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ON THE DISTRIBUTION OF SIX SPECIES OF POLYCHAETES IN THE ADYAR ESTUARY, MADRAS

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INTRODUCTION

MOST marine animals are stenohaline with a low range of tolerance of the differences in the salinity of external medium. Yet some have become euryhaline exhibiting a considerable range of tolerance, a few like *Heteromastus* sp., *Clistomastus* sp., (most capitellids), living as well in fresh water as in salt. Recent work has shown that the physiological independence and the emancipation from the limitations imposed by the changing environment in such homoiosmotic animals have been brought about by their ability to control the osmotic pressure of their body fluids by raising or lowering their internal concentration to suit the exigencies of the anisotonic media they inhabit. When such an investigation was extended to polychaetes, which are predominantly marine, it became apparent that they showed different types and grades of efficiency of the kidney (Krishnamoorthi, 1962) with regard to their osmoregulatory capacity and their tolerance to changes in the environment (Krishnamoorthi and Krishnaswamy, 1962 ; Krishnamoorthi, 1963). The tolerance to the external medium is of special significance to animals attempting to colonise and penetrate into brackish water habitats such as estuaries. With this object in view the present investigation was undertaken.

MATERIAL AND METHODS

The following polychaetes *Onuphis eremita, Glycera embranchiata, Loimia medusa, Diopatra variabilis, Clymene insecta* and *Marphysa gravelyi* were chosen for the study.

A series of Stations were located, as shown in the Map of the River Adyar (Fig. 1), along the banks of the River, covering as far as possible the range of brackish water conditions in the river. Weekly visits were paid to the Stations selected from where the material was collected. Samples of mud from both the bottom and the sides of the bank of the river where these polychaetes inhabit were collected. The procedure was as follows :

Areas of 1 sq.ft. were marked at different places and mud to a depth of 1 foot was dug out and brought to the laboratory where it was washed with fresh samples of brackish water in order to collect the worms from the sample of mud. Care was taken to see that the samples of mud were not mixed up with each other. From a lot of worms collected from each sample, the percentage of occurrence of each group of polychaetes was calculated and tabulated. The figures arrived at are the mean percentage of six samples. The same method was followed while determining the percentage of occurrence of polychaetes at all Stations.

