

## Distribution of hydromedusae from the exclusive economic zone of the west and east coasts of India

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Distribution and abundance of hydromedusae from the exclusive economic zone of the west and east coasts of India is carried out based on zooplankton collections (on board *FORV Sagar Sampada*) during the period 1985-1990. The 661 samples collected from 28 cruises of west and east coasts were analysed. Eighty species of 43 genera were observed. In the west coast highest population density was found from the southwest region whereas in the east coast it was from the north eastern part. *Aglaura hemistoma* was the most dominant species of west coast while *Liriope tetraphylla* was that of the east coast. *Solmundella bitentaculata* was the next abundant species of both the coasts. *Cytaeis tetrastyla*, *Rhopalonema velatum* and *Crossota alba* were the next commonly occurring species of west coast while *Rhopalonema velatum*, *Cytaeis tetrastyla*, *Bougainvillia fulva* and *Phialidium hemisphaericum* were the common forms of the east coast. *Aequorea conica* was noticed in swarms from west coast. The study indicates the richness of hydromedusae along the coastal waters of India.

Gelatinous zooplankton often function as key organisms in pelagic ecosystem<sup>1</sup>. Hydromedusae are important in the sense that they are exclusively carnivores and moreover, they are predators and hence they compete with other predators like fish larvae. During the International Indian Ocean Expedition, (I.I.O.E.) coastal areas were not thoroughly sampled. The Exclusive Economic Zone (EEZ) of India form about two-thirds of India's land mass. The available information on the distribution and abundance of hydromedusae are mainly for the west coast<sup>2-5</sup>. Ganapati & Nagabhushanam<sup>6</sup> reported the seasonal distribution of hydromedusae from Visakhapatnam coast. Distribution of hydromedusae based on the I.I.O.E. samples were studied by a few authors<sup>7-9</sup>. The present study is focused to fill the lacuna and it is based on the materials collected on board *FORV Sagar Sampada* during the period 1985-1990 from the EEZ of both west and east coasts of India.

### Materials and Methods

Zooplankton samples were collected from 28 cruises on board *FORV Sagar Sampada* during the

period 1985-1990. Oblique hauls were taken using a Bongo-60 net (mesh aperture 0.33 mm) equipped with a calibrated flow meter. Samples were preserved in 5% formaldehyde seawater solution and hydromedusae were separated, analysed and studied up to species level. The sampling details are given in the cruise reports of 1985 to 1990 of Central Marine Fisheries Research Institute, Cochin. The estimated abundance of hydromedusae is expressed as number/1000 m<sup>3</sup>.

### Results and Discussion

#### Environment

Arabian Sea Surface Watermass (ASSW) is found from surface to a depth of 100 to 150 m in the Arabian Sea and the higher salinity (>36‰) is traceable throughout its geographic region while surface salinity went down to 31‰ very near to the shore in certain areas. Everywhere temperature is higher than 21° and up to 30°C in northern part. High temperature values were found near the coasts as isolated patches. The dissolved oxygen content drops steadily below 50 m depth down to 1.13 ml/l. The southwest coast of India is under the influence of the monsoons, that cause a bi-annual reversal of the

surface gyre with the phenomena of upwelling especially intense during the southwest monsoon.

Bay of Bengal is like a large estuary; its surface waters have high temperature, low salinity and the latter decreasing northward<sup>10</sup>. Surface temperature of the EEZ of east coast varied from 24-30.5°C and the high values were noticed as localised patches near the coasts. Surface salinity found to be low, less than 30‰ and the highest value was 36‰ in the southern side. Dissolved oxygen value of the surface water varied from 4-7 ml/l. Devassy *et al.*<sup>11</sup> recorded the details of hydrographic conditions of Bay of Bengal. The present study materials are from the Arabian Sea surface watermass (ASSW) and Bay of Bengal Surface Watermass (BBSW).

