

CHONDROPHORA OF THE INDIAN OCEAN*

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ABSTRACT

The detailed study of the order Chondrophora based on the literature and on the collections of the R.V. *Vityaz*, INS *Kistna*, and R.V. *Diamantina* from the oceanic regions and from the coasts of India and Great Nicobar Island has revealed that only one species each of the genera *Porpita* Lamarck, *Porpema* Haeckel and *Velella* Lamarck occur in the Indian Ocean. In this paper, details regarding their locality records, with remarks on salient features and their variations of the material examined are presented. The dimorphism in *Porpita* (*P. porpita* Linne and *P. umbella* Muller), *Porpema* (*P. prunella* Haeckel and *P. globosa* Eschscholtz) and *Velella* Linne' and *V. lata* Chamisso and Eysenhardt) is explained as an adaptation for the prevention of total stranding of the species during that particular season. The seasonal distribution of these species in the different regions of the Indian Ocean i.e. Arabian Sea, Bay of Bengal including the Andaman Sea, Equatorial belt region, coast of South Africa and east coast of Australia, is also discussed correlating with oceanic currents and prevailing winds.

INTRODUCTION

THE CHONDROPHORA are aberrant pelagic tubularian anthomedusae having large floats invaginated at the aboral end, with ring of aboral tentacles; end of extension of wall of aboral chamber provided with mucus glands and gonozooids being borne on oral cone. They pass through the conaria larval stage (Delsman, 1923; Leloup, 1929, 1955; Totton, 1954). They were included with the siphonophores until Totton (1954) separated these diverse forms into distinct Order.

A detailed study of the Order Chondrophora based on the collections of the R.V. 'Vityaz' (35th cruise, 1962), I.N.S. 'Kistna' (25th cruise, 1964) and R.V. 'Diamantina' (3rd cruise 1962/3) from the oceanic regions and from the coasts of India and Great Nicobar Island has revealed that only one species each of the genera *Porpita* Lamarck (1801), *Porpema* Haeckel (1888), each with two sets of populations and *Velella* Lamarck (1801) with distinct dimorphic forms occur in the Indian Ocean. In this paper, details regarding the locality records, remarks on salient features, their variations in the material examined are presented. The geographical and seasonal distribution of these species in the Indian Ocean are discussed based on the present material and literature.

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Order *Chondrophora* (Chamisso & Eysenhardt, 1821)
= *Disconanthae* Haeckel, 1888

Two families, *Porpitiidae* Brandt, 1835, and *Velellidae* Brandt, 1835 are included in this Order.

Family *PORPITIDAE* Brandt, 1835

The family includes two genera *Porpita* and *Porpema*, the former with a flat, disc-shaped pneumatocyst and the latter with a strongly vaulted pneumatocyst.

Genus *Porpita* Lamarck, 1801

Bigelow (1911) revised this genus in detail and recognised three species of *Porpita*, *P. porpita* (Linne', 1758), *P. umbella* (O. F. Muller, 1776) and *P. pacifica* Lesson, 1826, on the basis of characters such as (1) the tubercles on the upper surface of the disc, (2) the arrangement of the stigmata, (3) comparative width of the limbus, (4) radial or branching arrangement of the canals of the limbus and (5) the number of the stalked tentacular nematocyst clusters on the tentacle. Moser (1925) however, followed Schneider (1898) in recognising only one species, *P. porpita* as valid. Later, Bigelow (1931) stressed the necessity for a critical comparative study of large series representing different growth stages from the three oceans before establishing the validity of species. Totton (1954) considered a single valid species *P. porpita* but retained the specific name *Umbella* in his list of species. In the present study, the *Porpitas* with varying characters are considered as two distinct populations of a single species *P. porpita*.

Porpita porpita (Linne' 1758) (Figs. 1a-d)

For synonymy cf. Bigelow, 1911, pp. 333, 353. Totton, 1954, p. 33. Daniel & Daniel, 1963, p. 186.

Material :

Station No.	Position		Date	No. of example	Z.S.I. Reg. No.	Remark
	Lat.	Long. E.				
V. 5179	.. 20°51'S	113°60'E	24-7-62	3	P 1627/1	Predominantly blue
V. 5204	.. 22°30'S	91°29'	25-8-62	1	—	"
V. 5214	.. 2°59'S	91°30'	4-9-62	4	P 1,13/1	"
V* 5218	.. 0°58'S	91°40'	7-9-62	12	P 1782/1	brownish yellow
V* 5221	.. 0°28'N	91°32'	9-9-62	2	P 1712/1	"
V. 5224	.. 2°00'N	91°33'	10-9-62	4	—	blue
V. 5225	.. 3°06'N	91°34'	12-9-62	2	P 1643/1	"
V. 5227	.. 5°03'N	91°32'	13-9-62	44	P 1706/1	"
V. 5230	.. 8°03'N	91°32'	15-9-62	34	P 1742/1	"
V. 5233	.. 13°20'N	91°32'	16-9-62	2	—	"
V. 5234	.. 13°20'N	90°00'	16-9-62	3	—	"
K. 361	.. 9°00'N	87°20'	12-6-64	3	—	"
Cambell Bay						
Great						
Nicobar	.. 6°50'N	93°50'	2-3-66	86	—	"

V = Vityaz ; K = Kistna ; * 'Umbella' population.

