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INTRODUCTION

Only a few investigations have been carried out on Hydrozoa from the Red Sea, the Suez Canal and the Gulf of Aden. A list of the hydropolyps recorded from these regions was provided by Schmidt (1972a) together with some new records from the Gulf of Aqaba. Previously eleven species of hydromedusae were known from the Red Sea (Haeckel, 1879; Keller, 1883; Vanhöffen, 1902, 1908, 1911; Kramp, 1968). Browne (1926) reported some genera from the Suez Canal, among them only the species *Turritopsis nutricula.* Additional species were reported by Furnestin (1958), Halim (1969) Schmidt (1972b, 1973a) and Schmidt and Klinker (1974).

Kramp (1959) published a survey on hydromedusae of the Atlantic Ocean and adjacent seas, but only a few important papers on the Mediterranean Sea have been published (Kramp, 1924; Ranson, 1936; Babnik, 1948; Hure, 1955). Except for some data from the »THOR«-Expedition (1908 to 1910), the knowledge of hydromedusae is generally restricted to those areas where biological laboratories are located: the south coast of France, the Gulf of Naples and the Adriatic Sea. The publications of Vannucci (1966), Berhaut (1969a, b), Albertini-Berhaut (1970a, b), Brinckmann-Voss (1970) and Goy (1972) also deal with the western basin. The northern coast of Africa and the entire eastern basin of the Mediterranean are insufficiently investigated. Papers concerning hydromedusae from the Eastern Mediterranean include Kramp (1924, 1959), Komarovsky (1959) and Dowidar and El-Maghraby (1970). A total of 133 plankton samples from this area were studied for hydromedusae (Schmidt, 1973d).

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METHODS AND MATERIALS

The study of the hydromedusae reported in this paper are based on the examination of 480 plankton samples from the Red Sea and 133 from the Eastern Mediterranean. The plankton samples were collected by various expeditions and by the author. Detailed information on the collections are given in Schmidt, (1972a, b; 1973a, b, c, d).

RESULTS

The list at the end of this paper includes all the hydromedusae found in the Red Sea (C) and/or the Eastern Mediterranean (B) to the present. It is based on the data available in the literature cited above and the results of the author's research. The nomenclature of Kramp (1961) is followed. The planktonic polyp generations of *Velella velella* and *Porpita porpita* are included. To allow an easy comparison, records of species are marked for the Western Mediterranean (A) the Gulf of Aden (D). The latter is a link between the Red Sea and the Indian Ocean. Species which apparently migrated through the Suez anal are designated (F). The Pacific and Atlantic Oceans are not taken in account.

List of hydromedusae recorded from the Red Sea and/or the Eastern Mediterranean Sea. — A Western Mediterranean; B — Eastern Mediterranean; C — Red Sea; D — Gulf of Aden; E — Indian Ocean; F — Suez Canal — migrants.

Anthomedusae	A	B	C	D	E	F
Dicodonium cornutum	—	—	+	—	—	—
Euphysa aurata	+	—	+	+	+	—
Euphysilla pyramidata	—	—	+	—	+	—
Euphysora annulata	—	—	+	—	+	—
E. bigelowi	—	+	+	—	+	+
Vannuccia forbesii	+	—	+	+	+	—
Velella velella	+	—	+	—	+	—
Porpita porpita	+	+	+	+	+	—
Halocordyle disticha var. *aus.*	+	—	+	—	+	—
Pachycordyle conica	—	—	+	+	—	—
Zanclea costata	+	—	+	—	+	—
Z. dubia	—	—	+	—	+	—
Z. orientalis	—	—	+	+	+	—
Cytaeis tetrastyla	+	—	+	+	+	—
Oceania armata	+	+	+	—	+	—
Turritopsis nutricula	+	+	+	—	+	—
Podocoryne meteoris	—	—	+	+	—	+
P. minima	+	—	+	+	—	+
Allorathkea ankeli	—	—	+	—	—	—
Bougainvillia fulva	—	—	+	+	+	—
B. muscoides	—	—	+	—	—	+
B. platygaster	—	—	+	—	+	—
B. ramosa	+	—	+	—	+	—
Köllikerina fasciculata	+	+	+	—	+	+
K. multicirrata	—	—	+	—	+	—
K. octonemalis	—	—	+	—	+	—
K. ornata	—	—	+	—	+	—

List cont'd.

	A	B	C	D	E	F
Thamnostoma eilatensis	−	−	+	−	−	−
Amphinema rugosum	+	−	+	−	+	−
Leuckartiara gardineri	−	−	+	−	+	−
L. octona	+	+	+	−	+	−
Merga violacea	+	+	+	+	+	−
Pandea conica	+	+	−	−	+	−
Pandeopsis scutigera	−	−	+	−	+	−
Protiara tropica	−	−	+	−	+	−
Zancleopsis gotoi	−	−	+	−	+	−
Bythotiara murrayi	+	+	−	−	+	−
Heterotiara anonyma	−	−	+	+	+	−
Leptomedusae	A	B	C	D	E	F
Laodicea fertilis	−	−	+	−	−	−
L. fijiana	−	+	−	−	−	+
L. indica	−	−	+	+	+	−
Gastroblasta timida	−	−	+	−	−	−
Obelia spp.	+	+	+	+	+	−
Phialidium ambiguum	−	−	+	−	−	−
P. hemisphaericum	+	+	+	−	+	−
P. lomae	−	−	+	−	−	−
P. malayense	−	−	+	−	+	−
Eucheilota menoni	−	−	+	−	+	−
E. tropica	−	−	+	−	+	−
E. ventricularis	−	−	+	−	+	−
Lovenella assimilis	−	−	+	−	+	−
L. cirrata	+	+	−	−	+	−
Phialella quadrata	+	+	−	−	−	−
Octophialucium indicum	−	−	+	−	+	−
Phialucium carolinae	−	−	+	−	+	−
Eirene kambara	−	−	+	−	−	−
E. tenuis	−	−	+	−	+	−
E. viridula	+	+	+	+	+	−
Helgicirrha schulzei	+	+	+	−	−	+
Eutima commensalis	−	−	+	−	+	−
E. curva	−	−	+	−	+	−
E. gegenbauri	+	+	−	−	+	−
E. hartlaubi	−	−	+	+	+	−
E. levuka	−	−	+	−	+	−
E. mira	−	+	−	−	−	−
E. modesta	−	−	+	+	−	−
Aequorea aequorea	+	+	+	−	+	−
A. australis	−	−	+	−	+	−
A. coerulescens	−	−	+	+	+	−
A. macrodactyla	−	−	+	+	+	−
A. parva	−	−	+	+	+	−
A. pensilis	−	−	+	−	+	−
Limnomedusae	A	B	C	D	E	F
Odessia maeotica	+	+	−	−	−	−
Gossea corynetes	−	+	−	−	+	−
Proboscidactyla ornata	+	−	+	+	+	−
Trachymedusae	A	B	C	D	E	F
Liriope tetraphylla	+	+	+	+	+	−
Geryonia proboscidalis	+	+	+	−	+	−
Petasus eucope	−	−	+	−	+	−
Halitrephes maasi	−	−	+	−	+	−
Aglaura hemistoma	+	+	+	+	+	−
Colobonema sericeum	−	−	+	+	+	−
Pantachogon haeckeli	+	+	+	+	+	−
Rhopalonema funerarium	+	+	+	+	+	−

List cont'd.

	A	B	C	D	E	F
R. velatum	+	+	+	+	+	—
Sminthea eurygaster	+	—	+	—	+	—
Narcomedusae	A	B	C	D	E	F
Solmundella bitentaculata	+	+	+	+	+	—
Pegantha aureola	—	—	+	—	—	—
P. forsskalii	—	—	+	—	—	—
Pegantha laevis	—	—	+	+	+	—
P. martagon	—	—	+	+	+	—
P. rubiginosa	+	+	—	—	—	—
P. triloba	+	—	+	+	+	—
Cunina frugifera	—	—	+	+	+	—
C. octonaria	+	+	+	+	+	—
C. peregrina	—	—	+	—	+	—
C. tenella	—	—	+	+	—	—

In contrast to the Red Sea (86 species) and the western part of the Mediterranean (115 species), only 30 hydromedusae are known from the eastern basin (Table 1). Of these species, 26 are recorded from the western part as well as 19 in all three mentioned regions. Except for four species, the hydromedusae of the eastern part are well distributed in the Mediterranean and other warm and temperate waters. Kramp (1959) suggested that the relatively high salinity is responsible for the poverty of hydromedusae in the Eastern Mediterranean. This opinion was refuted by laboratory experiments (Werner, 1968) and the previous records from the Red Sea which has a salinity higher than that of the Mediterranean (Schmidt, 1973a, b; Schmidt and Klinker, 1974).

Table 1. The number of hydromedusae species in different regions. If more than one region is indicated, the species are recorded from the other regions.

	Antho-medusae	Lepto-medusae	Limno-medusae	Trachy-lina	Total
Eastern Mediterranean	9	10	2	9	30
Western Mediterranean	55	29	6	25	115
Red Sea	36	29	1	20	86
Eastern and Western Mediterranean	8	8	1	9	26
Red Sea and Western Mediterranean	15	5	1	10	31
Red Sea and Eastern Mediterranean	7	5	0	8	20
Red Sea, Eastern and Western Mediterranean	6	5	0	8	19

Another way to calculate the density of species is to compare the number of species with the number of samples in which they were found. This can be done if the samples were taken with a standardized method or if their number is high enough. The number of species can then be divided by the number of samples. This has been done for the material the author checked from the Red Sea and the Eastern Mediterranean. The values of the latter region are provided in Table 2. It is important to note that not all the samples

used for calculation were taken quantitatively. But in this case the results are clear, even for an error of 100 percent. A value of 0.24 was calculated for open sea stations in the Eastern Mediterranean. This low value is of the same order of magnitude as the number of species per sample in the northern part of the Gulf of Aqaba. All other areas of the Red Sea show comparatively higher values. Even the average for the Red Sea is five to eight times higher (Schmidt, 1973a). The proportions are similar after splitting the species into orders or suborders. In the samples from the coastal stations (profiles off the coast of Israel), about 50 percent of the density of the open sea stations could be determined.

Table 2. The number of hydromedusae species per sample in the Eastern Mediterranean Sea. The number of species was divided by the number of samples in which these species were found. The calculation is based on the results in Schmidt (1973 d).

	Antho-medusae	Lepto-medusae	Trachy-medusae	Narco-medusae	Total
Coastal waters	0.06	0.06	0.08	0.04	0.24
Open sea	0.01	0.06	0.05	0.01	0.14
All stations	0.02	0.05	0.03	0.02	0.11

The previously recorded hydroids from the Red Sea have been divided into three groups (Schmidt, 1973c): The Indo-Pacific-Atlanto-Mediterranean species (IPAM), the Indo-Pacific species (IP) and the Atlanto-Mediterranean species (AM). The IPAM-species are cosmopolitian and have penetrated from the Indo-Pacific waters into the Red Sea through the Bab el Mandeb. Some of these species are recorded from the Suez Canal and theoretically could have penetrated from the north to the south. The IP-species are restricted to the Indian and Pacific Oceans. They undoubtedly migrated from these waters into the Red Sea. *Thyroscyphus fruticosus* and *Halocordyle disticha* var. *australis* were transported into the Mediterranean through the Suez Canal. The migratory route of *Filellum serratum* cannot be confirmed. Five hydroids belonging to the AM-species have been found near the harbor of Elat by diving and include *Tubularia larynx, Tubularia mesembryanthemum, Eaomedea dichotoma, Sertularella mediterranea and Kirchenpaueria pinnata.* It is quite certain that these species have been transported via the Suez Canal.

It is possible to divide the hydromedusae into the same three groups (IPAM, IP and AM) as was done with the hydropolyps. *Podocoryne meteoris, Köllikerina fasciculata* and *Helgicirrha schulzei* undoubtedly have been transported through the Suez Canal into the Red Sea. *Köllikerina fasciculata* has even been recorded in the Arabian Sea (Vannucci and Navas, 1973). *Helgicirrha schulzei* was only found near the Dahlak Archipelago, whereas the other two species are widely distributed in the Red Sea. *Podocoryne minima* and *Bougainvillia muscoides* belong not only to the AM-group but they also exist in the Pacific Ocean. Their transport through the Canal is possible. Two species of the IP-group passed through the Canal into the Eastern Mediterranean: *Laodicea fijiana* was found near the Egyptian coast and *Euphysora bigelowi* near Cyprus (Schmidt, 1973d). *Laodicea fijiana* was recorded from the Indian Ocean by Navas (1971), but was not found in the Red Sea.

DISCUSSION

The Hydrozoa raise a number of systematical problems caused essentially by two nearly separated systems for hydropolyps and hydromedusae. Therefore, it might be possible that new findings in life cycles change the results based on the present systematics. The statements based on the relation of species to number of samples should not be considered too important. Here and in all other cases the known mistakes of plankton sampling should be included. It is clear that 133 samples are not enough to draw valid conclusions but they can give hints for further research.

CONCLUSIONS

The scarcity of species of hydromedusae in the Eastern Mediterranean is obvious. The most probable explanation for the difference in the number of species is the lack of research and specialists for this group in that area. Further investigations should result in many new records. Another explanation for the low density of hydromedusae might be the lack of substrata for hydropolyps. Conclusions as to whether a hydroid or a hydromedusae has been transported through the Suez Canal are based only on their geographical distribution. Nothing is actually known about the manner of Hydroida passage through this water-way. But it seems probable that the Hydroida, representatives of a meroplanktonic group of animals, have the possibility of transport through the Suez Canal.

SUMMARY

This comparison is based on 480 plankton samples from the Red Sea and 133 from the Eastern Mediterranean, originating from various expeditions and from the author's collections. Relating total number of hydromedusae species to the number of samples taken either in various regions of the Red Sea or in the coastal or oceanic waters of the Mediterranean shows that there are twice as many species of hydromedusae on the average in the oceanic waters of the Eastern Mediterranean than in coastal waters. Only samples from Elat show comparably low numbers of species, the average for the Red Sea being five to eight times higher. The Eastern Mediterranean is, therefore, conspicuously poorer in species than the Red Sea, even on the level of orders and suborders within the hydromedusae.

Three hydromedusae, which were known previously from the Atlantic and Mediterranean waters only, are recorded from the Red Sea. A transport through the Suez Canal seems to be sure. On the other hand, two hydromedusae have been transported in the opposite direction. Little is known about faunistics and ecology of hydroids from the Eastern Mediterranean. Until now 49 species are known from the Red Sea, the majority from hard subtrates, making a comparison with the Eastern Mediterranean difficult where the hard substrates are relatively scarce. Five species of hydroids of Atlanto-Me-

diterranean origin could be found in the Red Sea. A transport through the Suez Canal is to be assumed. So far only two species seem to have been transported in the opposite direction.

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USPORENI STUDIJ HIDROIDNE FAUNE ISTOČNOG MEDITERANA I CRVENOG MORA

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KRATAK SADRŽAJ

U radu je izvršena usporedba planktonskog materijala iz Crvenog mora (480 uzoraka) i materijala iz istočnog Mediterana (133 uzorka). U istočnom Mediteranu u prosjeku se javlja dva puta više vrsta u otvorenom moru nego u obalnim vodama. U Crvenom moru srednje vrijednosti broja vrsta su za pet do osam puta više nego u istočnom Mediteranu. Jedino su uzorci iz Elata relativno siromašni vrstama. Iz ove usporedbe se vidi da se u istočnom Mediteranu javlja upadno manje vrsta nego u Crvenom moru. To isto se zapaža i na razini redova i podredova hidromeduza.

Tri hidromeduze, koje su otprije bile poznate samo za atlantske i mediteranske vode, zabilježene su u Crvenom moru, što ukazuje na transport kroz Sueski kanal. Dvije hidromeduze transportirane su u obrnutom smjeru. Faunistika i ekologija hidroida istočnog Mediterana slabo su poznate. U Crvenom moru je do sada poznato 49 vrsta. To su uglavnom vrste koje se javljaju na čvrstim supstratima, što otežava usporedbu s istočnim Mediteranom gdje su takvi supstrati relativno rijetki. U Crvenom moru javlja se pet vrsta hidroida koje su atlantskomediteranskog porijekla, što se tumači transportom kroz Sueski kanal. Samo se za dvije hidromeduze pretpostavlja da su bile transportirane u obrnutom smjeru.