#### Species composition

This study is based on 305 zooplankton samples from the west coast from Kandla to off Capecomorin and hydromedusae were found from 244 samples with 80% representation. Out of the 356 zooplankton samples collected from the east coast, from Sri Lanka to Calcutta coasts, hydromedusae were obtained from 273 samples having 76.7% occurrence. Eighty species of 43 genera were noticed from the EEZ of the west and east coasts of India. The species recorded are *Sarsia mirabilis*, *Euphysa aurata*, *E. tetrabrachia*, *E. japonica*, *Hybocodon forbesi*, *H. unicus*, *H. atentaculata*, *Ectopleura sacculifera*, *E. demortieri*, *Euphysora begelowi*, *E. normani*, *Zanclaea dubi*, *Cnidocodon leopoldi*, *Cladonema sp.*, *Cytaeis tetrastyla*, *C. vulgaris*, *Lizzia gracilis*, *Podocoryne apicata*, *Bougainvillia fulva*, *B. platygaster*, *B. bitentaculata*, *B. rumosa*, *Kollikerina octonemalis*, *Merga tergestina*, *Octotiarra russeli*, *Leukartaria octona*, *Pandea conica*, *Bythotiarra murrayi*, *Heterotiarra minor*, *Obeilia spp.*, *Phialidium hemisphaericum*, *P. brunescens*, *P. simplex*, *P. globosum*, *Eucheilota menoni*, *E. paradoxica*, *E. tropica*, *Phialucium condensum*, *P. carolinae*, *P. multitentaculatum*, *Octophialucium indicum*, *O. begelowi*, *Eirene ceylonensis*, *E. menoni*, *E. hexanemalis*, *Helgicirrho malayansis*, *Eutima curva*, *E. mira*, *E. commensalis*, *Aequorea aequorea*, *A. conica*, *A. parva*, *A. globosa*, *Proboscicidactyla ornata*, *Rhopalonema velatum*, *R. funarium*, *Pantachagon scotti*, *P. haeckaeli*, *Amphagone apicata*, *A. apsteini*, *Amphinema rugosum*, *Crossota alba*, *C. octonemalis*, *C. pedunculata*, *Aglaura hemistoma*, *Aglantha elata*, *A. digitata*, *A. intermedia*, *Geryonia proboscidalis*,

*Liriope tetrphylla*, *Aegina citra*, *Solmundella bitentaculata*, *Pegantha clara*, *Solmaris lenticulata*, *Cunina duplicata*, *C. ontonaria*, *C. perigrina* and *C. tenella*.

Among the 80 species *Euphysa tetrabrachia*, *Euphysa aurata*, *Hybocodon atentaculata*, *Ectopleura sacculifera*, *Cladonema sp.*, *Pandea conica*, *Bythotiarra murrayi*, *Heterotiarra minor*, *Eucheilota paradoxica*, *Eirene menoni*, *E. commensalis*, *Amphagone apsteini*, *Crossota pedunculata*, *Aglantha digitata*, *A. intermedia* and *Cunina perigrina* were recorded only from the west coast. Species confined to the east coast were *Sarsia mirabilis*, *Ectopleura demortieri*, *Lizzia gracilis*, *Bougainvillia bitentaculata*, *B. rumosa*, *Octotiarra russeli*, *Phialidium globosum*, *Eucheilota tropica*, *Phialucium cavolinae*, *P. multitentaculatum*, *Eirene ceylonensis*, *E. hexanemalis*, *E. mira*, *Aequorea globosa*, *A. pensilis*, *Pantachagon haeckaeli*, *Amphinema rugosum*, *Crossota octonemalis*, *Solmaris lenticulata* and *Cunia duplicata*.

In west coast, the highest density of medusae were found from the southwest region between Ratnagiri to Capecomorin (Fig. 1). In species diversity also southwest area occupied highest position. Maximum density of medusae was found off Ratnagiri. In the east coast the highest density was observed from off Kakinada to off Paradip. The maximum abundance, 5941/100 m<sup>3</sup>, was obtained off Paradip. High densities were noticed from Madras and Visakhapatnam coasts. *Aglaura hemistoma* was the most dominant species of west coast with 72% representation (Figs 2, 3). Highest densities of this species were observed between off Ratnagiri and off Cochin and low density was noticeable towards north. *Liriope tetrphylla* was the next abundant species with a representation of 70%. Maximum density was obtained quite near to the shores, from Mangalore to Capecomorin and then off Bombay (Fig. 4). *Liriope tetrphylla* occupied the dominant position with 71.1% representation in the east coast (Fig. 3). *Aglaura hemistoma* was the second dominant species of east coast (Fig. 2). Both these species are warm water, holoplanktonic, euryhaline and eurythermal. *Solmundella bitentaculata* occupied the next position in abundance and showed 67% occurrence (Fig. 5). In the east coast also this species ranked third position (Fig. 5) with 34.5% representation (Fig. 3). This species is also euryhaline, eurythermal and tolerates low oxygen levels down to 0.2 ml/l. The highest

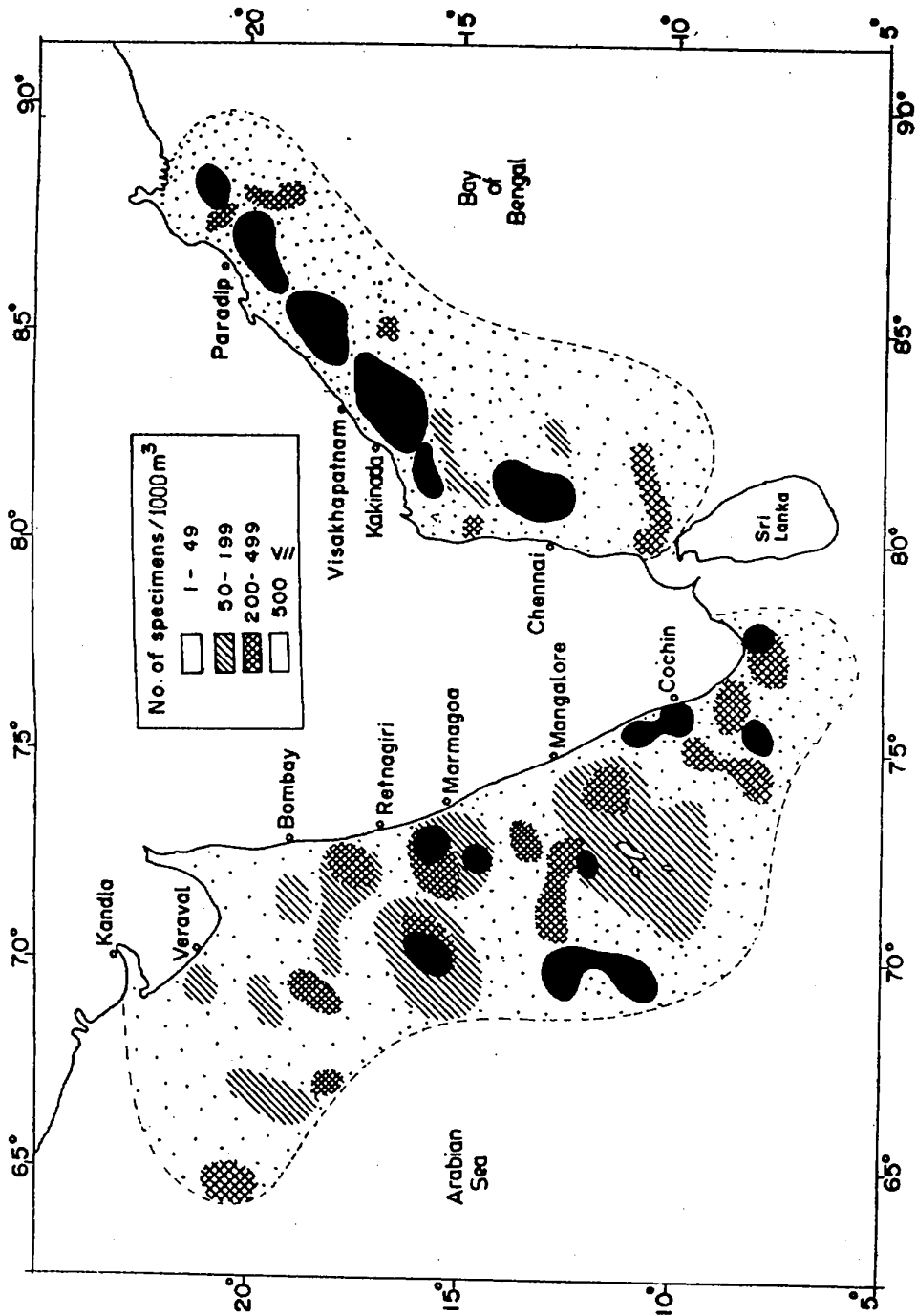


Fig. 1—Distribution of hydromedusae from EEZ of west and east coasts of India during 1985-1990.

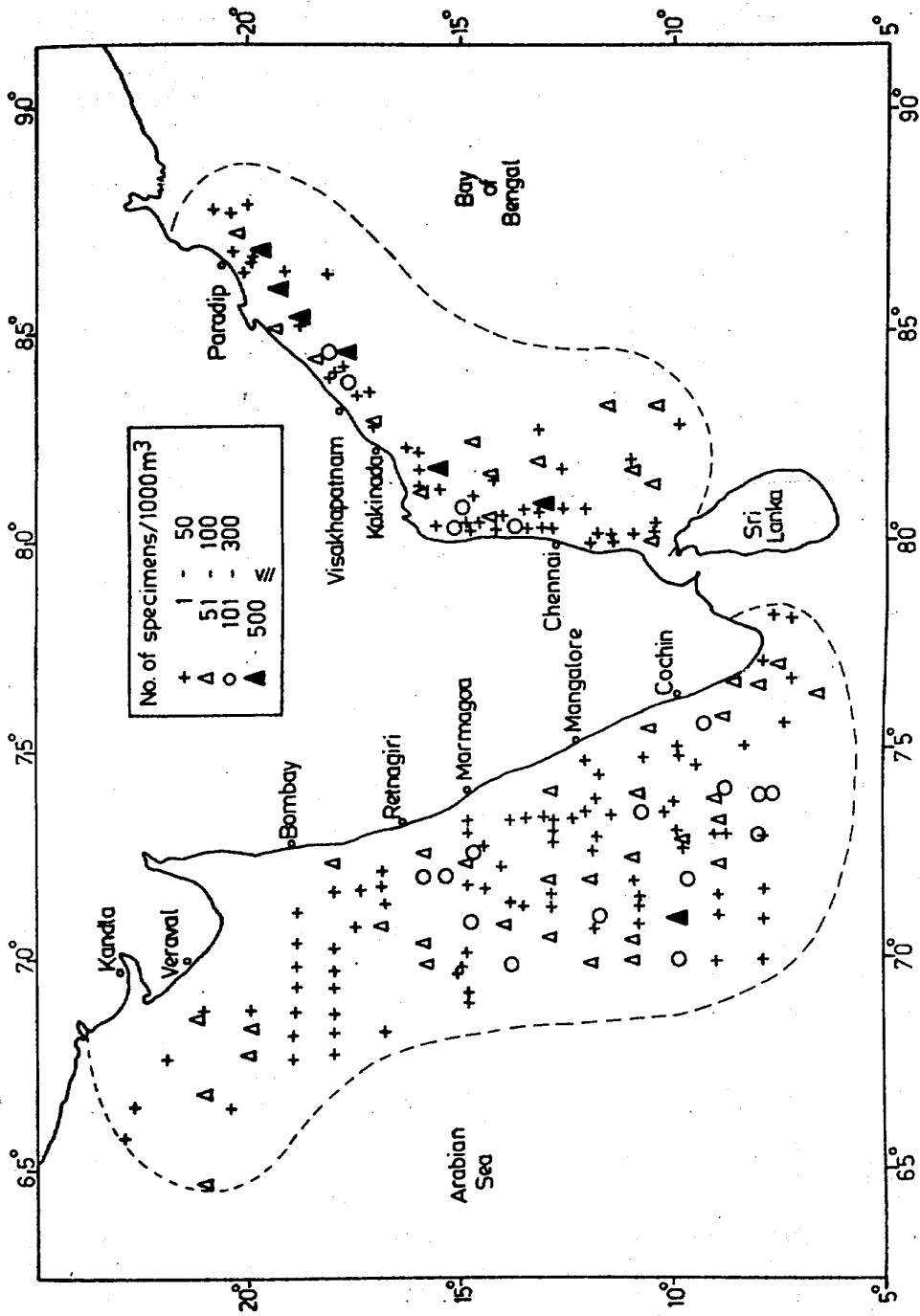


Fig. 2—Distribution and abundance of *Aglaura hemistoma*

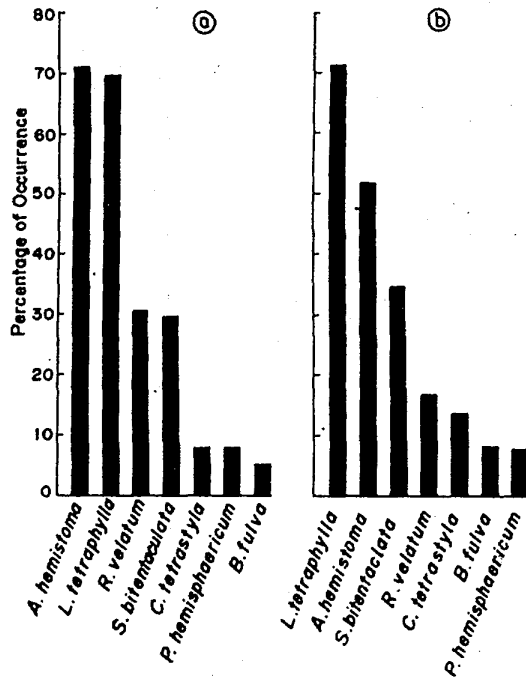


Fig. 3—Percentage occurrence of commonly occurring species in the west coast (a) and east coast (b).

density of this species was recorded off Goa, off Mangalore and off Capecomorin (Fig. 5). *Cytaeis tetrastyla* represented fairly well in the west coast especially from off Mangalore to off Capecomorin. *Rhopalonema velatum* the next abundant form and distributed in almost all watermasses. *Crossota alba* was found more in the southwest coast and probably it might have come from the subsurface watermass which emerged due to upwelling in this area. Earlier it was recorded from Indian Ocean Equatorial Watermass<sup>8</sup>. *Aglantha elata*, a deep water species caught from the upwelled areas of the southwest coast and Kramp<sup>12</sup> also observed this species from the upwelling areas of the west coast India. *Aequorea conica* was collected from the nearshore regions especially from Goa to Capecomorin and its maximum density (3182/1000 m<sup>3</sup>) off Cochin. A maximum of 181/m<sup>3</sup> of *Aequorea conica* was observed off Canannore<sup>13</sup>. *Phialidium hemisphaericum*, a widely distributed species occurred rarely in swarms. *Phialidium indicum* was present in swarm off Kandla and it was reported earlier from Bay of Bengal surface water<sup>14</sup>. *Octophialucium indicum*, *Bougainvillia fulva*, *Aglantha elata*, *A. digitata*,

*Aequorea aequorea*, *Eutima elliceana*, *Cuninc tenella*, *Cnidocodon leopoldi*, *Phialidium brunescens*, *Amphagon apicata* and *Eucheilota menoni* were commonly found in few numbers. Rest of the species were rarely seen from very few stations. *Eutima commensalis* was considered as an endemic species to Cochin estuary while its occurrence from offshore area might be quite accidental.

Maturity stages of *Aequorea conica*, *Liriope tetraphylla*, *Solmundella bitentaculata* and *Cytaeis tetrastyla* are depicted in Fig. 6. Juveniles and immature stages were dominated in the samples and the representation of adults especially of *Solmundella bitentaculata* was very low. All the samples of the present work were put under day and night categories and a marginal increase in values was noticed from night collections. Monthly analysis of hydromedusae were done and the postmonsoon season was found to be favourable for them. During this season food availability was more.

Arabian Sea Surface Watermass and Bay of Bengal Surface Watermass do not extend below 200 m depth. All the samples studied here taken from 150 m depth to surface. *Aglaura hemistoma* was found to be the dominant species of west coast while *Liriope tetraphylla* was the most dominant form of east coast.

Earlier findings also showed the same type of observation of these species in Arabian Sea and Bay of Bengal. In species composition Anthomedusae and Leptomedusae species represented more from the EEZ of west and east coasts of India and all these medusae have a hydroid stage in their life cycle. The cosmopolitan holoplanktonic species like *Aglaura hemistoma*, *Liriope tetraphylla* and *Solmundella bitentaculata* are those of the ASSW and BBSW species and all of them require high temperature, salinity and also they are quite tolerant of dissolved oxygen content variations. During January to April there is an increase of surface temperature and salinity which may be the optimum for richness and bulk. Shetye<sup>15</sup> and Shetye *et al.*<sup>16</sup> showed that the longshore component of the wind stress along the west coast of India is conducive to upwelling throughout the year but reaches a peak in July – August. Upwelling along the west coast appears to start in the southern regions (9°N) with the onset of summer season and intensifies in July – August and it gradually proceeds north and has been observed up to 15°N. Murthy & Varadachari<sup>17</sup> recorded upwelling along the east coast of India. In the upwelled areas

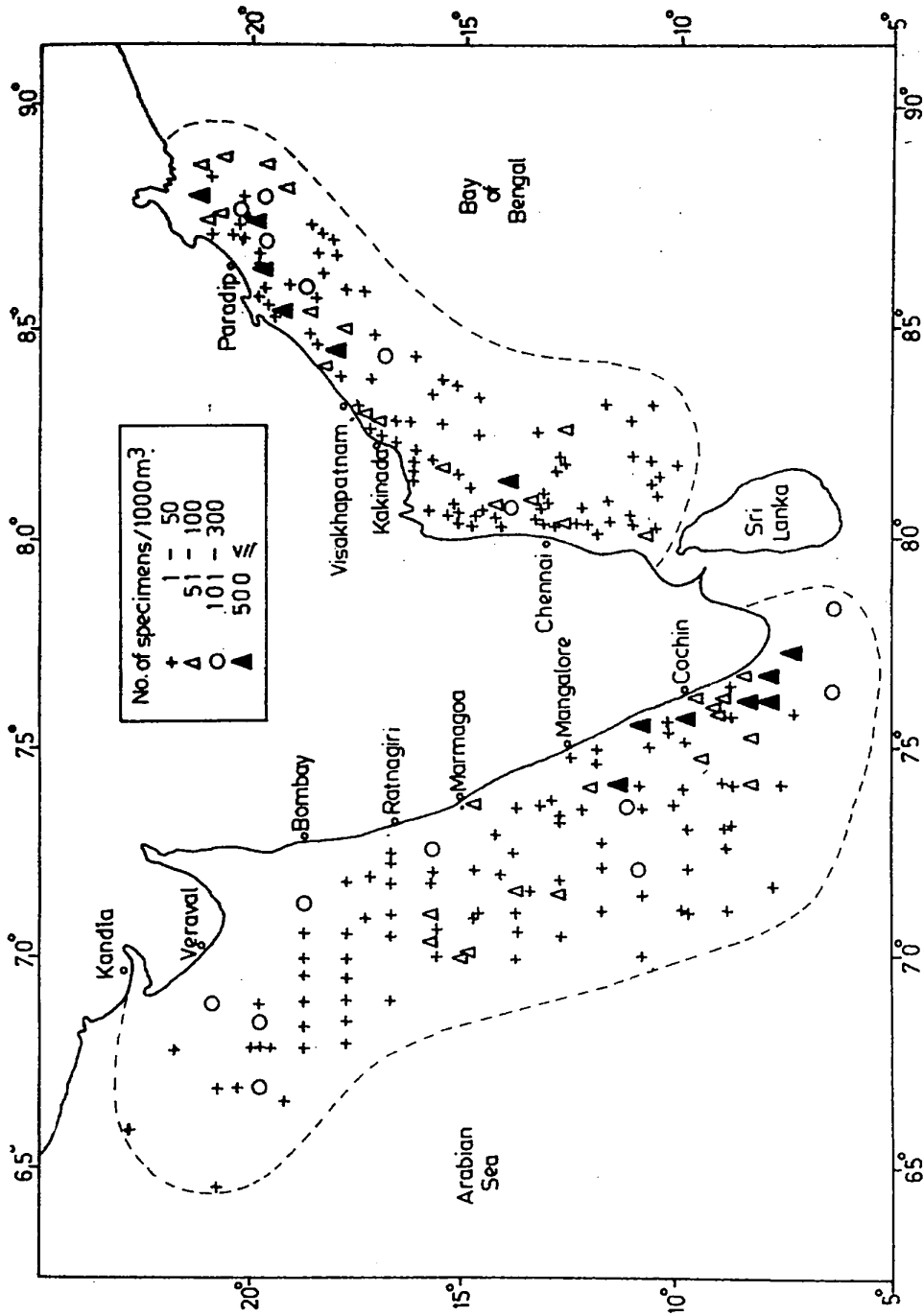


Fig. 4.—Distribution and abundance of *Liriope tetraphylla*.

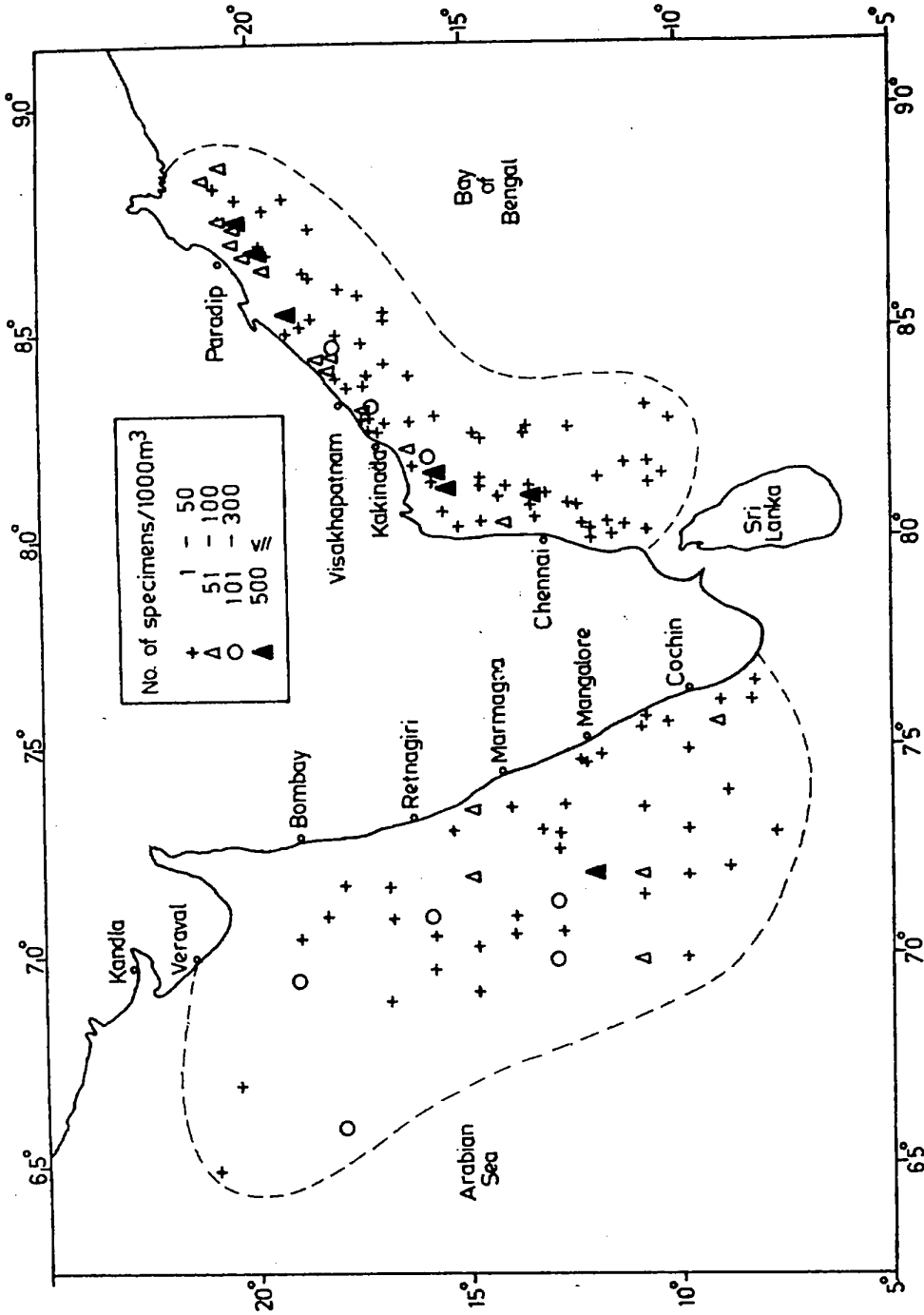


Fig. 5—Distribution and abundance of *Solmundella bitentaculata*

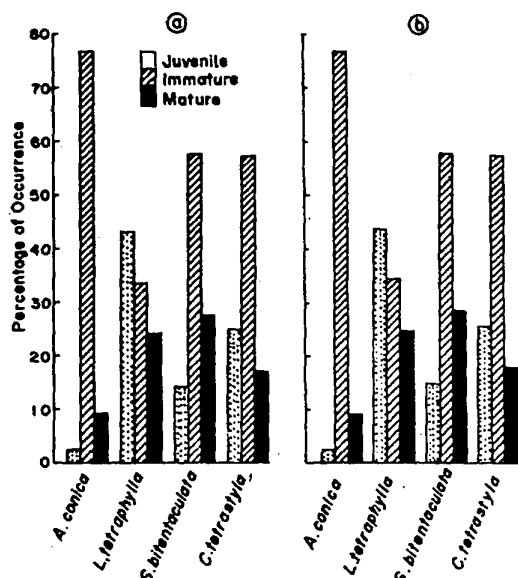


Fig. 6—Percentage composition of the different maturity stages of *Aequorea conica*, *Liriope tetraphylla*, *Solmundella bitentaculata* and *Cytaeis tetrastyla* in the (a) west coast and (b) east coast

there will be plenty of food available and the density of a population always depends on the availability of suitable food material. Factors such as salinity, temperature, currents, suitable food availability, breeding seasons of the parent stock etc. regulate the distribution of medusae during different seasons of the year. Highest densities are reported in postmonsoon season when salinity is high (>35‰). High aggregations of zooplankton above the thermocline during day and night have been recorded from the Irish Sea<sup>18</sup>. Margalef<sup>19</sup> suggested that coastal upwelling systems are less mature and organisation is prevented from increasing in the upwelling areas by vertical movements and its variability, food chains are kept shorter. Kramp reported that the rise in temperature as the reason for the distinct increase in production of meroplanktonic hydromedusae. Here, in this tropical water, temperature variation is comparatively less and perhaps influence of temperature may not affect much. Earlier records coincide with the present findings that some species make use of the suitable available food material and rapidly increase their number and at times in the coastal waters and estuaries the entire zooplankton will become nothing but hydromedusae. Bridge<sup>23</sup> considered dominance as a measure of successful

evolution. Mc Gown & Walker<sup>22</sup> suggested predation as the significant factor controlling diversity.

The study indicates the richness of hydromedusae along the coastal waters of India. There is well-defined enhancement in population density towards south along the west coast while a reverse trend was obtained on the east coast. The tropical environmental conditions appear to be congenial to support a diverse community of Hydromedusae.

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