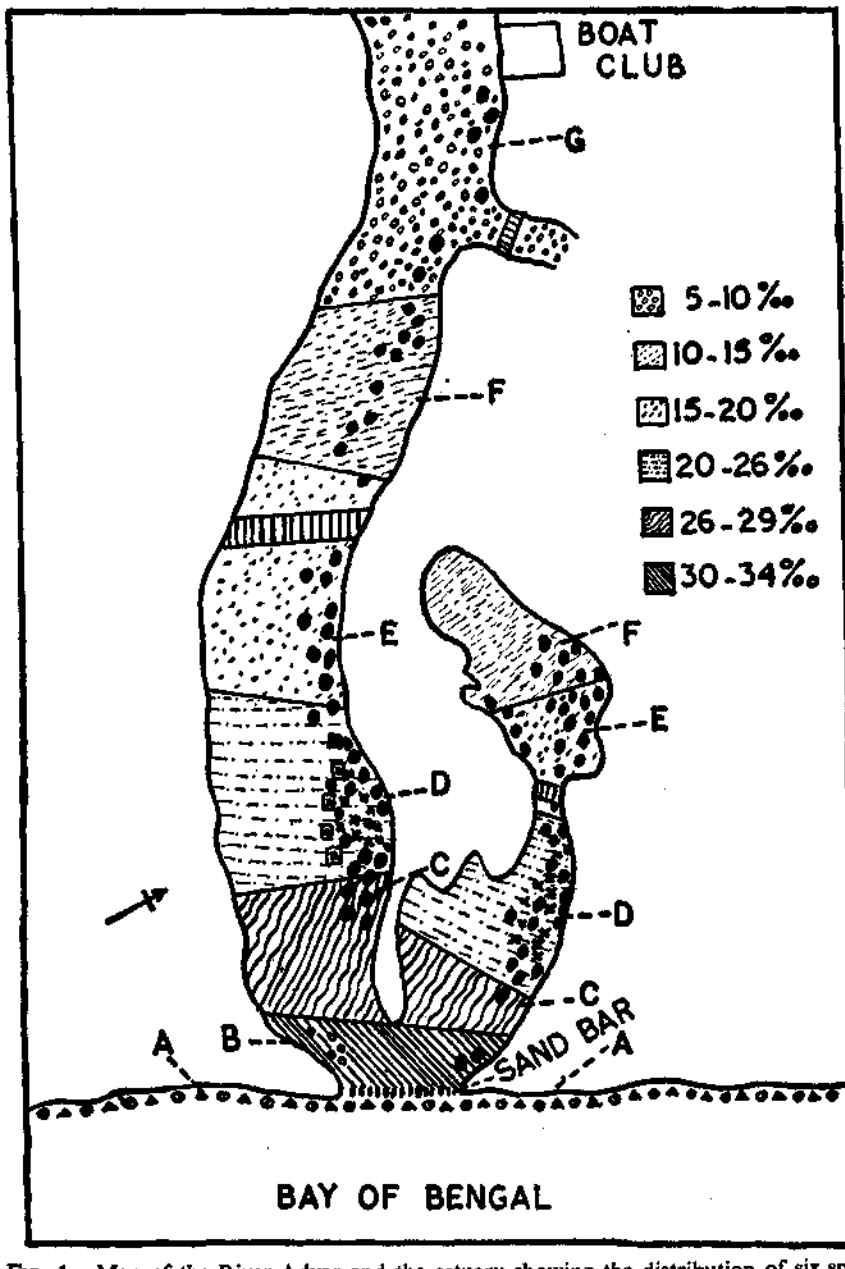

FIG. 1. Map of the River Adyar and the estuary showing the distribution of six species of polychaetes. (● *M. gravelyi* : × *D. variabilis* ; ▣ *C. insecta* : ○ *L. medusa* : ⊙ *G. embranchiata* and ▲ *O. eremita*).

Results

It is evident from the figures (Table 1) that at Station A the salinity of the waters range between 30-34‰ and the predominating polychaetes in this region are *O. eremita* and *G. embranchiata*, none of the other genera being represented. They become scarce in other Stations, even at Station B, though the salinity range is between 30-34‰. But at Station B, *L. medusa* alone is well represented it being absent at Station A. While *M. gravelyi* alone occurs at Station C, *D. variabilis* and *C. insecta* again become scarce, *M. gravelyi* alone predominating once again. From the above facts it was evident that while *M. gravelyi* had migrated to a greater extent, even to regions where the salinities range between 5-10‰, *D. variabilis* and *C. insecta* were restricted to regions of 20-26‰, and *O. eremita*, *G. embranchiata* and *L. medusa* never left a region with a salinity range between 30-34‰. It also argues that the salinity of the waters has been a barrier for these polychaetes in their migrations to regions of lower osmotic pressures.

Table 1

Distribution of various genera of polychaetes at different stations

Station	Salinity range, ‰	Percentage of occurrence of					
		Onuphis eremita	*Glycera embranchiata*	*Loimia medusa*	*Diopatra variabilis*	*Clymene insecta*	*Marphysa gravelyi*
A	30-34	52	48	nil	nil	nil	nil
B	30-34	nil	nil	94	nil	nil	6
C	26-29	nil	nil	nil	nil	nil	100
D	20-26	nil	nil	nil	33	31	36
E	15-20	nil	nil	nil	nil	nil	100
F	10-15	nil	nil	nil	nil	nil	nil
G	5-10	nil	nil	nil	nil	nil	nil

Discussion

The facts favourable for the penetration of marine fauna into the mouths of rivers have been analysed by many workers. It has been maintained that temperature is an important factor (Pannikkar & Aiyar, 1937; Broekema, 1941; Wickgren, 1953; Kinne, 1956b; Verwey, 1957). This may probably explain the abundance of marine fauna in the tropical brackish-waters (Panikkar, 1951). However, the importance of salinity as a factor in the distribution of animals cannot be minimised. Recently Veerabadhra Rao (1951) has stressed the effect of salinity on the spawning and development of a back-water Oyster. A similar observation was made by Remane (1934), Redeke (1933) and Topping & Fuller (1942) emphasising that salinity was an equally important factor. Viewed against this knowledge, in the distribution of *M. gravelyi*, *D. variabilis*, *C. insecta*, *L. medusa*, *G. embranchiata* and *O. eremita* in the brackish-water zones of Adyar,it may be seen that, the temperature remaining the same, the extent of penetration varies. The differences in the degree of migration of the polychaete genera studied appear to be accounted for on the basis of the different capacities of their nephridia for osmoregulation (Krishnan, 1952; Krishnamoorthi, 1962).

