

# Fauna of the Mangrove Ecosystem

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## Summary

### INTRODUCTION

Mangrove ecosystems, bordering tropical and subtropical estuaries and open seafront, represent a transitional area between the marine and terrestrial biotopes and thus form an integral part of the intertidal or littoral zone. However, depending on the natural gradient, coupled with tidal amplitude, the horizontal expanse, may extend either upshore to the infraterrestrial region or downshore, to the sublittoral.

A general belief, that animals are of minor significance in the mangrove ecosystem, does exist (Kestner 1963). In fact, it is only recently that the distribution, abundance and importance of the mangrove fauna, has been realized (Macnae 1968). However, the faunal aspects of mangrove ecosystem are currently understudy (Plaziat 1974) and no worldwide synthesis is available, as each of the authors have considered only those mangroves he knew personally.

In the footsteps of earlier workers an attempt is made here, to present and discuss the relevant aspects of mangrove fauna, as observed along the Indian coast.

### Ecosystem Characteristics

The animals of the mangroves find themselves in a stressful situation of widely fluctuating environmental parameters. The mangrove fauna is a composite of terrestrial, estuarine and marine organisms.

*Tide, Wave Action, Suspended matter:* As mangroves develop in shallow waters and intertidal areas, the tidal influence is appreciably

strong. It is the tidal amplitude that determines the distribution and zonation of the fauna. A large tidal range associated with a gently shelving slope promotes the development of an expansive mangrove ecosystem (Chapman 1974).

Weak wave action is a characteristic feature of the mangrove ecosystem and it results in the formation of a deposition environment. Suspended matter varies from 84 to 960 mg/l in the water. While the high values are invariably associated with maximum riverine flow, the lower values, coincide with marine regime, especially during the summer season. Due to the lack of vigorous water motion, the fine sediments, tend to settle on the bottom. The result is an accumulation of soft sediments, where poor intersitial circulation, high organic content and high microbial populations, lead to anoxic conditions.

*Temperature:* The effect of a thermal gradient in an intertidal ecosystem is three dimensional, with discernible temporal and spatial variations.

During low tide, when the mud flats are exposed, air temperatures may be quite high with a telling effect on the biota. Water temperatures show wide variations, soil temperatures may display temperature range of higher magnitude than the air and water temperatures.

*Salinity:* Salinity varies widely mainly due to the interaction of riverine and tidal flow: variations are generally more sudden and more extreme than observed in the nearby estuary itself. A sudden shower of rain, during low tide phase, may reduce the salinity to near zero. whereas the return of high tide may inundate the area with almost full strength sea water. Further, the

salinity of the interstitial water, remains higher than in the overlaying water by an order of magnitude, mainly because of high evaporation during the low tide phase and the retention of salts, due to the compactness of the substratum.

*Dissolved oxygen* : The oxygen content of the water is generally low and is probably due to the large amount of suspended matter, which causes oxidation reactions and higher consumption of oxygen (Teixeira et al. 1969). The thickness of the oxygenated layer in the sediments depends on a number of factors, such as, grain size, amount of organic material and water turbulence (Kinne 1967).

*Substratum* : The typical sediments of mangroves are peaty, soft, sandy or clayey mud (Schuster 1952). While seaward fringes are muddy, the landward fringes are invariably sandy. The mangrove sediments originate from clastic detritus drained by rivers and calcareous debris, formed either biologically (by shelled animals) or by inorganic precipitation.

Navalkar (1943), while studying the physical factors of the mangrove soils, reported the percentage grain size distribution in the surficial sediments, with the following pattern :

Type of sediment	Size (mm)	Percentage
Coarse sand	2.0	3.9-4.0
Fine sand	0.2	38.2-38.6
Silt	0.02	29.5-33.1
Clay	0.002	3.9-4.3

Important material for the development of the substratum in a mangrove is coarse silt or fine sand around 0.64 to 0.128 mm particle size (Kestner, l.c.). Addition of finer particles of silt and/or clay makes the substratum more cohesive.

The particle size is of great importance, as it controls the ability to retain and circulate water. This has a significant bearing for the habitation of organisms in the interstices of the substratum. If the particle size becomes fine, the circulation practically ceases and the result is the formation

of anaerobic conditions within the substratum. In general the substratum in the mangroves is characterised by low oxygen, high salt content, fine grained sediments with high organic content.