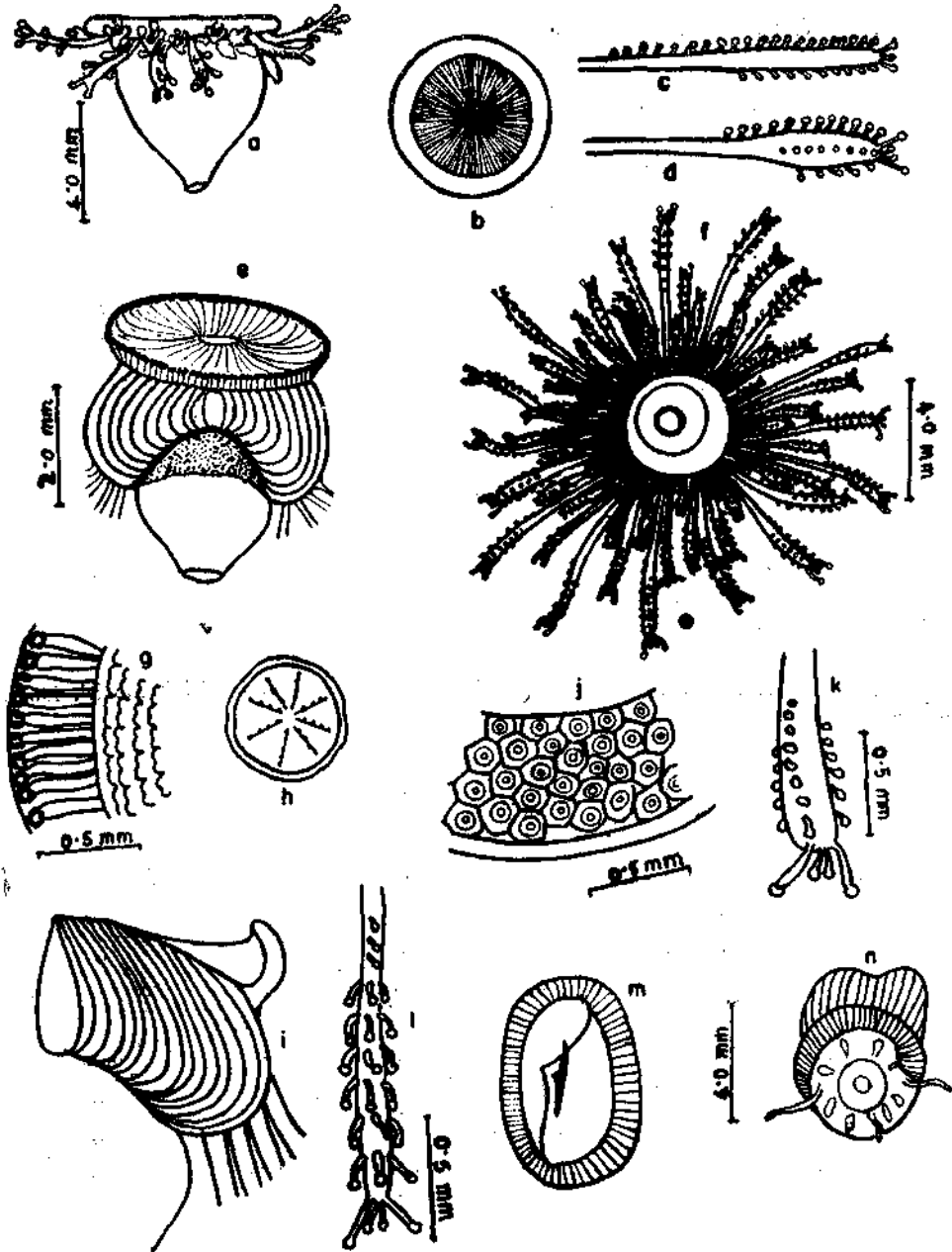


Fig. 1. a. *Porpita porpita* ('porpita' population-young); b. *Porpita porpita* ('umbrella' population showing broad limbus); c. Tentacle of *Porpita porpita* ('porpita' population); d. Tentacle of *Porpita porpita* ('umbrella' population); e. *Porpema prunella* ('globosa' population—side view); f. *porpema prunella* ('globosa' population—ventral view); g. 'globosa' population—enlargement of limbus; h. 'globosa' population—upper view showing eight rows of tubercles; i. 'globosa' population—enlarged view of the chambers; j. 'globosa' population—Tentacular zone showing bases of tentacles; k. 'globosa' population—young tentacle; l. 'globosa' population—mature tentacle; m. *Velella velella*—upper view, and n. *Velella velella*—ratartia stage.

[3]

In all the specimens the pneumatocysts are flat, disc-shaped with a thin central region and thicker margin. The examples from all the stations (except Vityaz station No. 5218 & 5221) bear numerous, prominent centrally placed tubercles on surface which are unconnected with the peripherally situated stigmata. The radial plications are not prominent. The limbus is narrow (5-6% of diameter) with canals forming an irregular net-work. The tentacles bear 14 to 29 stalked nematocyst clusters on the long rows, 11 to 14 on the two short rows and 3 at the tip. These are diagnostic features of the '*porpita*' population.

The specimens from Vityaz Stn. Nos : 5218 and 5221 differ from others in having fewer tubercles on surface. The radial plications are prominent. The limbus is broad (10-11% of diameter) with canals retaining the general radial arrangement. The tentacles bear 9 to 15 stalked nematocyst clusters on the long rows and 6 to 8 on the two short rows and 4 at the tip (2 long and 2 short). These are the distinguishing characters of the '*umbella*' population.

Distribution : The geographical distribution and seasonal occurrence in the Indian Ocean of the two populations of *Porpita porpita* are presented in Fig. 2. An analysis of the chart reveals that the species abounds in the warm regions of the three oceans. The '*porpita*' population is distributed in the Indo-Pacific, whereas the '*umbella*' population is distributed mainly in the Atlantic Ocean and the Mediterranean Sea. There appears to be no authentic record of the '*porpita*' population in the Atlantic Ocean or Mediterranean Sea, although as pointed out by Bigelow (1931) '*porpita*' may be expected to round the Cape of Good Hope from the Indian Ocean into the South Atlantic during January-March when the warm Agulhas current reaches the greatest westward extension when the surface temperature of South Western Africa is highest. The '*umbella*' population however, has been recorded from the Indian Ocean, in the Maldives (Bigelow, 1904) and near the Equator along longitude 90°E (present material). It is not clear whether Totton's records in the South East coast of Africa and (North West Indian Ocean are those of '*umbella*' population or the '*porpita*' population since the description of the species given in page 34 agrees with those of '*porpita*' population but listed as '*umbella*' on page 15. The '*umbella*' population has also been recorded in the Pacific Ocean at two places *i.e.* Tokora Island (Tokioka, 1953) and Indo-China Sea (Dawydoff, 1937).

In the oceanic region of the Indian Ocean the '*porpita*' populations seem to occur through out the year. The stranding of this population along the east coast of India takes place during the north-east monsoon period from October to December (Sundara Raj, 1927; Menon, 1931; Leloup 1931; Ganapathi and Subba Rao, 1959; Daniel & Daniel, 1963) and during March along the east coast of Great Nicobar Island (present study). Along the west coast of India the '*porpita*' populations have been recorded during the south-west monsoon period from May to August. The '*umbella*' populations have been recorded only twice in the Indian Ocean *i.e.*, during January, near the Maldiva Island (Bigelow, 1904) and in September 1962 near the Equator (present material).

Genus *Porpema* Haeckel, 1888

= *Porpalia* Haeckel, 1888

Bigelow (1911) retained both *Porpema prunella* (Haeckel, 1888) and *P. globosa* (Eschscholtz, 1825) provisionally. He considered *P. medusa* Haeckel, 1888 as a

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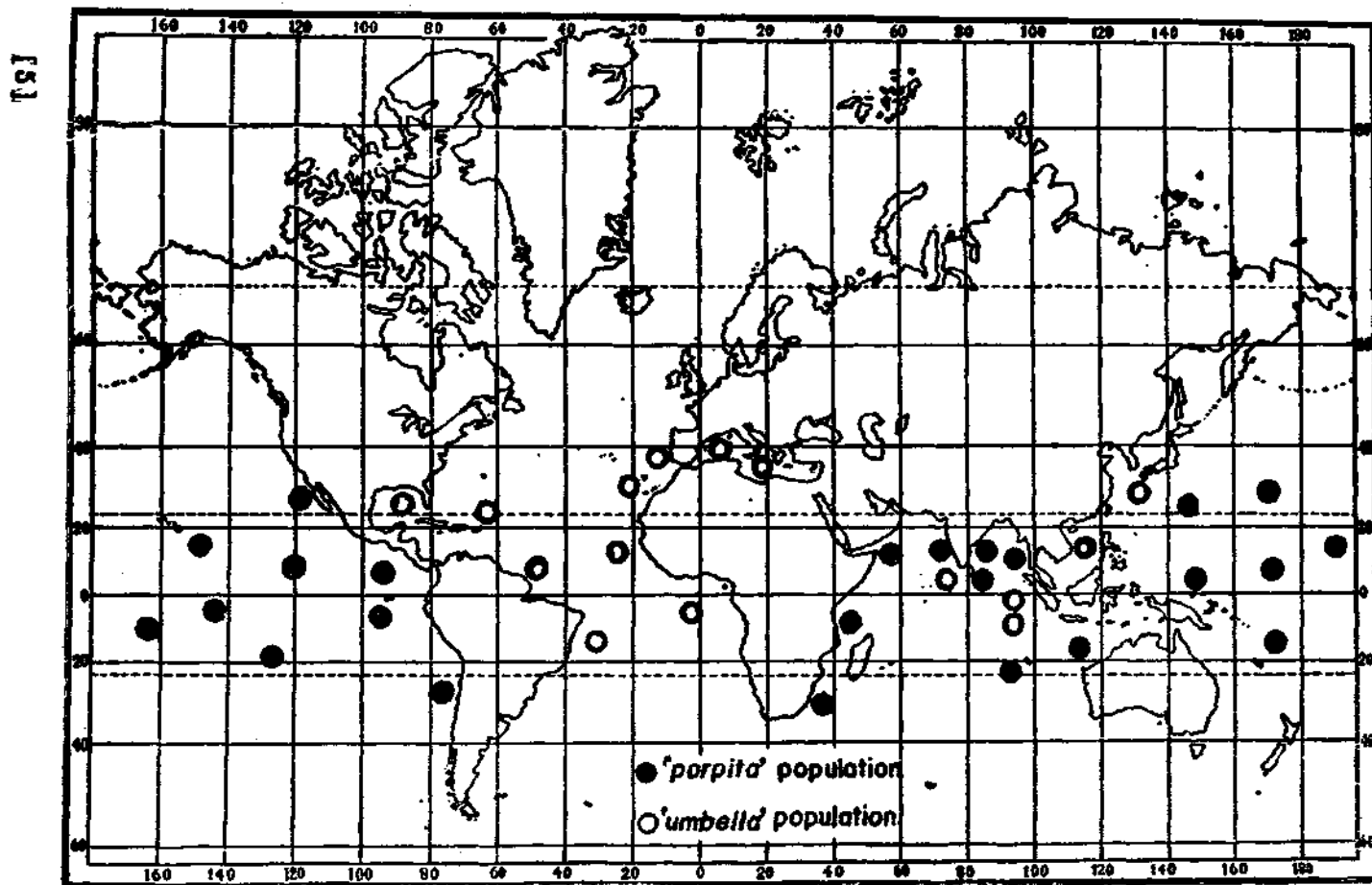


Fig. 2. Map showing the distribution of 'Porpita' and 'umbella' populations of *Porpita porpita* (Linne).

synonymy of *P. globosa* mainly on the basis of Haeckel's description. However, a perusal of the figures of the tentacles with numerous stalked nematocyst clusters given by Haeckel (1888) indicate that *P. medusa* is referable to *P. prunella*. Totton (1954) considered only *Porpema prunella* as valid and felt that one genus *Porpita* was enough to contain both *Porpita porpita* and *Porpema prunella*. In the present study *P. prunella* and *P. globosa* are treated as two distinct populations ('*prunella*' and '*globosa*' populations) of the single valid species *P. prunella*.

***Porpema prunella* (Haeckel, 1888) (Fig. 1 e-l)**

Porpita globosa Eschscholtz, 1825, p. 744; 1829, p. 178, taf. 16, fig. 4.

Discalia medusina Haeckel, 1888 a, p. 30; 1888b, p. 48, pl. 49, figs. 1-6 (larval stage).

Porpalia prunella Haeckel, 1888a, p. 30; 1888b, p. 58; pl. 48.

Porpalia globosa Haeckel, 1888a, p. 30; 1888b, p. 58.

Porpema medusa Haeckel, 1888a, p. 30; 1888b, p. 61, pl. 47.

Porpita prunella Schneider, 1898, p. 195.

Porpema prunella Bigelow, 1911b, p. 327, pls. 25-27, 28 figs. 11-15.

Boone 1938, p. 44.

Material : A single sample from Dm 3/63 station 119 (Sample No. 1852/E) at lat. 24°30'S and Long. 110°E.

Description : The sample examined measures 5.0 mm in diameter, and is globular in shape (Text fig. 1e, f).

Limbus : The limbus measures 0.65 mm in width. The margin is entire and characteristically deflected upwards. The number of canals present in the central region (probably 13-14) is not discernible but the forty or so canals in limbus showing the radial arrangement are very clear. The number of marginal muciparous glands corresponds with the number of radial canals present in this region (Text fig. 1g).

Pneumatocyst : The pneumatocyst is strongly vaulted (Text fig. 1i). There are 13 or 14 circular chambers besides the central chamber. The surface view (Text fig. 1h) shows the 8 radiating rows of projections or stigmata.

Tentacular Zone (Text fig. 1j-l) : The tentacular zone is broad, extending over the entire bulged region as described in detail by the previous workers (Haeckel, 1888b; Bigelow, 1911). There are 4 concentric and alternating rows of tentacles in various stages of growth. The bases of these tentacles form honey-comb like markings. The well grown tentacles are (long, measure 5.0 to 7.5 mm in length and bear stalked nematocyst clusters on the club-shaped distal ends. There are 9-10 nematocyst clusters on the long rows and 5 to 7 on the two short rows and 4 at the tip (2 long and 2 short).

Gastrozoid (Text fig. 1e, g, z) : The centrally placed large, conical gastrozoid measures 2.5 mm in length. The base of the gastrozoid occupies almost the entire under surface.

Gonozooids : The gonozooids are not clearly seen.

The present specimen resembles the single sample of *P. globosa* recorded and figured by Eschscholtz (1825, 1829) in the globular shape and in the presence of fewer number of stalked nematocyst clusters in the tentacles. The tentacles of *P. prunella* however, bear 19 to 24 stalked nematocyst clusters on all the three rows (Bigelow, 1911).

Distribution : The geographical and seasonal distribution of the two populations of *Porpema prunella* are presented in Fig. 3. The 'prunella' population was first recorded on the north coast of New Guinea by Haeckel (1888) in March in the Pacific Ocean. Later, it was recorded in the Eastern Tropical Pacific during December by Bigelow (1911) and young forms during August near Marquesas Island which is intermediate between the two previous records (Boone, 1938). *Porpema lenticula* recorded between Aden and Bombay and *Porpema pileata* from off the coast of Chile by Haeckel are nomenanuda but considered here as locality records. *Discalia medusina* Haeckel (1888) is a larval stage of *Porpema* recorded from the Pacific Ocean.

A single sample of the 'globosa' population recorded by Eschscholtz (1825/29) near Cape Verde Island in the Atlantic Ocean, and the present record near Western Australia during August are the only two records in the world oceans.

Family VELELLIDAE Brandt, 1835

This family consists of only one valid genus *Verella* Lamarck, 1801.

Genus *Verella* Lamarck, 1801

According to Totton (1954) two species of this genus were considered as valid by previous workers, viz. *Verella Verella* (Linne, 1758) of the Atlantic Ocean and *V. lata* Chamisso & Eysenhardt, 1821, of the Indo-Pacific, the breadth in proportion to length being greater in *lata* than in *verella*. The North West direction of sail was more common for *V. lata* whereas the majority of *V. verrella* had South West direction of sail. The existence of forms with variable breadth/length ratio and since in other respects there was no constant differences between the two, only one species of *Verella*, *V. verrella* including two distinct dimorphic forms, one with North West direction of sail and the other with South West direction of sail has been considered as valid (Totton, 1954; Daniel & Daniel, 1963; Edwards, 1966).

[7]

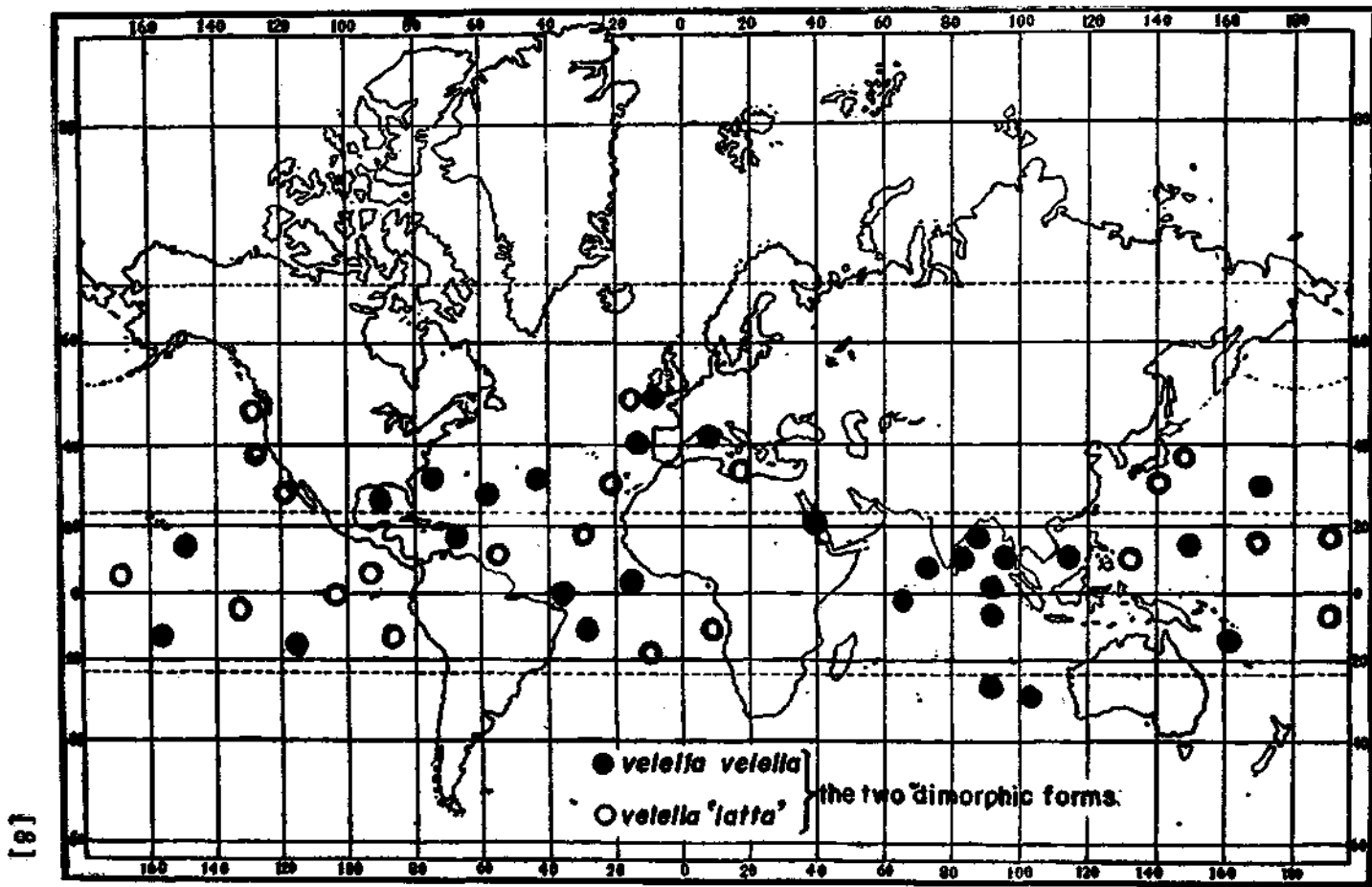


Fig. 3. Map showing the distribution of the 2 dimorphic forms of *Verella verella* (Linne).

Verella verella (Linne', 1758) (Text fig. 1m, n)

For synonymy see Daniel & Daniel 1963, p. 187.

Material :

Station No.	Position		Date	No. of Examples	Z.S.I. Reg. No.	Direction of Sail
	Lat.	Long. E				
V. 5194 ..	32°39'S	101°12'	18-8-62	12	P 1721/1	SW
V. 5196 ..	32°34'S	94°14'	20-8-62	30 (25 rataria)	P 1768/1	1 SW 29 NW
V. 5199 ..	26°02'S	91°38'	23-8-62	2	P 1715/1	SW
V. 5208 ..	9°16'S	91°27'	30-8-62	3	P 1773/1	SW
V. 5218 ..	0°59'S	91°40'	7-9-62	1	P 1780/1	SW
V. 5219 ..	0°39'S	91°37'	8-9-62	1	P 1748/1	SW
V. 5220 ..	0°08'N	91°43'	8-9-62	1	P 1687/1	SW
V. 5225 ..	3°06'N	91°34'	12-9-62	2	P 1644/1	SW
V. 5227 ..	5°03'N	91°32'	13-9-62	68 (50 rataria)	P 1704/1	SW
V. 5230 ..	8°03'N	91°32'	15-9-62	15	P 1743/1	SW
V. 5231 ..	9°02'N	91°32'	15-9-62	7	P 1769/1	SW
K. 359 ..	9°00'N	85°00'	11-6-64	33	—	SW
K. 361 ..	9°00'N	87°20'	12-6-64	14	—	SW
K. 378 ..	12°36'N	80°40'	20-6-64	1	—	SW
Dm3/102 ..	14°00'S	110°E	17-7-62	2	—	SW

V = 'Vityaz'; K = 'Kistna'; Dm3 = 3rd cruise 'Diamantina'; SW = South West; NW = North West.

The young ones (Rataria stage) are oval and the larger ones are rectangular in shape. The sail in young specimens is rounded whereas in slightly older specimens it is triangular. The oval-shaped gastrozoid lies along the longitudinal axis. The sexual siphons have long pedicels/bearing bunches of medusoid gonophores. The tentacles form a single concentric row. In the older specimens the Br/L ratio is 40% (average) and the direction of sail is South West, except in Station V. 5196, where out of 30 specimens, 29 have North West direction of sail.

Distribution : The geographical and seasonal distribution of the two dimorphic forms (NW and SW forms) in the Indian Ocean are presented in Fig. 4. This species has a wider latitudinal distribution than *P. porpita*. Forms with South West direction of sail (SW) appears to be abundant in the Indian Ocean whereas forms with North West direction of sail (NW) predominates in the Pacific Ocean.

[9]

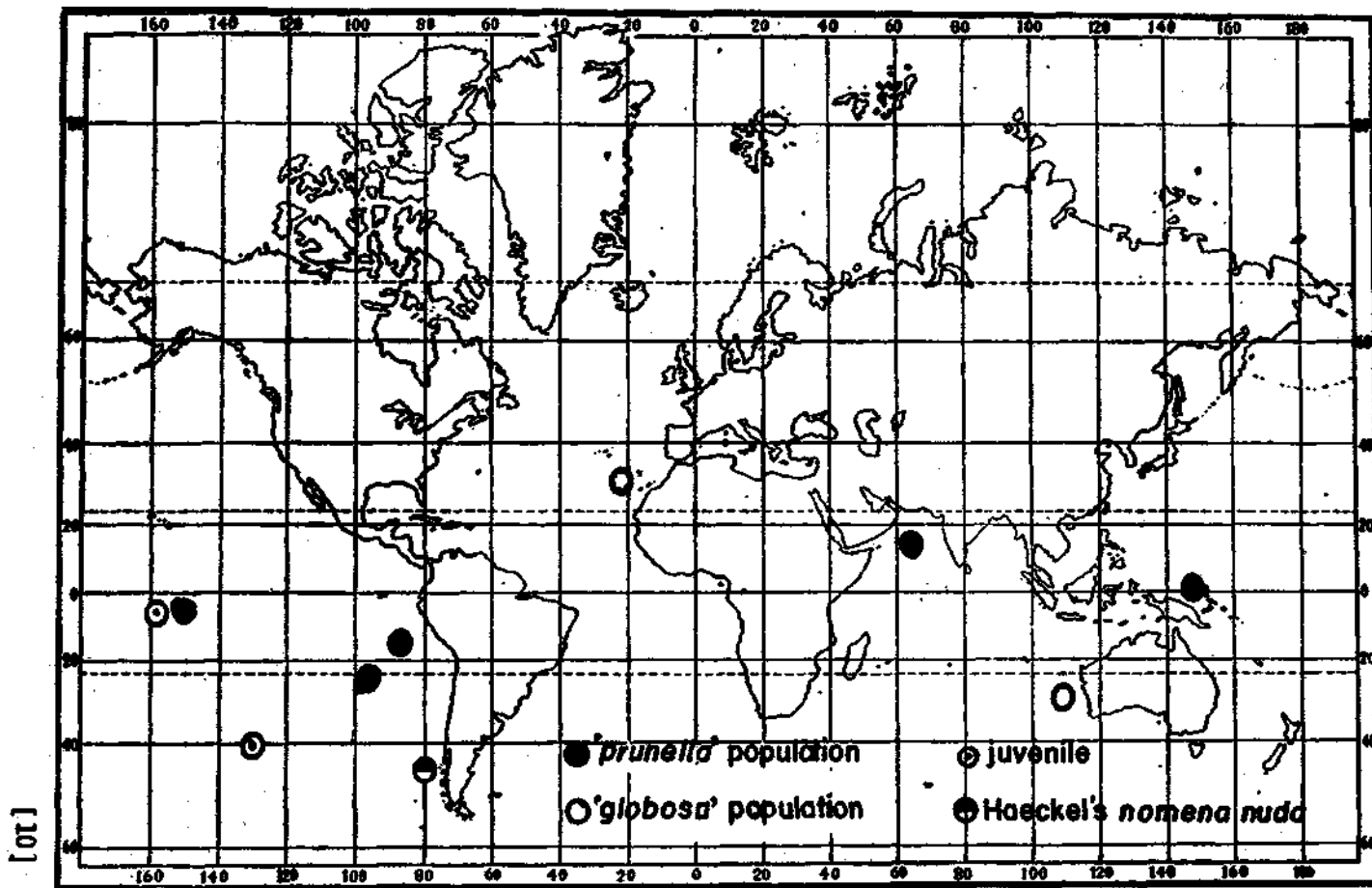


Fig. 4. Map showing the distribution of 'prunella' and 'globosa' populations of *Porpema prunella* Haeckel.

The distribution of the dimorphic forms of this species in the Atlantic Ocean and the Mediterranean Sea has been discussed by Edward (1966). Although the occurrence of both NW and SW forms in the warm regions of all the three Oceans has been established, more data on percentage of occurrence of these dimorphic forms in relation to the wind and surface currents in the Indian and Pacific Oceans are needed.

This species occurs throughout the year in the Indian Ocean. In the East Coast of India these have always been recorded along with *P. porpita* during the north-east monsoon period October to December and on the West Coast during the south-west monsoon period (May to August).

REMARKS

Among the Porpitids there appear to be two sets of populations, 'porpita' and 'umbrella' populations of *Porpita porpita*; and 'prunella' and 'glogosa' populations of *Porpema prunella*. The populations of these two species show a striking parallel similarity or line of evolution in their number of stalked nematocyst clusters i.e. greater number noted in the 'porpita' and 'prunella' populations on the one hand and the much reduced number observed in the 'umbrella' and 'glogosa' populations on the other. So far, no intermediate forms of *Porpita* or of *Porpema* showing variations in the tubercles and stigmata, number of stalked nematocyst clusters or in the width and nature of the canals of the limbus have been recorded. It is probable that sexually mature individuals of the same species differ widely in appearance, due to variations for ontogenetic reasons verging on neoteny. However, more data are needed regarding the varying characters of these populations and their occurrence in the Atlantic and Pacific Oceans and the percentage of these forms in the over lapping areas in the Indian Ocean.

The dimorphic forms of *Verella* which are mirror images of each other (SW and NW direction of Sails) recall similar condition observed in certain Siphonophora viz, the left and right-handed specimens of *Physalia physalia* and the gonophores produced by *Ceratocymba dentata*. According to Totton (1960) in *Physalia* this dimorphism is probably not due to ecological factors or due to genetic differences but is fixed from a very early phase of its life-history on the first windy day after the larvae surfaces. In *Verella* the differentiation into the two dimorphic forms is probably established at the rataria stage or earlier, since the direction of sail is clearly discernible even at this stage. The occurrence of dimorphic forms in *V. varella* helps in the survival of the species during adverse conditions thereby preventing total stranding at a particular season and also aids in dispersal.

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