Other ecological factors such as the availability of suitable food, the prevalence of optimum percentage of oxygen for respiration and the nature of backwater flora and fauna congenial to the existence of these marine polychaetes also have to be considered. The importance of conditions favourable for the normal reproduction and safe development of these migrators cannot be minimised. In this connection the present study of these brackish-water polychaetes shows how the eggs are protected (Krishnamoorthi, 1951) ; how the early development abbreviated (Aiyar, 1931 ; Krishnan, 1936) and how the precocious development of the nephridium in the metatrochophore and nectochaetae is of a degree of osmoregulatory capacity sufficient to withstand sudden dilution of the medium (Krishnamoorthi, 1951).

The significance of the greater adaptability exhibited by *M. gravelyi* and lesser degrees of specialisation in the other forms is more pronounced when viewed in relation to the habits and distribution of the group as a whole. *M. gravelyi, D. variabilis,* and *C. insecta* are sharply contrasted from *O. eremita, L. medusa* and *G. embranchiata* in that the last mentioned three are purely marine in habitat. Of the eight species recorded so far in the genus *Onuphis, Onuphis bisipicta* from Indo-Malayan regions ; *O. dorsalis, O. verngreni, O. intermedia* and *O. fragalis* all from W. African and Angola coasts ; *O. litoralis* and *O. gorgonensis* from Panama and *O. investigators* from Arabian sea clearly indicate their distribution to marine habitats. Similarly *Loimia variegata* from Indo-Malayan regions ; *L. montagui* from the Pacific ; *L. minuta* off the coast of Florida ; *L. annulifilis* and *L. turgida* from East Indies show that they are confined to the sea. *Glycera tessellata* and *G. capitata* var *benguellana* from the coast of S.W. Africa ; *G. rouxii* from China ; *G. unicornis* from Sweden ; *G. convoluta* var. *capensis* from S. Africa and *G. spadix* from Gulf of Davao are confined to the sea. Of the Genus *Diopatra, Diopatra neapolitana* alone has been recorded off the coast of France, while *D. cuprea, D. orientalis* and *D. striata* have been recorded from brackish-water. *Asychis plimmertonensis, Macroclymenella stewartensis* and *Nichomache* from Schmarda ; *Clymene tropica* from Panama ; *C. annandalei* from Amoy, China and *C. grossa* var *newporti* from S. California show a similar distribution as the worms belonging to the genus *Diopatra.* The genus *Marphysa,* however shows a much varied and cosmopolitan distribution. Of the six species known in this genus, only *Marphysa mortenseni* and *M. sanguinea* from the Pacific have been recorded from sea, whereas *M. hentschei* from the brackish-waters of Brazil ; *M. sanguinea* var *americana* from the Canal Zone of S. America where waters are less saline (Monro, 1933) ; *M. sinensis* and *M. orientalis* from brackish-waters of Amoy, China all go to prove their wide distribution, even to regions of less saline media. The second mentioned form, *M. sanguinea* has also been recorded from Wailupe Pond (Abbot, 1946) and its occurrence in an almost fresh water pond is significant because the same species has been recorded from the sea. Thus the wide distribution of *Marphysa* indicate a tendency towards an assumption of freshwater life. Although factors like temperature, especially in the tropics (Panikar, 1951), availability of minerals of biological importance etc., have played a part in the migration of animals from a marine habitat to less dilute media, the importance of nephrida and their role in osmoregulation are too arresting to be neglected. The modifications undergone by the nephrida as a result of environmental factors they had to face during their migrations, are too true to be doubted. In this connection the observation of Pearse (1939) that ' Heredity gave the ability and environment provided the opportunity ' seems to be quite apt.