*Organic matter* : As a combined effect of weak circulation and high organic inputs, mainly from decaying foliage and debris, there is a large amount of organic matter in the sediments. The cumulative effect of degradation of mangrove litter through bacterial action results in the remineralization of organic matter and the formation of nutrient pools (Ferguson Wood 1964), which is large when compared to that of the adjacent estuarine sediments and reveals the richness of organic content in the mangrove ecosystem (Parulekar et. al. 1980). While the organic matter in a high productivity estuarine system varies from 2.4 to 18.9 mg/g of bottom deposits, the analogous values in mangrove sediments fluctuate between 8.6 and 52.9 mg/g. over an annual cycle. However, the high organic matter content being largely labile and, hence, highly oxidative in nature, ends up creating difficult living conditions for the mangrove fauna.

#### Origin and Type of Fauna

Ekman (1335) has said that the mangrove fauna with its low species diversity but great number of individuals, is highly characteristic. Fisher (1940) reported that the mangrove fauna should be considered as composed of elements from mud flats plus the general brackish water fauna. Sandison and Hill (1966) also endorsed the idea of the non specificity of mangrove fauna.

Tabb et al (1962) inferred that the fauna of mangroves is characteristic and very similar to the fauna of the rocky shores. Macnae (l.c.) recorded that there is no specialized mangrove fauna, in the sense, that the species that occur in the mangroves do not occur in other habitats, though the same species may occur in many mangrove ecosystems within the same faunistic region. In the tropics and subtropics, such faunal elements are always associated with mangroves and, thus, in this sense, there is a characteristic mangrove

fauna. In fact, each author compared the fauna of the mangrove of his region to the faunas of neighbouring environments and it was found that the faunas were significantly different because the species association was different, also because of different relative abundance of species. The fauna is distinct when the mangrove formation is large, however, this does not imply that the species do not occur in non-mangrove habitats (Day 1974).

Teal (1962) identified the following type of fauna for mangroves and salt marshes :

Type	Distribution
Terrestrial species	Upper littoral & Infraterrestrial Fringe
Aquatic species	Mid & Lower Littoral, Estuarine
Marsh/Mangrove species	Planktonic in larval stages; Mangrove inhabitant throughout the life cycle

These types, occur in most of the mangroves. However, the distribution characteristics are subjected to variations and overlapping, which are locality-specific. Though terrestrial groups may contribute even more than 50% of the mangrove fauna, the aquatic species are found (Teal l.c.) to be more important in the energetics of the ecosystem.

#### Distribution and Abundance

The fauna of the mangrove ecosystem can broadly be divided into two categories :

- (i) inhabiting the hard substrate offered by mangrove vegetation (trunk, stilt roots etc)-
- (ii) inhabiting the muddy substrate

Category (i)—can further be subdivided into two sub-types, on the basis of habitat preference. Accordingly,

- (i.a.) wandering or mobile forms
- (i.b.) fixed or sessile forms

Similarly, category ii, which is dominated by marine forms, can further be divided into two sub-types, namely,

- (ii.a.) Infauna or burrowing forms
- (ii.b.) Epifauna or forms errant on the substratum

Qualitative and quantitative distribution of the mangrove fauna is governed by tidal amplitude, light penetration, nature of the substratum and distance from the sea (Dwivedi et al. 1974), and, accordingly, the fauna can best be studied, by adopting the following criteria.

- (i) in relation to tidal amplitude i.e. Vertical distribution.
- (ii) in relation to the expanse i.e. horizontal distribution.

Vertical distribution can be studied by demarcating the zone, on the basis of the characteristic and/or dominant organism. Berry (1963) identified three zones, namely, High Tree Zone, Lower Tree Zone, and Marginal Zone. Dwivedi et al. (l.c.) recognized the following five zones for describing the vertical as well as the horizontal distribution of the fauna of the mangroves of Goa, India.

1. *Littorina* Zone : Extends upwards of Highest High water of Spring (HHWS) and corresponds with the High Tree Zone of Berry (l.c.) and is comparable with the littorinid zone of the rocky intertidal region (Stephenson and Stephenson; 1949). The dominant organism is the periwinkle gastropod. *Littorina* spp.

2. *Nerita* zone : Corresponds to the lower tree zone of Berry (l.c.) where the dominant species are the *Nerita* spp. it varies in extension according to tidal range. Upper and lower limits of this zone are bound by HHWS and Mean Sea Level (MSL), respectively.

3. Barnacle-Oyster Zone : