DISTRIBUTION OF SIPHONOPHORES IN THE REGIONS ADJACENT TO THE SUEZ AND PANAMA CANALS

ANGELES ALVARIÑO[1]

ABSTRACT

These studies are based on the material collected by Israeli cruises in the eastern Mediterranean and the Red Sea (Gulf of Elat), and by Scripps Institution of Oceanography Expeditions in the Caribbean and the Pacific regions adjacent to the Panama Canal. Published information on the distribution of siphonophores in those areas and in adjacent regions is included. Distributional tables and maps are also included.

The eastern Mediterranean collections encompass 21 species of siphonophores. Most of these species have been previously recorded in the western Mediterranean. *Eudoxia russelli* (eudoxid of *Chelophyes appendiculata*), *Sulculeolaria angusta*, and *S. chuni* have not been previously observed in any Mediterranean region. New records for the eastern Mediterrranean are: *Ch. contorta, Diphyes bojani, D. dispar, Lensia campanella, L. meteori, L. subtilis, S. quadrivalvis, S. turgida, Rosacea plicata, Physophora hydrostatica*, and *Apolemia uvaria*. Few species previously observed in the Mediterranean were not present in the collections here analyzed.

Fifteen species of siphonophores appeared in the material from the Gulf of Elat. New records for the Red Sea are *Ch. appendiculata, E. russelli, Diphyopsis mitra*. The other species present (*Ch. contorta, Diphyes dispar, L. subtilis, S. chuni, S. quadrivalvis, Abylopsis eschscholtzi, A. tetragona, Enneagonum hyalinum, Cordagalma cordiformis, Agalma elegans*, and *A. okeni*) have been previously observed in the Red Sea.

New records at both sides of the Suez Canal which could be considered indicative of migration along this waterway are: *Ch. appendiculata* (Mediterranean to the Red Sea), and *S. chuni* (Red Sea to the Mediterranean). However, the species are cosmopolitan in distribution, and the source of the populations in the regions adjacent to the Suez Canal may be in the adjacent oceanic regions.

Thirty species of siphonophores were observed in the Caribbean and Pacific regions adjacent to the Panama Canal. Most of the species are new records for those regions. Twenty one more species, not present in the collections here analyzed, had been previously recorded at either or in both the Caribbean, Gulf of Mexico and/or in regions of the Pacific adjacent to the area surveyed.

Particular attention is devoted to the distribution of closely related pairs of allopatric species, *Muggiaea atlantica–M. kochi*, and *Ch. appendiculata–Ch. contorta*. *Muggiaea kochi* (neritic species) and *Ch. appendiculata* inhabit the Caribbean, Gulf of Mexico and adjacent regions of the western tropical Atlantic. *Muggiaea atlantica* (neritic species) and *Ch. contorta* inhabit the Pacific regions off Mexico and Central America. However, few specimens of *Ch. contorta* and *M. atlantica* were also observed in the Caribbean at locations near the opening of the Panama Canal, and specimens of *Ch. appendiculata* and *M. kochi* occurred at locations in the Pacific close to the Panama Canal. This distributional incidence may suggest that migration or artificial transport is taking place via the Panama Canal. It is also indicated that few specimens of *L. challengeri* (Indo-Pacific species) were observed near the opening of the Panama Canal in the Caribbean.

New data have been published on the siphonophores of the regions adjacent to the Suez Canal (eastern Mediterranean and the Red Sea), as well as for the regions adjacent to the Panama Canal (western Caribbean and the Central American Pacific). Bigelow and Sears (1937) included data on the distribution of the siphonophores in the eastern Mediterranean, and Lakkis (1971) on the Lebanese region. Schneider (1898), Totton (1954), and Halim (1969) presented information on the siphonophores of the Red Sea. Bigelow (1911) analyzed the siphonophores of the eastern tropical Pacific, which included few locations in the regions here surveyed; Alvariño (1968, 1972) studied the siphonophores of the tropico-equatorial oceanic regions, and Alvariño (1971) covered the Central American Pacific including also a compilation of distributional data for the world oceans.

[1]Southwest Fisheries Center, National Marine Fisheries Service, NOAA, P. O. Box 271, La Jolla, CA 92037.

Manuscript accepted September 1973.
FISHERY BULLETIN: VOL. 72, NO. 2, 1974.

The present work constitutes a more detailed survey on the siphonophores of the regions adjacent to the above mentioned interoceanic canals. These studies are based on the Siphonophorae material (65 plankton samples) collected by Israel in the eastern Mediterranean during 1967, 1968, 1969, and 18 plankton samples (Red Sea, 1969, 1970) corresponding to two locations in the Gulf of Elat; and the 64 plankton samples from Scripps Institution of Oceanography Expeditions (La Creuse 1962, Bonacca 1963, *Thomas Washington* 1969) in the Caribbean and Pacific regions adjacent to the Panama Canal. The Scripps Institution collections covered larger regions than the area in which the present studies are concentrated, and the total collections of the mentioned expeditions have been analyzed and the results included in Alvariño (1968, 1971, 1972).

The present studies chiefly concern with the distribution and some ecological aspects of the siphonophores. The subject is treated under two parts: 1) distribution of siphonophores in the eastern Mediterranean and the Red Sea, and 2) the siphonophores of the western part of the Caribbean and the Central American Pacific.

The pattern of distribution of the species is presented. Tables with the distribution of the species include also references on previous records for the regions.

Maximum density for most of the species off Israel and around Cyprus can be attributed to the high productivity of the region (Lakkis, 1971).

The present study also indicates the Red Sea includes fewer species than the Indian Ocean. This factor may be related to the high salinity and temperature of the Red Sea, as well as to the shallowness of the sill at Bab el Mandeb.

The incidence of both polygastric and eudoxid forms in most of the samples shows breeding is taking place in those regions, and that reproduction may be an uninterrupted process along the year.

A large number of species of siphonophores are truly cosmopolitan, inhabiting the Arctic, Antarctic, Indian, Pacific, and Atlantic Oceans, whereas other species inhabit only the Atlantic, Pacific, and Indian Oceans (Alvariño, 1971), and some others are restricted to the Indian Ocean, adjacent waters and the southeastern Asiatic regions, while few are restricted to either the Atlantic or the Indo-Pacific regions.

Owing to the above mentioned biogeographic considerations, particular emphasis in the distribution of the species should be dedicated to the pairs of closely related species allopatric in distribution. The pairs to be considered correspond to the Panamanian region: *Chelophyes appendiculata–Ch. contorta* (respectively related to cold-temperate, and warm waters), *Muggiaea atlantica–M. kochi* (inhabiting respectively the neritic temperate and neritic warm waters), and *Lensia challengeri–L. fowleri* (respectively Indo-Pacific and Atlantic species).

The evidence of a two way migration "via" the Panama Canal, as shown by the distribution presented by several species at the regions adjacent to the entrance to the Panama Canal, could be active, by progression of the population along the waterway, or passively transported in the ballast waters or the waters used in the cooling system of ships. Therefore, migrations could be also greatly intensified or enhanced by passive transport along the canal.

METHODS

The plankton samples here analyzed were not collected in uniform manner. The plankton collections from the eastern Mediterranean and the Gulf of Elat were obtained with a standard plankton net of the Villefranche type, as designed and described by Working Party No. 2 (1968). The net has a mouth internal diameter of 57 cm, a total length of 261 cm, and 200-μ mesh. Vertical, oblique, and horizontal tows were taken. The vertical and oblique hauls in the eastern Mediterranean and the Gulf of Elat reached from 200 m to the surface, and the horizontal tows were obtained at various depths in the upper 200 m at a speed of 2-3 knots during 10 min.

The material from the Scripps Institution collections corresponds to 1–m net oblique hauls taken from about 140 m to the surface, and at less than 100 m or less than 50 m in shallow waters; and the ½–m net oblique tows were obtained from about 150 m to the surface and the horizontal hauls at various depths between 50 and 0 m.

Each total plankton sample was analyzed for siphonophores, and the number of specimens determined for both polygastric and eudoxid forms. However, owing to the diversity of the collecting methods used, and the time span

covered by the collections, quantitative data are not considered, and only qualitative data are included in the presentation of the results.

DISTRIBUTION OF SIPHONOPHORES IN THE EASTERN MEDITERRANEAN AND THE RED SEA

Twenty-one species of siphonophores were observed in the eastern Mediterranean collections, and fifteen species in the Gulf of Elat (Red Sea) collections.

Eudoxia russelli (eudoxid of *Ch. appendiculata*), *Sulculeolaria angusta*, and *S. chuni* are new records for the Mediterranean.

Chelophyes contorta, Diphyes bojani, D. dispar, Lensia campanella, L. meteori, L. subtilis, Sulculeolaria quadrivalvis, S. turgida, Rosacea plicata, and *Apolemia uvaria* are first records for the eastern Mediterranean. These species have been previously observed in the western Mediterranean. The only previous records of *Ch. contorta* for the Mediterranean correspond to the Alborán Sea (Alvariño, 1957). Therefore, the presence of the species in the Levant Mediterranean basin could be considered a tracer of Atlantic waters. All the Mediterranean species are also found in the Atlantic. Some of the species have permanently established populations in the Mediterranean, while others may be only remains of the Atlantic flow.

Most of the species previously found in the eastern Mediterranean (Bigelow and Sears, 1937; Lakkis, 1971) were also observed in the collections here analyzed.

Some species previously found in the western Mediterranean (*M. atlantica, L. fowleri, Clausophyes ovata, Ceratocymba sagittata, Vogtia pentacantha, V. spinosa, Praya cymbiformis, Amphicaryon acaule, Anthophysa rosea, Rhizophysa filiformis, Cordagalma cordiformis, Athoribya rosacea,* and *Nanomia cara*) have not been observed in the eastern Mediterranean (Alvariño, 1971; Lakkis, 1971) (Table 1).

The most abundant species in both distributional coverage of the surveyed region and in number of species, *Ch. appendiculata, D. dispar, Hippopodius hippopus, Bassia bassensis* were found along the years, and in December appeared scattered or absent (Figures 1, 2, 6, 8). *Eudoxoides spiralis, S. turgida, S. quadrivalvis*, and *S. angusta* followed in decreasing order of abundance in both space covered and number of individuals (Figures 3, 5). These species appeared abundantly off Israel, Lebanon, Syria and around Cyprus. *Sulculeolaria angusta* and *S. turgida* were also found in the Cretan region.

Species with few scattered records are, *E. russelli* (north of Cyprus), *Ch. contorta* (off Israel and between Syria and Cyprus), *D. bojani, M. kochi, L. campanella, L. multicristata, L. subtilis, S. chuni, A. tetragona, R. plicata, A. uvaria, Agalma elegans*, and *Physophora hydrostatica* (spread along the Levant basin). (Figures 1-8.)

It is worthy of notice that the maximum density for most of the species of siphonophores appeared at the easternmost part of the Mediterranean Sea, off Israel and around Cyprus, which can be attributed to the high productivity of the region (Lakkis, 1971).

The species scattered along the eastern Mediterranean, not previously observed in this sea, could be considered tracers of Atlantic waters (Oren, 1971).

The presence of *L. multicristata* (a mesoplanktonic species) off Tira, Israel, could be an indicator of upwelling.

It is well established that the fauna of the eastern Mediterranean is an impoverished fauna from that of the western basin. Many species do not reach the Levant Mediterranean basin, and only appear accidentally there, and few become established in the area. Por (1971) considered that "The colder areas of the Aegean Sea probably constitute an environment in which the Atlantic fauna is much better represented and better fitted to withstand the competition of the tropic immigrants."

Siphonophorae fauna of the Red Sea is poorer than that of the Indian Ocean, both in number of species and in the density of the respective populations. The Gulf of Elat may also include fewer species than the main Red Sea basin. The Gulf of Elat collections correspond to the winter months. Some of the species observed in the Gulf of Elat constitute new records for the Red Sea (*Ch. appendiculata, E. russelli,* and *Diphyopsis mitra*). Por (1971) stated that siphonophores and other holoplanktonic groups have not been found in the Suez Canal waters.

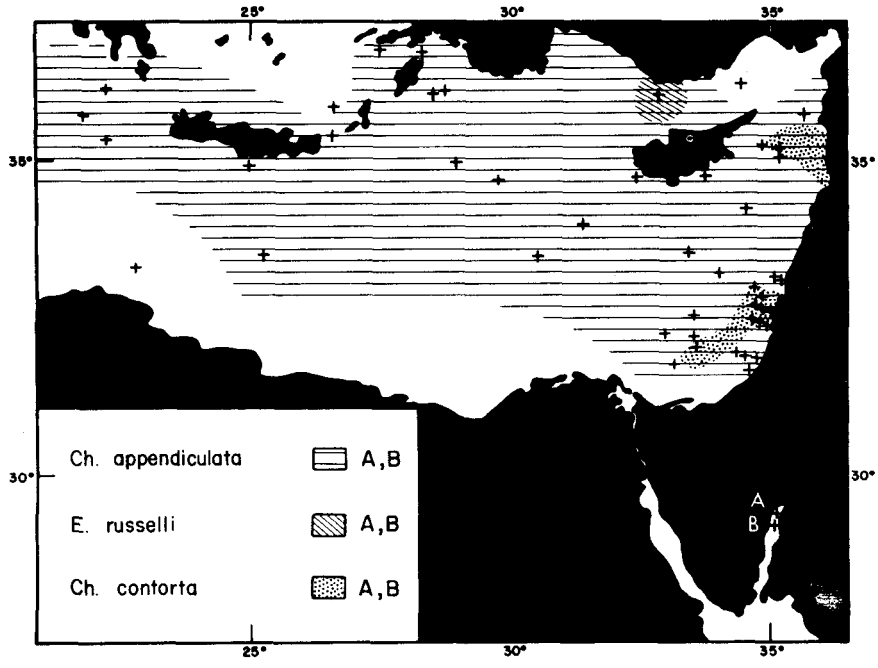

FIGURE 1.—Distribution of *Chelophyes appendiculata*, *Eudoxia russelli*, and *Chelophyes contorta* in the regions adjacent to the Suez Canal.

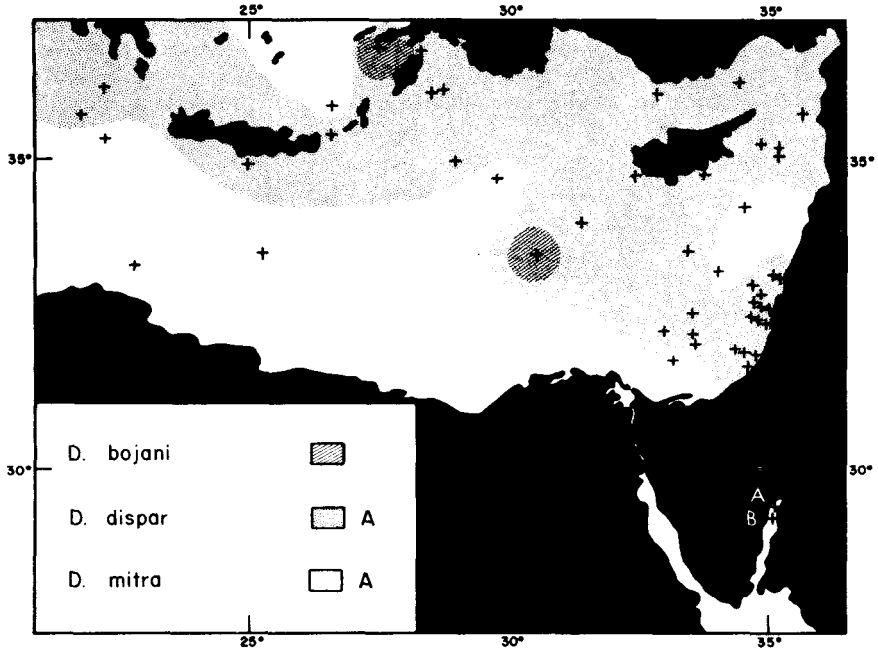

FIGURE 2.—Distribution of *Diphyes bojani*, *Diphyes dispar*, and *Diphyopsis mitra* in the regions adjacent to the Suez Canal.

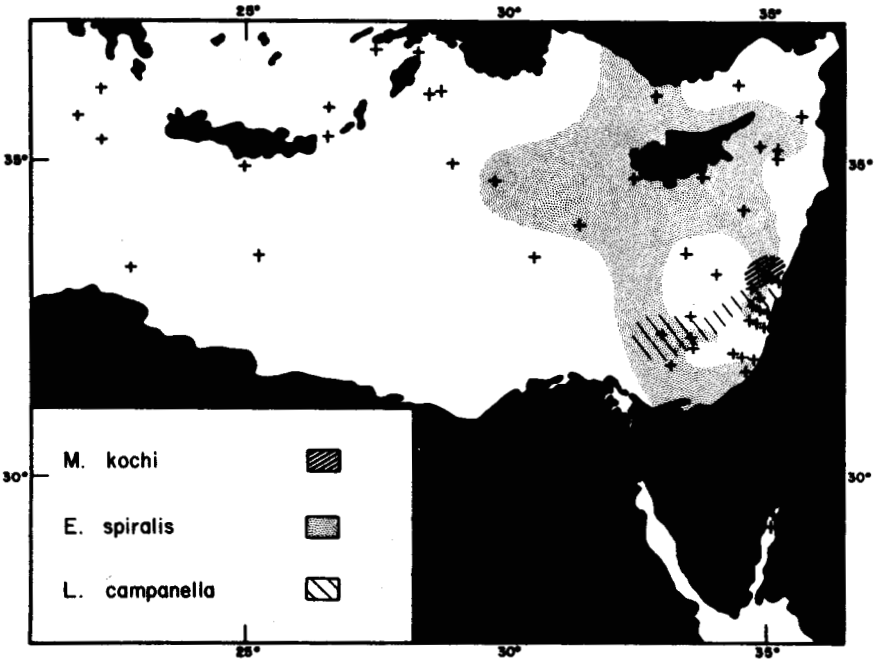

FIGURE 3.—Distribution of *Muggiaea kochi*, *Eudoxoides spiralis*, and *Lensia campanella* in the regions adjacent to the Suez Canal.

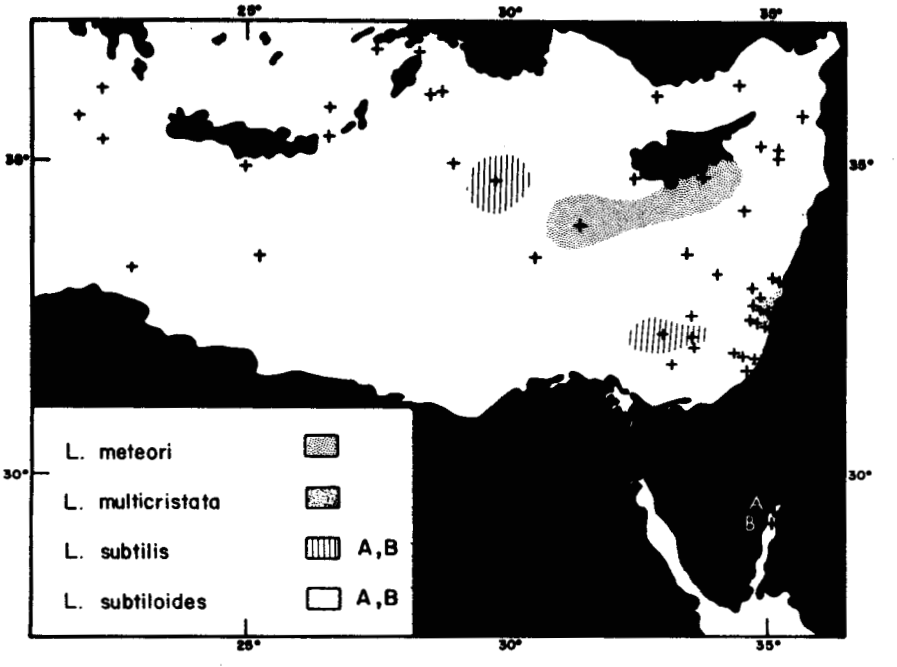

FIGURE 4.—Distribution of *Lensia meteori*, *Lensia multicristata*, *Lensia subtilis*, and *Lensia subtiloides* in the regions adjacent to the Suez Canal.

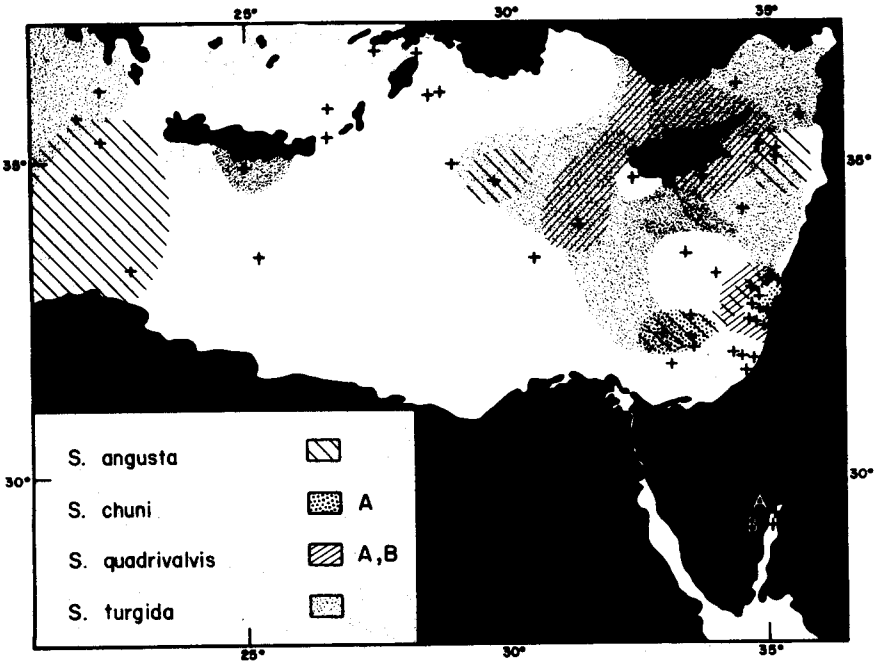

FIGURE 5.—Distribution of *Sulculeolaria angusta, Sulculeolaria chuni, Sulculeolaria quadrivalvis,* and *Sulculeolaria turgida* in the regions adjacent to the Suez Canal.

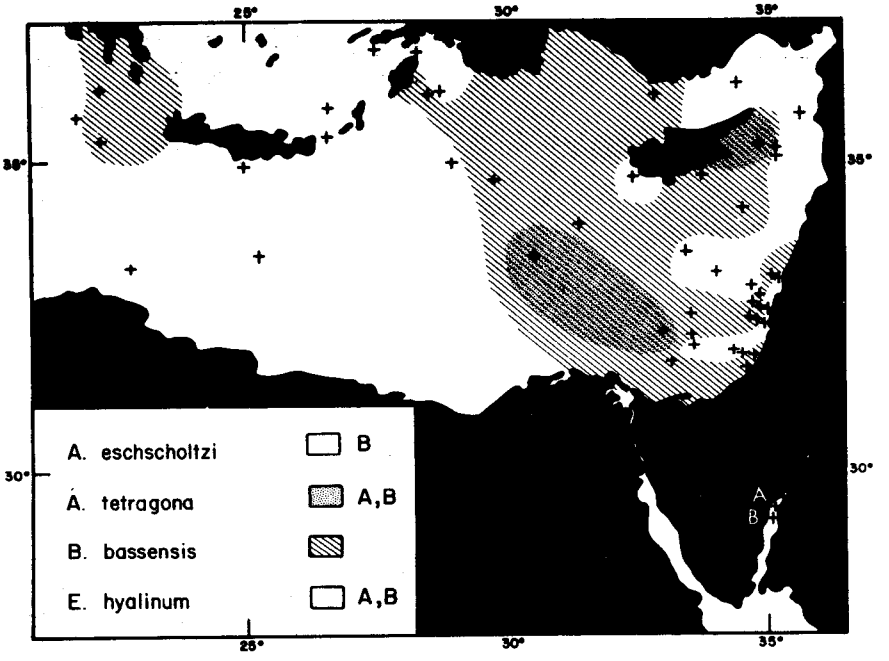

FIGURE 6.—Distribution of *Abylopsis eschscholtzi, Abylopsis tetragona, Bassia bassensis,* and *Enneagonum hyalinum* in the regions adjacent to the Suez Canal.

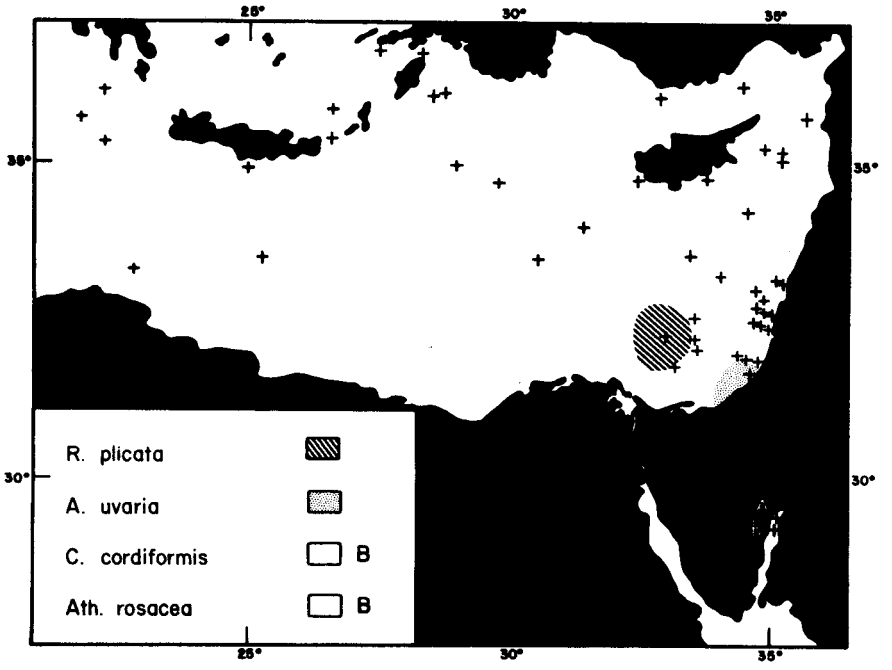

FIGURE 7.—Distribution of *Rosacea plicata, Apolemia uvaria, Cordagalma cordiformis*, and *Athoribya rosacea* in the regions adjacent to the Suez Canal.

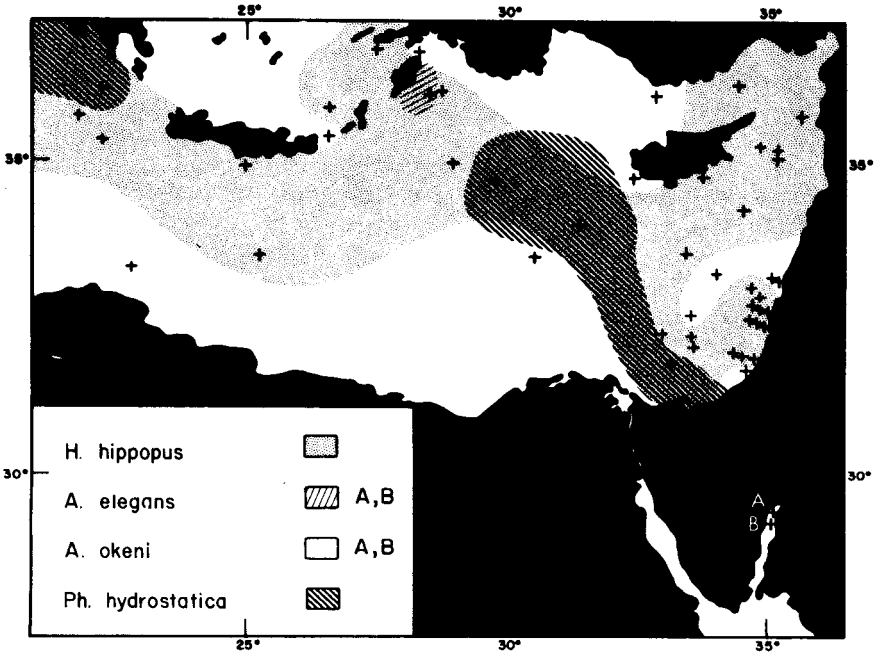

FIGURE 8.—Distribution of *Hippopodius hippopus, Agalma elegans, Agalma okeni*, and *Physophora hydrostatica* in the regions adjacent to the Suez Canal.

Other new records for the Gulf of Elat are *Diphyes dispar, L. subtilis, L. subtiloides, S. chuni, S. quadrivalvis, A. eschscholtzi, A. tetragona, E. hyalinum, C. cordiformis, A. rosacea, A. elegans*, and *A. okeni*. These species, except *Ch. contorta*, were only previously observed in either the central and the southern Red Sea or both (Figures 1, 2, 4-8). *Ch. contorta* was previously observed in the Gulf of Elat (Furnestin, 1958).

The depth of the sill at Bab el Mandeb does not exceed 100 m (Halim, 1969) and consequently meso and bathypelagic species are extensively excluded from the Red Sea. Halim considered the scarcity of species in the Red Sea as due to the "excluding action of the deep outflow over the sill at the southern entrance of the Red Sea on the deep water species; and . . . the effect of the high (21.5°–22°C) minimum temperature of the Red Sea deep water in inhibiting many species. . . ." He also considers excluding features the "high salinity (40.5–41.0‰) and the very low oxygen content (below 1 ml/l in summer and 2 ml/l at the end of the winter) below sill depth."

Similar interpretation could be applied for the paucity of the Mediterranean siphonophores as compared with the Atlantic, because of the sill at Gibraltar.

Thorson (1971) stated that "the physical-chemical conditions for the animals to pass the Canal have improved enormously although there are still obstacles for the migration of many species."

Seasonal variations in occurrence, abundance and in the distributional pattern presented by the species of siphonophores in both the Levant Mediterranean basin and the Gulf of Elat are to be expected. The various populations may show changes in both location and time of year. These changes may be due to the characteristics of the flow through the Strait of Gibraltar, and Bab el Mandeb respectively, and the characteristics of the circulation in the Mediterranean and the Arabian Sea, as well as the aspects of the vertical migration (Halim, 1969), and the ontogeny of the population.

Most of the siphonophores, except for a few species as explained above, present a wide almost cosmopolitan distribution (Alvariño, 1971). However, species abundant in the western Mediterranean and the Atlantic reaching the easternmost Mediterranean region could be considered "indicators" or tracers of the Atlantic waters. This could be similarly applied to some Indo-Pacific or Indian Ocean species reaching the Red Sea.

SIPHONOPHORES OF THE WESTERN CARIBBEAN AND THE CENTRAL AMERICAN PACIFIC

The pairs of closely related species allopatric in distribution, *Ch. appendiculata-Ch. contorta, M. atlantica-M. kochi,* and *L. challengeri–L. fowleri* deserve special attention.

Chelophyes appendiculata inhabits the temperate oceanic regions, and appears scattered along the tropico-equatorial realm, while *Ch. contorta* presents a distribution restricted to the tropico-equatorial regions (Alvariño, 1971).

Muggiaea atlantica inhabits the neritic temperate eastern Pacific, Transition region (band between the Subarctic and Central Pacific), the Japanese neritic waters and the neritic regions of the temperate Atlantic. *Muggiaea kochi* occupies the neritic tropico-equatorial Atlantic and the eastern equatorial Pacific (Alvariño, 1971).

Lensia challengeri is an Indo-Pacific species, and *L. fowleri* is most probably restricted to the Atlantic waters (Alvariño, 1971).

However, *Ch. appendiculata, M. kochi*, and *L. fowleri* appear widely distributed in the Caribbean region annex to the Panama Canal and in adjacent regions of the Caribbean, Gulf of Mexico, and western tropical Atlantic. *Ch. contorta, M. atlantica,* and *L. challengeri* appear in the Central American Pacific region. Few specimens of *Ch. appendiculata* and *M. kochi* were observed at locations near the opening of the Panama Canal in the Pacific, and few specimens of *Ch. contorta, M. atlantica,* and *L. challengeri* occurred at locations near the opening of the Panama Canal in the Caribbean. These observations suggest the Caribbean and the Pacific populations may be able to migrate or survive artificial transport via the Panama Canal (Figures 9-11, Table 2).

The species of siphonophores appearing abundantly distributed in the surveyed region in both the Caribbean and the Central American Pacific are *Diphyes bojani, D. dispar, Diphyopsis mitra*, and *A. eschscholtzi. Diphyes bojani* occurred at all Caribbean stations, except for the close to

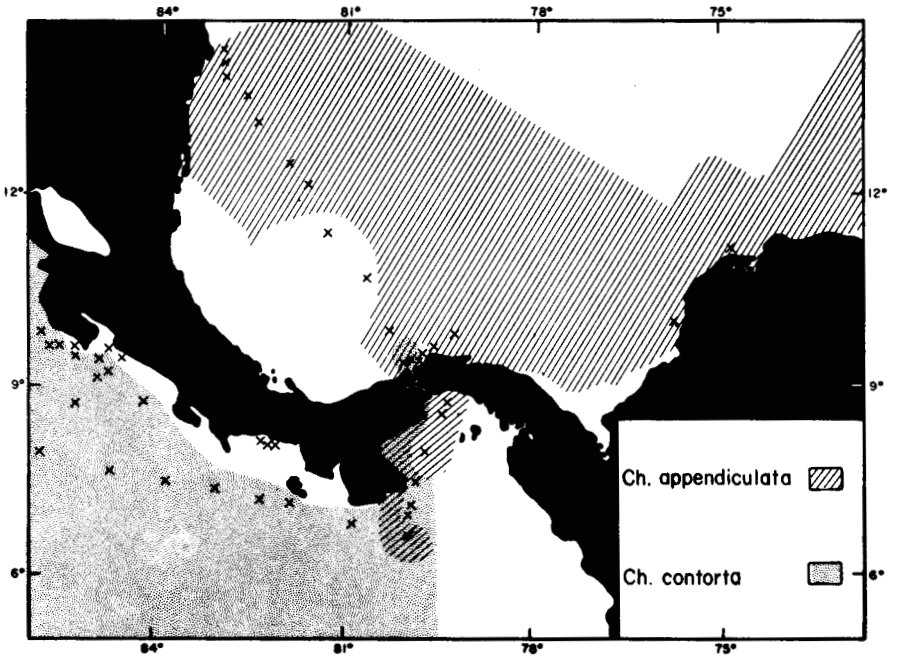

FIGURE 9.—Distribution of *Chelophyes appendiculata* and *Chelophyes contorta* in the regions adjacent to the Panama Canal.

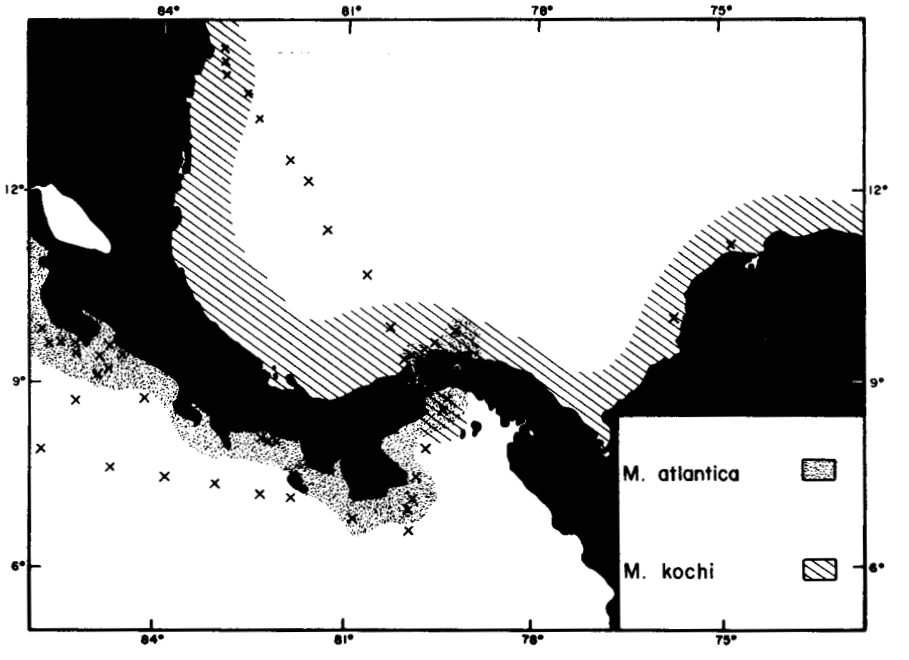

FIGURE 10.—Distribution of *Muggiaea atlantica* and *Muggiaea kochi* in the regions adjacent to the Panama Canal.

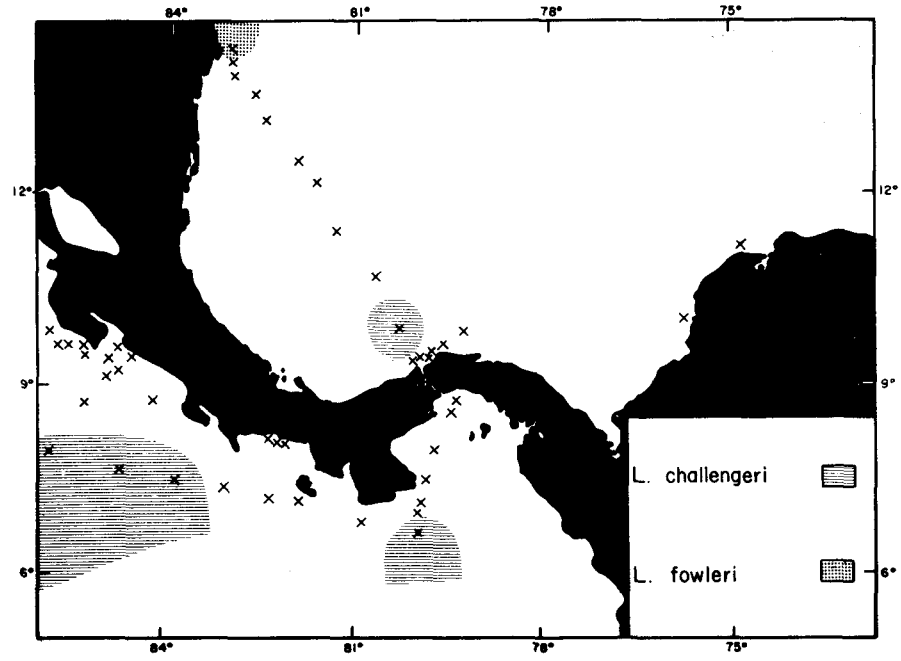

FIGURE 11.—Distribution of *Lensia challengeri* and *Lensia fowleri* in the regions adjacent to the Panama Canal.

shore locations off Huani, Nicaragua, off Puerto Colombia and Cartagena de Indias, and east to the entrance of the Panama Canal. In the Pacific region it was only missing at the northernmost station in the Gulf of Panama, south of Peninsula de Azuero, south of Coiba Island, off Gulf of Nicoya, and off Punta Arenas and Punta Guiones (Costa Rica) (Figure 12).

Diphyes dispar and *Diphyopsis mitra* appeared abundantly distributed in the Pacific region, and only in two locations in the Caribbean. *Diphyes dispar* was present off Colombia and off Laguna Perlas (Nicaragua), and *Diphyopsis mitra* at two locations a few miles north of Panama (Figures 12, 13).

Abylopsis eschscholtzi was only absent at a few stations in the Caribbean and in the Central American Pacific (Figure 14).

Species scattered distributed in both the Caribbean and the Pacific regions were *Eudoxoides spiralis, A. tetragona, S. chuni, A. okeni,* and *E. hyalinum. Eudoxides spiralis* was present only at five Caribbean locations, which include two stations off Nicaragua and three off the entrance to the Panama Canal, and in the Pacific appeared at two stations southeast of Peninsula de Azuero and at two offshore stations west of Costa Rica (Figure 13).

Abylopsis tetragona appeared off Colombia and near the entrance of the Panama Canal in the Caribbean, and south of the Azuero Peninsula, south of Coiba Island, west of Nicoya Peninsula, and at one offshore station west of Costa Rica in the Pacific (Figure 14).

Sulculeolaria chuni was observed at three locations over the deepest part of the western Caribbean, and in the Gulf of Panama, south of Nicoya Peninsula, and at two offshore stations west of Costa Rica in the Pacific (Figure 16).

Agalma okeni was found once in the Caribbean region (off Costa de Mosquitos, Nicaragua), and in the Pacific regions appeared from the Azuero Peninsula to Coiba Island, south of Costa Rica and west of Nicoya Peninsula (Figure 19).

Enneagonum hyalinum was only observed at the western Caribbean, and at several locations in the Pacific extending northwestwards from Coiba Island (Figure 17).

Species scattered distributed in the surveyed region of the Central American Pacific were, *S. quadrivalvis, S. turgida, B. bassensis,* and *H. hippopus* (Figures 16-18).

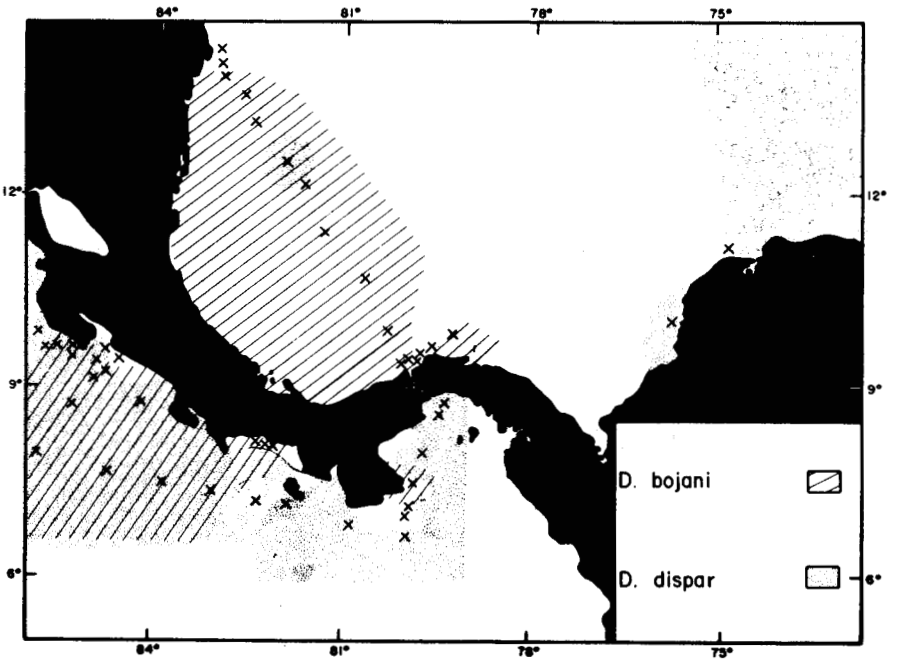

FIGURE 12.—Distribution of *Diphyes bojani* and *Diphyes dispar* in the regions adjacent to the Panama Canal.

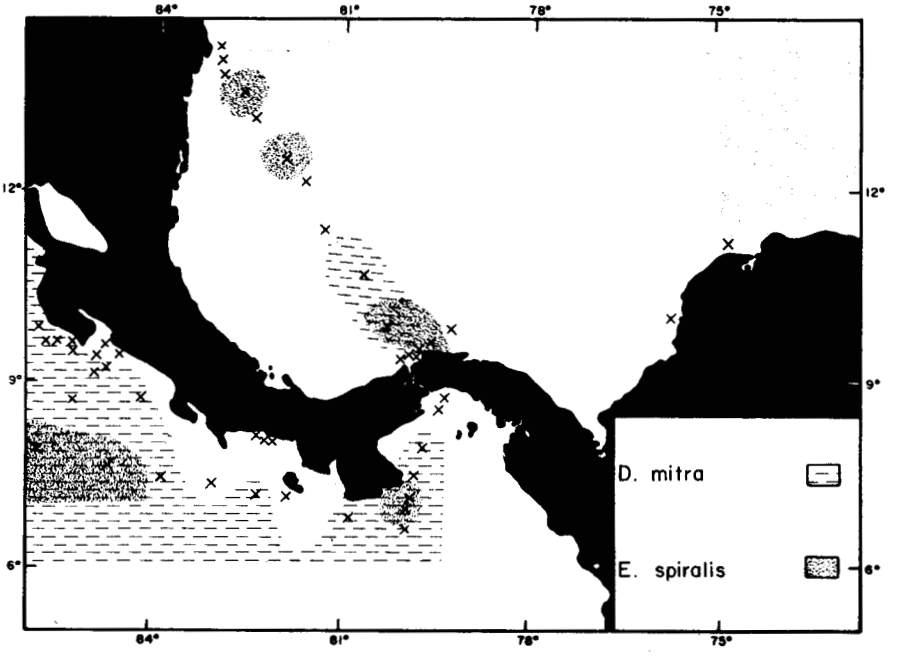

FIGURE 13.—Distribution of *Diphyopsis mitra* and *Eudoxoides spiralis* in the regions adjacent to the Panama Canal.

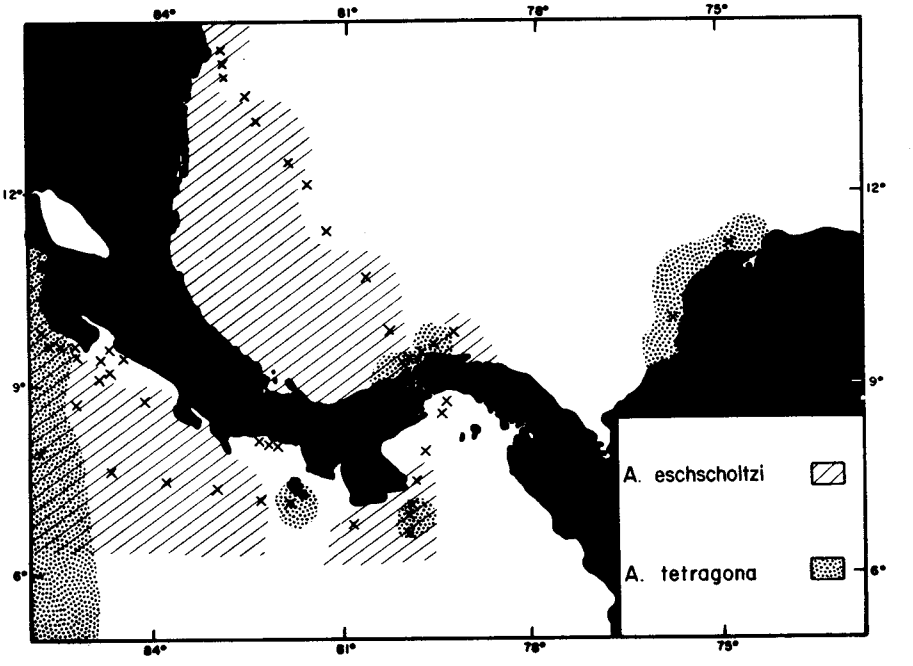

FIGURE 14.—Distribution of *Abylopsis eschscholtzi* and *Abylopsis tetragona* in the regions adjacent to the Panama Canal.

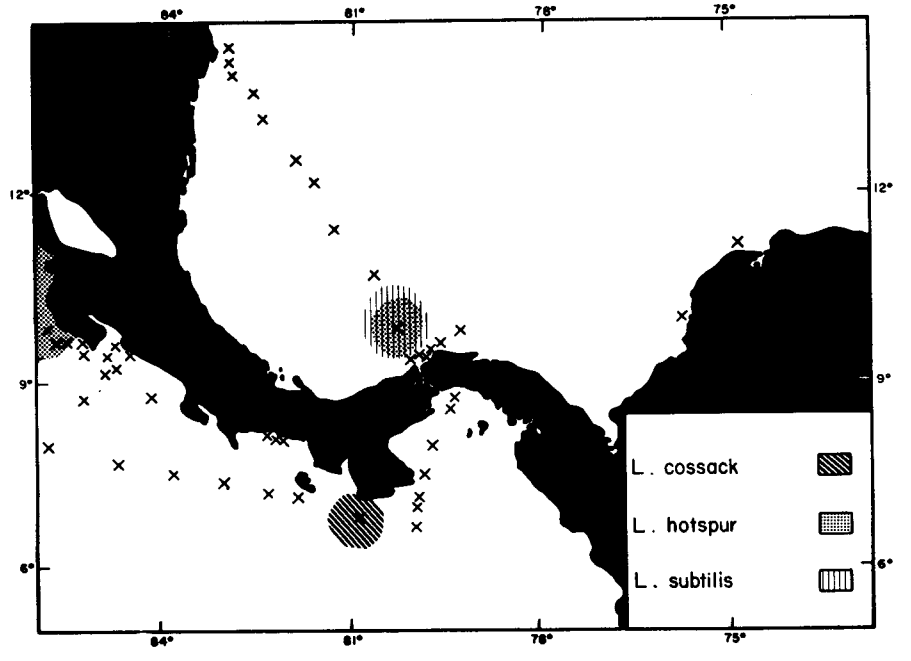

FIGURE 15.—Distribution of *Lensia cossack*, *Lensia hotspur*, and *Lensia subtilis* in the regions adjacent to the Panama Canal.

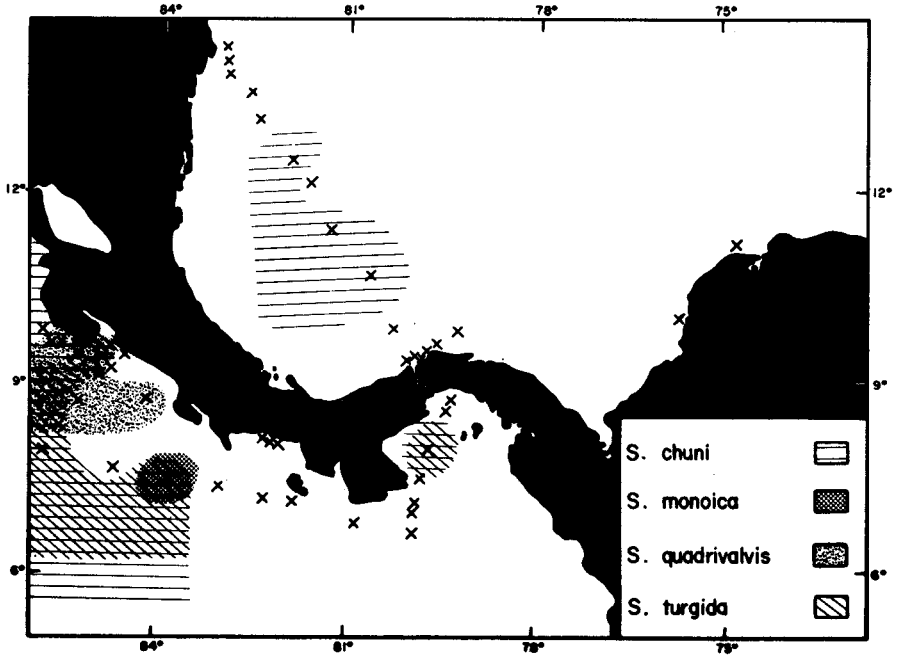

FIGURE 16.—Distribution of *Sulculeolaria chuni*, *Sulculeolaria monoica*, *Sulculeolaria quadrivalvis*, and *Sulculeolaria turgida* in the regions adjacent to the Panama Canal.

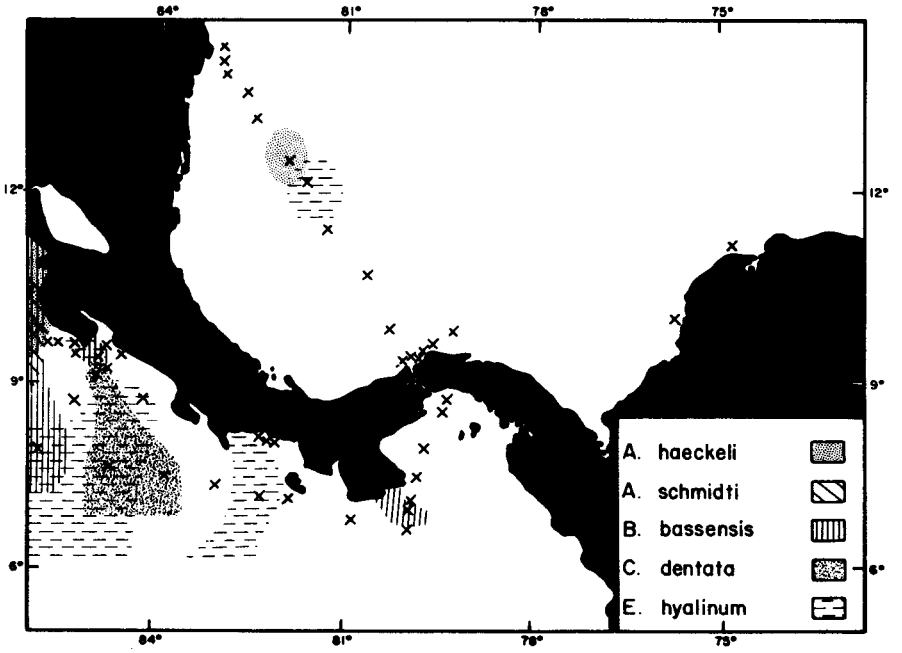

FIGURE 17.—Distribution of *Abyla haeckeli*, *Abyla schmidti*, *Bassia bassensis*, *Ceratocymba dentata*, and *Enneagonum hyalinum* in the regions adjacent to the Panama Canal.

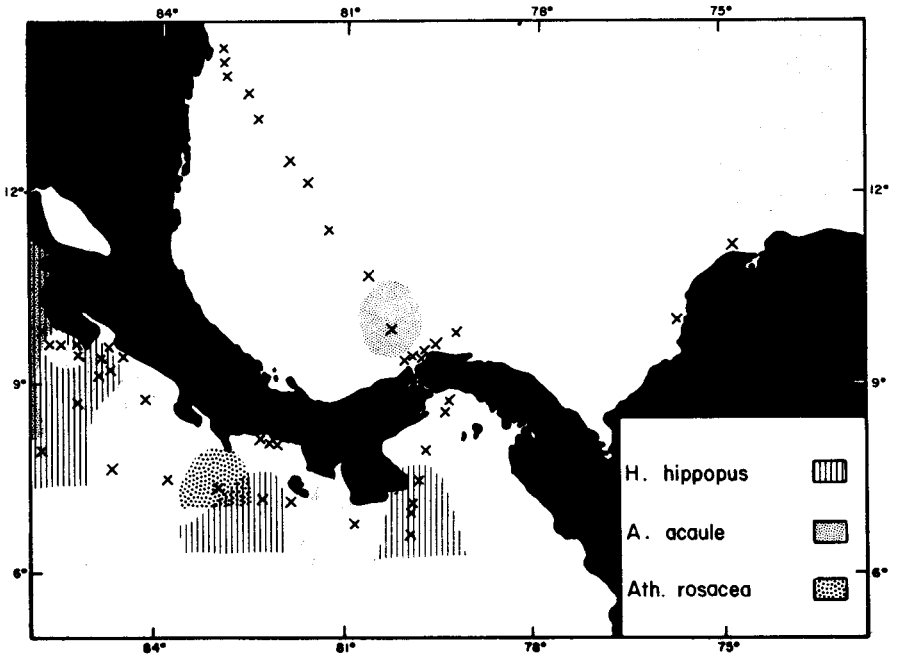

FIGURE 18.—Distribution of *Hippopodius hippopus*, *Athoribya rosacea*, and *Amphicaryon acaule* in the regions adjacent to the Panama Canal.

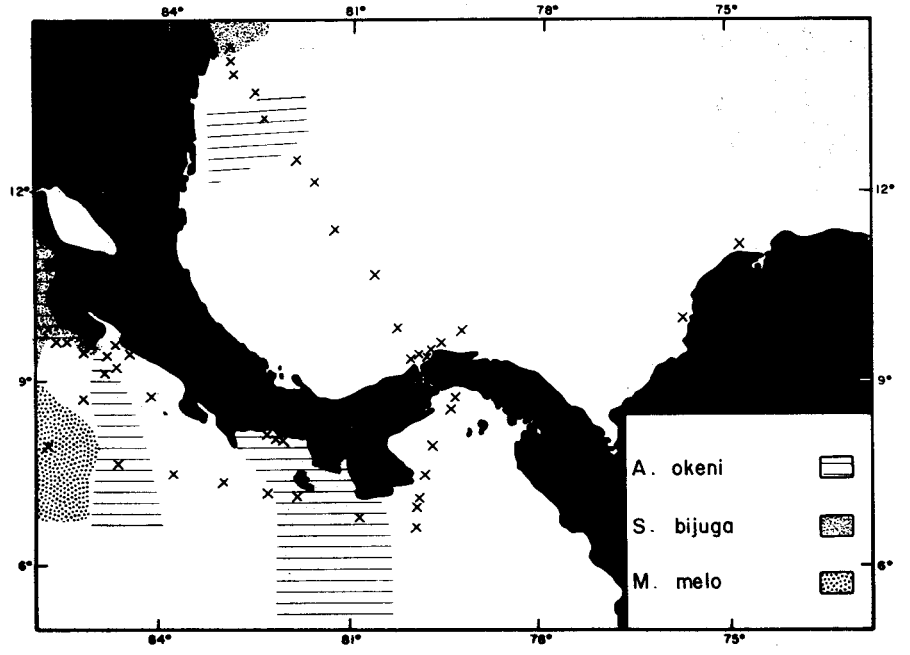

FIGURE 19.—Distribution of *Agalma okeni*, *Stephanomia bijuga*, and *Melophysa melo* in the regions adjacent to the Panama Canal.

TABLE 1.—Siphonophores of the regions adjacent to the Suez Canal.

Species	Eastern Mediterranean	Red Sea
Chelophyes appendiculata Eschscholtz, 1829	*, **	
	32°20'N-34°51'E	Gulf of Elat:
	32°45'N-34°57'E	29°30'N-34°55'E
	33°03'N-34°55'E	29°25'N-34°50'E
	35°05'N-35°00'E	
	33°00'N-35°00'E	
	32°55'N-34°34'E	
	35°35'N-35°26'E	
	34°50'N-28°55'E	
	35°55'N-28°37'E	
	36°30'N-28°13'E	
	36°31'N-27°27'E	
	35°14'N-26°33'E	
	33°25'N-30°20'E	
	33°10'N-33°50'E	
	31°31'N-34°28'E	
	32°23'N-34°37'E	
	34°37'N-32°20'E	
	32°30'N-33°21'E	
	31°42'N-34°28'E	
	32°46'N-34°53'E	
	32°50'N-34°50'E	
	33°25'N-33°14'E	
	32°01'N-33°25'E	
	33°25'N-25°15'E	
	34°47'N-25°10'E	
	35°11'N-22°15'E	
	35°35'N-21°50'E	
	35°57'N-22°15'E	
	34°10'N-34°29'E	
	35°57'N-32°23'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	35°50'N-31°15'E	
	32°43'N-34°38'E	
	32°10'N-32°50'E	
	32°07'N-33°24'E	
	31°42'N-33°00'E	
	35°55'N-28°33'E	
Eudoxia russelli Totton, 1932	35°57'N-32°23'E	Gulf of Elat: 29°30'N-34°55'E 29°25'N-34°50'E
Chelophyes contorta (Lens & Riemsdijk, 1908)	**	*+
	32°45'N-34°57'E	Gulf of Elat:
	35°05'N-35°00'E	29°25'N-34°50'E
	32°23'N-34°37'E	
	32°50'N-34°51'E	
	32°01'N-33°25'E	
	32°43'N-34°38'E	
Diphyes bojani (Eschscholtz, 1829)	**	
	36°31'N-27°27'E	
	33°25'N-30°20'E	
Diphyes chamissonis Huxley, 1859		+
Diphyes dispar Chamisso & Eysenhardt, 1821	**	+
	34°50'N-32°47'E	Gulf of Elat:
	35°05'N-35°00'E	29°30'N-34°55'E
	33°00'N-35°00'E	
	32°46'N-34°53'E	
	32°55'N-34°34'E	
	35°35'N-35°26'E	
	35°05'N-34°05'E	
	34°50'N-28°55'E	
	35°55'N-28°37'E	
	36°30'N-28°13'E	
	36°31'N-27°27'E	
	35°14'N-26°33'E	
	33°25'N-30°20'E	
	31°31'N-34°28'E	
	32°23'N-34°37'E	
	34°37'N-32°20'E	
	32°30'N-33°21'E	
	31°42'N-34°28'E	
(Diphyes dispar)	33°25'N-33°14'E	
	32°01'N-33°25'E	
	34°47'N-25°10'E	
	35°35'N-21°50'E	
	35°57'N-22°15'E	
	32°20'N-34°51'E	
	31°37'N-34°32'E	
	31°44'N-34°26'E	
	32°45'N-34°49'E	
	32°50'N-34°50'E	
	35°57'N-32°23'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
	32°43'N-34°38'E	
	32°10'N-32°50'E	
	32°07'N-33°24'E	
	35°00'N-35°00'E	
	35°55'N-28°33'E	
Diphyopsis mitra Huxley, 1859		Gulf of Elat: 29°30'N-34°55'E
Muggiaea atlantica Cunningham, 1892	*, **	+
Muggiaea kochi Will, 1844	*, **	
	33°03'N-34°55'E	
Eudoxoides spiralis Bigelow, 1911	*, **	
	35°05'N-35°00'E	
	31°31'N-34°28'E	
	34°37'N-32°20'E	
	32°50'N-34°51'E	
	34°35'N-29°40'E	
	34°10'N-34°29'E	
	35°57'N-32°23'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
	32°43'N-34°48'E	
	32°10'N-32°50'E	
	32°07'N-33°24'E	
	31°42'N-33°00'E	
Clausophyes ovata Keferstein & Ehlers, 1861	**	
Sphaeronectes spp.	*, **	+
Lensia campanella Moser, 1925	**	+
	32°43'N-34°38'E	
	32°10'N-32°50'E	
	32°07'N-33°27'E	
Lensia conoidea Keferstein & Ehlers, 1861	*, **	
Lensia fowleri Bigelow, 1911	**	+
Lensia hotspur Totton, 1954		+
Lensia meteori Leloup, 1934	**	+
	*	
	34°35'N-33°35'E	
	33°50'N-31°15'E	
Lensia multicristata Moser, 1925	*, **	
	32°45'N-34°49'E	
Lensia subtilis Chun, 1886	**	+
	34°35'N-29°40'E	Gulf of Elat:
	32°10'N-32°50'E	29°30'N-34°55'E
	32°07'N-33°24'E	29°25'N-34°50'E
Lensia subtiloides Lens & Riemsdijk, 1908	*, **	+
		Gulf of Elat: 29°30'N-34°55'E
Sulculeolaria angusta Totton, 1954		
	35°05'N-35°00'E	
	32°55'N-34°34'E	
	32°46'N-34°53'E	
	37°17'N-22°47'E	
	35°11'N-22°15'E	
	34°35'N-29°40'E	
	32°07'N-33°24'E	
	35°00'N-35°00'E	
Sulculeolaria biloba Sars, 1846	*, **	

TABLE 1.—*Continued.*

Species	Eastern Mediterranean	Red Sea
Sulculeolaria chuni		+
Lens & Riemsdijk, 1908	32°10'N-32°50'E	Gulf of Elat:
	32°07'N-33°24'E	29°30'N-34°55'E
	32°45'N-34°49'E	
Sulculeolaria quadrivalvis	**	+
Blainville, 1834	32°21'N-34°48'E	Gulf of Elat:
	32°55'N-34°34'E	29°30'N-34°55'E
	35°57'N-32°23'E	29°25'N-34°50'E
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
Sulculeolaria turgida	**	
(Gegenbauer, 1854)	32°45'N-34°49'E	
	35°35'N-35°26'E	
	34°47'N-25°10'E	
	35°35'N-21°50'E	
	35°57'N-22°15'E	
	34°35'N-29°40'E	
	34°10'N-34°29'E	
	35°57'N-32°23'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
	32°43'N-34°38'E	
	32°10'N-32°50'E	
	35°00'N-35°00'E	
Abylopsis eschscholtzi	* **	+
Huxley, 1859		Gulf of Elat:
		29°25'N-34°50'E
Abylopsis tetragona	* **	+
Otto, 1823	33°25'N-30°20'E	Gulf of Elat:
	35°05'N-34°38'E	29°30'N-34°55'E
	32°10'N-32°50'E	29°25'N-34°50'E
Bassia bassensis	* **	+
Quoy & Gaimard, 1834	33°03'N-34°55'E	
	33°25'N-30°20'E	
	31°31'N-34°28'E	
	32°23'N-34°37'E	
	32°30'N-33°21'E	
	35°11'N-22°15'E	
	35°57'N-22°15'E	
	34°35'N-29°40'E	
	34°10'N-34°29'E	
	32°46'N-34°53'E	
	35°57'N-32°23'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
	32°43'N-34°48'E	
	32°10'N-32°50'E	
	32°07'N-33°24'E	
	31°42'N-33°00'E	
	31°37'N-34°32'E	
	35°55'N-28°33'E	
Ceratocymba sagittata	**	
Quoy & Gaimard, 1827		
Enneagonum hyalinum	* **	+
Quoy & Gaimard, 1827		Gulf of Elat:
		29°25'N-34°50'E
Hippopodius hippopus	* **	+
Forskal, 1776	32°21'N-34°48'E	
	35°39'N-26°34'E	
	35°05'N-35°00'E	
	32°23'N-34°37'E	
	32°55'N-34°34'E	
	35°35'N-35°26'E	
	35°05'N-34°05'E	
	34°50'N-28°55'E	
	35°55'N-28°37'E	
(*Hippopodius hippopus*)	36°31'N-27°27'E	
	32°46'N-34°53'E	
	33°25'N-33°14'E	
	32°01'N-33°25'E	
	34°47'N-25°10'E	
	33°25'N-25°15'E	
	37°17'N-22°47'E	
	35°11'N-22°15'E	
	35°35'N-21°50'E	
	35°57'N-22°15'E	
	34°35'N-29°40'E	
	34°10'N-34°29'E	
	32°50'N-34°50'E	
	32°20'N-34°51'E	
	31°37'N-34°32'E	
	31°42'N-34°28'E	
	31°44'N-34°26'E	
	32°45'N-34°49'E	
	34°35'N-33°35'E	
	35°05'N-34°38'E	
	33°50'N-31°15'E	
	32°43'N-34°38'E	
	32°10'N-32°50'E	
	32°07'N-33°24'E	
	31°42'N-33°00'E	
	35°00'N-35°00'E	
	35°55'N-28°33'E	
Vogtia glabra Bigelow, 1918	* **	
Vogtia pentacantha Kolliker, 1853	**	
Vogtia spinosa Keferstein & Ehlers, 1861	**	
Praya cymbiformis Chiaje, 1841	**	
Rosacea plicata Quoy & Gaimard, 1827	**	
	32°10'N-32°50'E	
Amphicaryon acaule Chun, 1888	**	+
Amphicaryon ernesti Totton, 1954		+
Anthophysa rosea Brandt, 1835	**	+
Apolemia uvaria Lesueur, 1811	**	
	36°31'N-27°27'E	
Rhizophysa filiformis Forskal, 1775	**	
Cordagalma cordiformis Totton, 1932	**	+
		29°25'N-34°50'E
Athoribya rosacea (Forskal, 1775)	**	+
		29°25'N-34°50'E
Agalma elegans Sars, 1846	* **	+
	35°55'N-28°33'E	Gulf of Elat:
		29°30'N-34°55'E
		29°25'N-34°50'E
Agalma okeni Eschscholtz, 1825	* **	+
		Gulf of Elat:
		29°30'N-34°55'E
		29°25'N-34°50'E
Stephanomia bijuga (Chiaje, 1841-42)	* **	+
Stephanomia rubra Vogt, 1852	* **	+
Nanomia cara Agassiz, 1865	**	
Physophora hydrostatica Forskal, 1775	**	
	35°57'N-22°45'E	
	34°35'N-29°40'E	
	35°50'N-31°15'E	
	31°42'N-33°00'E	
Forskalia edwardsi Kolliker, 1853	* **	+

* Previously observed (see Alvariño, 1971; Lakkis, 1971).
\+ Previously observed in the Red Sea (Alvariño, 1971 compilation of distributional data).
**Previously observed in the western Mediterranean (see Alvariño, 1971).

TABLE 2.—Siphonophores of the regions adjacent to the Panama Canal.

Species	Caribbean Sea region	Central American Pacific	Species	Eastern Mediterranean	Red Sea
Chelophyes appendiculata	* **		*(Diphyopsis mitra)*		07°12'N-79°54'W
	11°07'N-74°47'W	08°41'N-79°31'W			07°02'N-79°57'W
	10°19'N-75°38'W	08°48'N-79°30'W			06°40'N-79°59'W
	09°46'N-79°20'W	08°00'N-79°43'W			06°55'N-80°50'W
	09°37'N-79°39'W				07°18'N-82°25'W
	09°27'N-79°48'W				07°30'N-83°54'W
	14°19'N-83°09'W				07°39'N-84°46'W
	13°56'N-82°59'W				07°57'N-85°49'W
	13°38'N-82°38'W				08°48'N-85°57'W
	13°12'N-82°25'W				09°07'N-84°58'W
	12°31'N-81°52'W				09°32'N-85°10'W
	12°11'N-81°38'W				09°51'N-85°43'W
	10°04'N-80°22'W		*Muggiaea atlantica*		**
Chelophyes contorta		**		09°28'N-84°21'W	09°38'N-85°44'W
	09°27'N-79°48'W	07°30'N-79°54'W		09°46'N-79°20'W	08°41'N-79°31'W
	09°25'N-79°57'W	08°46'N-84°11'W		09°27'N-79°48'W	07°30'N-79°54'W
		09°13'N-84°45'W			08°10'N-82°13'W
		09°28'N-85°15'W			08°10'N-82°15'W
		09°39'N-85°41'W			08°10'N-82°16'W
		07°12'N-79°54'W			09°13'N-84°45'W
		07°02'N-79°57'W			09°28'N-85°15'W
		06°55'N-80°50'W			09°39'N-85°41'W
		07°12'N-81°48'W			08°48'N-79°30'W
		07°18'N-82°25'W			07°12'N-79°54'W
		07°27'N-83°04'W			07°02'N-79°57'W
		07°30'N-83°54'W			06°55'N-80°50'W
		07°39'N-84°46'W			09°07'N-84°58'W
		07°51'N-85°49'W			09°23'N-84°52'W
		08°48'N-85°17'W			09°39'N-84°44'W
		09°07'N-84°58'W			09°32'N-85°10'W
		09°23'N-84°52'W			09°51'N-85°43'W
		09°51'N-85°43'W	*Muggiaea kochi*	**	
Dimophyes arctica (Chun, 1897)	**	**		11°07'N-74°47'W	08°41'N-79°31'W
				10°19'N-75°38'W	
Diphyes bojani	**	**		09°46'N-79°20'W	
	09°46'N-46°20'W	07°30'N-79°54'W		09°37'N-79°39'W	
	09°27'N-79°47'W	08°10'N-82°13'W		09°28'N-79°46'W	
	09°27'N-79°38'W	08°10'N-82°15'W		09°27'N-79°47'W	
	13°56'N-82°59'W	08°10'N-82°16'W		14°19'N-83°09'W	
	13°38'N-82°38'W	08°46'N-84°11'W		14°07'N-83°01'W	
	13°12'N-82°25'W	09°13'N-84°45'W		13°56'N-82°59'W	
	12°31'N-81°52'W	09°28'N-85°15'W		13°38'N-82°38'W	
	12°11'N-81°38'W	09°39'N-85°41'W		10°04'N-80°22'W	
	11°27'N-81°15'W	07°27'N-83°04'W		09°25'N-79°57'W	
	10°44'N-80°45'W	07°30'N-83°54'W	*Eudoxoides spiralis*	**	**
	10°04'N-80°22'W	07°39'N-84°46'W		09°37'N-79°39'W	07°12'N-79°54'W
		07°57'N-85°49'W		09°28'N-79°46'W	07°02'N-79°57'W
		08°48'N-85°17'W		13°38'N-82°38'W	07°39'N-84°46'W
		09°07'N-84°58'W		12°31'N-81°52'W	07°57'N-85°49'W
		09°23'N-84°52'W		10°04'N-80°22'W	
Diphyes dispar	* **	* **	*Lensia campanella*	**	**
	10°19'N-75°38'W	09°38'N-85°44'W	*Lensia challengeri*		**
	08°46'N-84°11'W	08°48'N-79°30'W	Totton, 1954	10°04'N-80°22'W	06°40'N-79°59'W
	09°13'N-84°45'W	08°00'N-79°43'W			07°30'N-83°54'W
	09°28'N-85°15'W	06°40'N-79°59'W			07°39'N-84°46'W
	09°39'N-85°41'W	06°55'N-80°50'W			07°57'N-85°49'W
	12°31'N-81°52'W	07°12'N-81°48'W	*Lensia conoidea*		**
		07°27'N-83°04'W	Lensia cossack Totton, 1941	**	**
		07°30'N-83°54'W			06°55'N-80°50'W
		07°39'N-84°36'W	*Lensia fowleri*	**	
		07°57'N-85°49'W		14°19'N-83°09'W	
		08°48'N-85°17'W	*Lensia hotspur*	**	**
		09°07'N-84°58'W		10°04'N-80°22'W	09°51'N-85°43'W
		09°23'N-84°52'W	*Lensia lelouveteau*	**	
		09°39'N-84°44'W	Totton, 1941		
		09°32'N-85°10'W	*Lensia meteori*		**
		09°51'N-85°43'W	*Lensia multicristata*	**	
Diphyopsis mitra	**	**	*Lensia reticulata*	**	
	10°44'N-80°45'W	07°30'N-79°54'W	Totton, 1954		
	10°04'N-80°22'W	08°46'N-84°11'W	*Lensia subtilis*	* **	
		09°13'N-84°45'W		10°04'N-80°22'W	
		09°28'N-85°15'W	*Sulculeolaria bigelowi*		**
		09°39'N-85°41'W	(Sears, 1950)		
		08°00'N-79°43'W	*Sulculeolaria biloba*	**	**

TABLE 2.—*Continued.*

Species	Eastern Mediterranean	Red Sea	Species	Eastern Mediterranean	Red Sea
Sulculeolaria chuni	**	**	*(Ceratocymba dentata)*		07°39'N-84°46'W
	12°31'N-81°52'W	08°00'N-79°13'W			09°07'N-84°58'W
	11°27'N-81°15'W	07°30'N-83°54'W	*Ceratocymba leuckarti* Huxley, 1859	**	**
	10°44'N-80°45'W	07°57'N-85°49'W			
		09°23'N-84°52'W	*Ceratocymba sagittata*	**	
Sulculeolaria monoica Chun, 1888	**	**	*Enneagonum hyalinum*	**	* **
		07°30'N-83°54'W		12°11'N-81°38'W	07°18'N-82°25'W
Sulculeolaria quadrivalvis	**	**			08°46'N-84°11'W
		08°46'N-84°11'W			07°39'N-84°46'W
		09°28'N-85°15'W			07°57'N-85°49'W
		08°48'N-85°17'W			09°07'N-84°58'W
		09°07'N-84°58'W			09°23'N-84°52'W
		09°23'N-84°52'W			09°32'N-85°10'W
Sulculeolaria turgida		**	*Hippopodius hippopus*	**	**
		08°00'N-79°43'W			07°30'N-79°54'W
		07°30'N-83°54'W			07°12'N-79°54'W
		07°57'N-85°49'W			07°02'N-79°57'W
		09°23'N-84°52'W			06°42'N-79°59'W
Abyla carina Haeckel, 1888	**				07°18'N-82°25'W
Abyla haeckeli	* **	* **			07°57'N-85°49'W
Lens & Riemsdijk, 1908	12°31'N-81°52'W	09°51'N-85°43'W			08°48'N-85°17'W
Abyla schmidt Sears, 1953	**				09°07'N-84°58'W
		09°51'N-85°43'W			09°23'N-84°52'W
Abylopsis eschscholtzi	* **	* **			09°32'N-85°10'W
	10°46'N-79°20'W	07°30'N-79°54'W			09°51'N-85°43'W
	14°19'N-83°09'W	08°46'N-84°11'W	*Vogtia glabra*	**	
	14°07'N-83°01'W	09°28'N-85°15'W	*Vogtia pentacantha*	**	
	13°12'N-82°25'W	09°39'N-83°09'W	*Vogtia spinosa*		**
	12°31'N-81°52'W	07°12'N-97°54'W	*Rosacea plicata*		**
	10°44'N-80°45'W	07°02'N-79°57'W	*Nectopyramis natans* Bigelow, 1911		**
	10°04'N-80°22'W	06°40'N-79°59'W			
	09°25'N-79°57'W	06°55'N-80°50'W	*Amphicaryon acaule*	* **	**
		07°18'N-82°25'W		10°04'N-80°22'W	09°51'N-85°43'W
		07°27'N-83°04'W	*Amphicaryon ernesti*	**	
		07°30'N-83°54'W	*Rhizophysa filiformis*	**	
		07°39'N-84°46'W	*Athoribya rosacea*		07°27'N-83°04'W
		07°57'N-85°49'W	*Agalma elegans*	**	
		08°48'N-85°17'W	*Agalma okeni*	**	* **
		09°07'N-84°58'W		13°12'N-82°25'W	06°55'N-80°50'W
		09°51'N-85°43'W			07°12'N-81°48'W
Abylopsis tetragona	* **				07°39'N-84°46'W
	11°07'N-74°47'W	09°38'N-85°44'W			09°07'N-84°58'W
	10°19'N-75°38'W	07°02'N-79°57'W			09°32'N-85°10'W
	09°37'N-79°39'W	07°57'N-85°49'W			09°51'N-85°43'W
	09°25'N-79°57'W	09°51'N-85°43'W	*Stephanomia bijuga*	**	**
Bassia bassensis	**	* **		14°19'N-83°09'W	09°32'N-85°10'W
		07°02'N-79°57'W			09°51'N-85°43'W
		07°57'N-85°49'W	*Stephanomia rubra*	**	
		09°23'N-84°52'W	*Physophora hydrostatica*		**
		09°51'N-85°43'W			
Ceratocymba dentata		* **	*Melophysa melo*		*
Bigelow, 1918		07°30'N-83°54'W	Quoy & Gaimard, 1827		07°57'N-85°49'W

*Previously observed.
**Previously observed in adjacent regions of the Caribbean Sea and/or the Gulf of Mexico, and adjacent regions of the Pacific Ocean (see Alvariño, 1971 compilation of distributional data).

Species present at few locations in the surveyed region of the Caribbean and Pacific were, *L. hotspur, Abyla haeckeli*, and *A. acaule. Lensia hotspur* and *A. acaule* were only found at one location to the north off the entrance of the Panama Canal in the Caribbean, and west of the Peninsula de Nicoya in the Pacific (Figures 15, 18). *Abyla haeckeli* was observed once off Costa de Mosquitos, Caribbean Sea, and at one location off Punta Guiones in the Pacific (Figure 17).

Species present once or at few locations in the Pacific region were, *L. cossack, S. monoica, Abyla schmidti, C. dentata, Melophysa melo, A. rosacea,* and *Stephanomia bijuga* (Figures 15-19).

Lensia subtilis and *L. fowleri* were found only once each, respectively at few miles north of the entrance to the Panama Canal, and off Huani in the Caribbean (Figures 11, 15).

The information presented here should be considered only as a basis for future and more

detailed sets of investigations to enlighten further the distribution and the characteristics of the populations of siphonophores, their fluctuations in time and locations, concurrently with the hydrographic, ecological characteristics and other variants.

The author regrets that the pertinent hydrographic data obtained concurrently with the zooplankton collections were not available in time to be included in the discussion of results.

ACKNOWLEDGMENTS

I am deeply indebted to B. Kimor, O. H. Oren, and F. D. Por, for providing me with the valuable Israeli collections of siphonophores from the eastern Mediterranean and the Gulf of Elat, and from their encouragement to complete this piece of work. This paper was presented at the XVII International Zoological Congress, Symposium on Biological Effects of Interoceanic Canals, Monte Carlo, 24-30 September 1972.

REFERENCES

ALVARIÑO, A.
1957. Zooplancton del Mediterraneo occidental. Bol. Inst. Esp. Oceanogr. 81:1-26.
1964. Report on the Chaetognatha, Siphonophorae and Medusae of the MONSOON Expedition in the Indian Ocean. Prelim. Results Scripps Inst. Ocean. Investigations in the Indian Ocean during Expeditions MONSOON and LUSIAD (1960-1963). Rep. Scripps Inst. Oceanogr., p. 103-108.
1968. Los Quetognatos, Sifonoforos y Medusas en la region del Atlantico Ecuatorial bajo la influencia del Amazonas. Ann. Inst. Biol. Univ. Nac. Autónoma Méx., Ser. Cienc. Mar Limnol. 39(1):41-76.
1970. Tropico-Equatorial Zooplankton. Proc. IV Latino-American Congress of Zoology 2:395-426.
1971. Siphonophores of the Pacific with a review of the world distribution. Bull. Scripps Inst. Oceanogr., Univ. Calif. 16:1-432.
1972. Zooplankton from the Caribbean, Gulf of Mexico, mediate regions of the Pacific and Fisheries. Proc. IV Nac. Congress of Oceanography, México, p. 223-247.

ARON, W. I., AND S. H. SMITH.
1971. Ship canals and aquatic ecosystems. Science (Wash., D.C.) 174:13-20.

BIGELOW, H. B.
1911. The Siphonophorae. Rep. Sci. Res. Exped. Eastern Tropical Pacific U.S. Fish. Comm. Steamer ALBATROSS, 1904-1905. Mem. Mus. Comp. Zool. Harvard Coll. 38:173-401.

BIGELOW, H. B., AND M. SEARS.
1937. Siphonophorae. Rep. Dan. Oceanogr. Exped., 1908-1910, Mediterr. 2(H.2):1-144.

BROWNE, E. T.
1926. Siphonophorae from the Indian Ocean. Trans. Linn. Soc. Lond., Zool., 2d Ser. 19:55-86.

BRUCKS, J. T.
1971. Currents of the Caribbean and adjacent regions as deduced from drift-bottle studies. Bull. Mar. Sci. 21:455-465.

FURNESTIN, M. L.
1958. Contrib. knowledge of the Red Sea, No. 6. Quelques échantillons de zooplancton du Golfe d'Eylath (Akaba). Bull. Isr. Sea Fish. Res. Stn., Haifa 16:6-14.

HALIM, Y.
1969. Plankton of the Red Sea. Oceanogr. Mar. Biol. Annu. Rev. 7:231-275.

HALIM, Y., S. K. GUERGUES, AND H. H. SALEH.
1967. Hydrographic conditions and plankton in the South East Mediterranean during the last normal Nile Flood (1964). Int. Rev. gesamten Hydrobiol. 52:401-425.

HOPPER, A. F.
1960. The resistance of marine zooplankton of the Caribbean and South Atlantic to changes in salinity. Limnol. Oceanogr. 5:43-47.

KIMOR, B.
1971. Plankton relations of the Red Sea, Persian Gulf and Arabian Sea. Abstracts Symposium on the Biology of the Indian Ocean with special reference to the IIOE, Kiel.

LAKKIS, S.
1971. Contribution à l'étude du zooplancton des eaux libanaises. Mar. Biol. (Berl.) 11:138-148.

LATIF, A. F. A.
1971. Marine fisheries of the Gulf of Suez. Abstracts Symposium on Indian Ocean and adjacent Seas 262:169-170.

OREN, O. H.
1957. Changes in temperature of the eastern Mediterranean Sea in relation to the catch of the Israel trawl fishery during the years 1954-55 and 1955-56. Bull. Inst. Oceanogr. Monaco 54(1102):1-15.
1967. The fifth cruise in the eastern Mediterranean "CYPRUS-05" May 1967. Hydrographic data. Bull. Isr. Sea Fish. Res. Stn., Haifa 47:55-63.
1969. Oceanographic and biological influence of the Suez Canal, the Nile and the Aswan Dam on the Levant Basin. Progr. Oceanogr. 5:161-167.
1970. The Suez Canal and the Aswan High Dam. Their effect on the Mediterranean. Underwater Sci. Technol. J. 2:222-229.
1971. The Atlantic water in the Levant Basin and on the shores of Israel. Cah. O.R.S.T.O.M. (Off. Rech. Sci. Tech. Outre-Mer), Sér. Oceanogr. 23(3):291-297.

POR, F. D.
1971. One hundred years of Suez Canal—a century of Lessepsian migration: Retrospect and viewpoints. Syst. Zool. 20:138-159.

RUBINOFF, I.
1968. Central American Sea-level canal: Possible biological effects. Science (Wash., D.C.) 161:857-861.

SCHNEIDER, K. C.
1898. Mitteilungen über Siphonophoren III. Systematische und andere Bemerkungen. Zool. Anz. 21:51-200.

THORSON, G.
1971. Animal migrations through the Suez Canal in the past recent years and the future. (A preliminary report.) Vie Milieu 21:841-846.

TOTTON, A. K.
1954. Siphonophora of the Indian Ocean together with systematic and biological notes on related specimens from other oceans. Discovery Rep. 27:1-162.

WORKING PARTY NO. 2.
1968. Smaller mesozooplankton. *In* J. H. Fraser (editor), Standardization of zooplankton sampling methods at sea, p. 153-159. UNESCO Monogr. Oceanogr. Methodol. 2, Zooplankton sampling.