Summary

The distribution of six species of polychaetes viz., *M. gravelyi*, *D. variabilis*, *G. embranchiata*, *O. eremita*, *C. insecta* and *L. medusa* has been studied on the basis of percentage of occurrence at various stations in the Adyar estuary, Madras. Among the polychaetes studied *M. gravelyi* was found to exhibit the greatest penetration occurring in regions were salinities were as low as even 5-10 parts per mille. It is argued that besides factors like salinity, temperature, availability of food, protection to eggs, abbreviations of stages in the life history and precocious development of nephridia in the larvae, factors like capacities for tolerance of salinity and abilities for osmotic regulation as reflected in the grades of structural modifications of nephridia, may have played an equally important role in the successful establishment and distribution of these polychaetes in the estuary.

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References

Abbot, D. P. 1946. Some Polychaetous Annelids from a Hawaiian fish pond. *Univ. Hawaii Res. Publ.*, **23** : 1-24.

Aiyar, R. G. 1931. An account of the development and breeding habits of a brackish-water polychaete of the genus *Marphysa*. *Jour. Linn. Soc. London*, **37** : 398-404.

Broekema, M. M. M. 1941. Seasonal movements and the osmotic behaviour of the shrimp. *Crangon crangon*. *L. Arch. Neer. Zool.*, **6** : 1-100.

Kinne, O. 1956b. Über den Einfluss des Salzegenaltes und der Temperatur auf Wachstum Form und Vermehrung bei dem Hydroidopolypen *Cordylophora caspia* (Pallas), *Thecata, Clavidae*. I. Mitteilung über den Einfluss des salzgenaltes auf Wachstum und Entwicklung mariner, brackishcer und limnischer organismen. *Zool. Jahrb., Allg. Zool. W. phys.*, **66** : 565-638.

Krishnan, G. 1936. The development of *Diopatra variabilis* (Southern). *Zeits. wiss. Zool. Leipzig*, **147** : 513-525.

———. 1952. On the nephridia of Neridiae in relation to habitat. *Proc. Nat. Inst. Sci. India.*, **18** : 241-255.

Krishnamoorthi, B. 1951. Studies on the osmotic properties of eggs and larvae of a brackish-water polychaete, *Marphysa gravelyi* Southern. *Proc. Indian Acad. Sci.*, **34** : 199-209.

———. 1962. Salinity tolerance and Volume regulation in four species of polychaetes. *Ibid.*, **56**(6) : 363-371.

———. 1963. Gross morphology and histology of nephridia in four species of polychaetes. *Ibid.*, **57**(3) : 195-209.

——— and Krishnaswamy, S. 1962. On the activity of *Marphysa gravelyi* Southern (Polychaeta) under heterosmotic conditions. *Ibid.*, **57** : 83-87.

Monro, C. C. A. 1933. On a collection of Polychaeta from Dry Tortugas, Florida. *Ann. Mag. Nat. Hist. London*, **12** : 244-269.

PANIKKAR, N. K., AND AIYAR, R. G. 1937. The brackish-water fauna of Madras. *Proc. Indian Acad. Sci.*, 6 : 284-336.

PANIKKAR, N. K. 1951. Physiological aspects of adaptation to estuarine conditions. *Proc. Indo-Pacific Fish. Counc.*, 2 Meeting, April, 1950, Cronulla, New S. Wales, Australia. Sec. II & III : 162-175.

PEARSE, A. S. 1939. *The Migrations of Animals from Sea to Land.* Univ. Press, Durham, North Carolina.

REDEKE, H. C. 1933. Uber die Jetzigen Stand Unserer Kenntnisse der Flora und Fauan des Brackwassers. *Verh. Iternat. Verein theor. angen. Limnol.*, 6 : 46-61.

REMANE, A. 1934. Die Brackwasser fauna. *Verh. Deutsch. Zool. Cesell., Zool. Anz., Suppl.*, 7 :34-74.

TOPPING, F. L., AND FULLER, J. L. 1942. The accommodation of some marine invertebrates to reduced osmotic pressures. *Biol. Bull.*, 82 : 372-384.

VEERABHADRA RAO, K. 1951. Observations on the probable effect of salinity on the spawning, development and setting of the Indian backwater Oyster, *Ostrea madrasensis* Preston. *Proc. Indian Acad. Sci.*, 33 : 231-256.

VERWEY, J. 1957. A plea for the study of temperature influence on osmotic regulation. *L' Anne. Biol.*, 33 : 129-149.

WICKGREN, B. J. 1953. Osmotic regulation in some aquatic animals with special reference to the influence of temperature. *Acta Zool. Fennica*, 71 : 1-102.