three stations. Many species of Calycophorae with well developed mesoglea harboured these larvae. Usually, bracts (rarely gonophores) of the eudoxid phases were preferred, *i.e. Eudoxoides mitra* Huxley (10 stns), *Abylopsis eschscholtzi* (Huxley) (6 stns.), *Diphyes dispar* Chamisso & Eysenhardt (5 stns.), *Bassia bassensis* (Quoy and Gaimard) (2 Stns.), *Diphyes bojani* (Eschscholtz) (1 stn.), *Abylopsis tetragona* (Otto) (1 Stn.), *Ceratocymba leuckarti* (Huxley) (1 stn.), and *Abyla haeckeli* Lens & Van Riemsdijk (1 stn.). They also occurred in the anterior and posterior nectophores of some of these spices and in *Lensia fowleri* (Bigelow), *Lensia hotspur* Totton and *Sulculeolaria chuni* (Lens and Van Riemsdijk) near the somatocyst, nectosac and within the cavity of the nectosac (Fig. 1c–f).

The amphipods occurring at forty-one stations are juvenile stages I and II of *Phronima* sp. Usually one to three juveniles of the same stage occurred within a single nectophore or bract. These larvae measure 0.5 mm to 3.0 mm in length. The fifth peraeopod in all these larval forms are not differentiated from the other appendages. However, at Station Dm5/152/63, one example could be assigned to *P. pacifica* Streets, due to the strongly produced posterior border of the merus and trapezoidal shape of the carpus (Fig. 1g). At station Ko 20, a single specimen could be identified as *P. colletti* Bovallius due to the characteristic shape of the carpus in the 5th peraeopod (Fig. 1h).

Chang-Tai Shih (1969) who studied the systematics, biology and distribution of the family Phronomidae in great detail recognised 8 species of *Phronima*: *P. sedentaria* (Forsskål), *P. atlantica* Guerin, *P. solitaria* Guerin, *P. curvipes* Vosseler, *P. pacifica* Streets, *P. colletti* Bovallius, *P. stebbingi* Vosseler, and *P. affinis* Vosseler. Of these, the first four are large species preferring the barrels of the pelagic tunicates for breeding purposes. *P. colletti, P. pacifica* and *P. stebbingi* are small species whose females according to Chang-Tai Shih (1969), have never been found in the barrels of tunicates either in the material studied by him or reported as

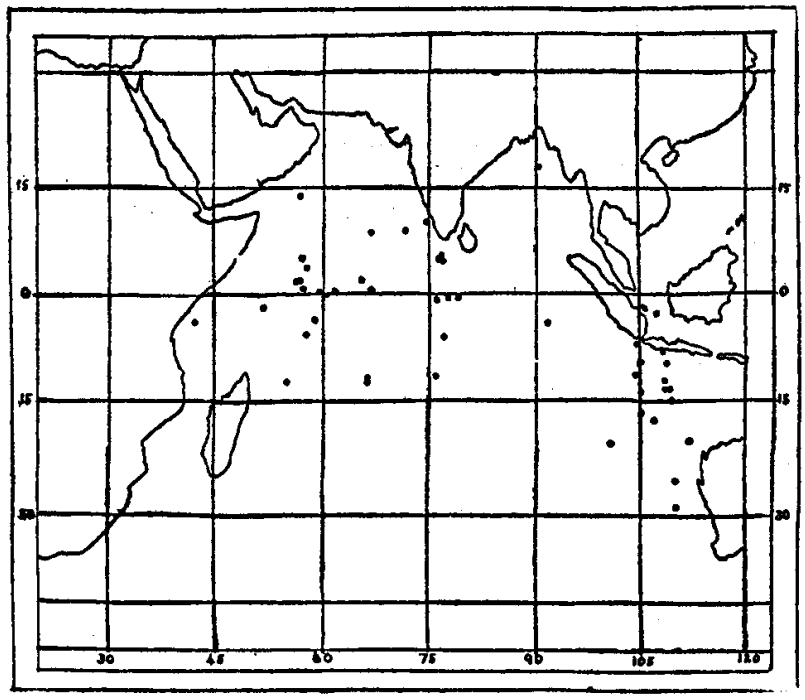

Fig. 2. Records of the juvenile stages of Amphipoda found within the Siphonophora collected during the International Indian Ocean Expedition.

such in earlier literature. *P. affinis* is a rare species and *P. stebbingi* has been recorded only once in the Indian Ocean. It is, therefore, possible that the larval

forms encountered in this study are those of *P colletti* or *P. pacifica.* This is further supported by the fact that only small species can enter through the mouth of the nectosac and deposit their juveniles in the mesoglea of the nectophore. However, in the bracts of *A. okeni* no entry holes could be detected. The mode of entry into the bract or nectophore should be by piercing the wall of the bract or nectophore. Subsequently the puncture is repaired by the siphonophore. The juveniles desert the siphonophores when their 5th peraeopods have become differentiated by piercing the wall of the nectosac or bract.

Of the 4 species of *Hyperia* known so far, one species *H. galba* (Montagu) has been recorded from medusae (Chevreux and Fage, 1925). A young specimen which occurred within the nectosac of the anterior nectophore of *Diphyes dispar* (stn. Di 5437) is identified provisionally as belonging to *Hyperia galba* (Fig. 1 i). An immature stage of this species occurred within the bract of *A. okeni* (stn. Di 5408) (Fig. 1 j).

The fourth species of Amphipoda, *Euprimno macropus* Guerin (?) occurred within the nectosac of the posterior nectophore of *A. tetragona* at stn. Dm2/73/63 (Fig.1 k).

The presence of juveniles of *Phronima* right through the year means that the areas in which they occur in the Indian Ocean are continuously supplied with new broods, implying that breeding occurs throughout the year.

The distribution of these larvae in the Indian Ocean is presented in Fig. 2. This indicates that in two areas, one on the equatorial region of the western sector (between Lat. 10°S to 15°N and Long. 50°E to 80°E) and the other on the south eastern sector (between Lat. 30°S to 20°N and Long. 90°E to 110°E) there is a concentration of these forms. These areas may be the breeding grounds of these two species of *Phronima.*

At R.V. "Vityaz" stations 5198 (Lat. 28°01′S) 5214 (Lat. 2°59′S) and 5220 (Lat. 00°08′N) along 91°30′E Long., the association of the siphonophore *Physalia physalis* (Linné) with the fish, *Nomeus albula* (Meuschen) have been recorded. Its association with *Nomeus gronovii* (Gmelin) and *Shedophilus maculatus* (Gunther) is well known. The effect to toxin from the stinging cells of the tentacles have been discussed by Totton (1960).

REFERENCES

CHANG-TAI SHIH 1969.. The systematics and biology of the family Phronimidae (Crustaceal Amphipoda). *Dana Report.*, No. 74 : 1-100.

CHEVREUX, E. AND L. FAGE 1925. Amphipodes. In: *Faune de France*, 9: 1-488.

DANIEL, R. 1971. Siphonophora from the Indian Ocean in the collections of the Zoological Survey of India, Calcutta. *Mem. Zool. Sur. India,* (In Press).

TOTTON, A.K. 1960. Studies of *Physalia physalis* (L.) Part I. Natural History and Morphology. *Disc. Rep.*, 30 : 301-368.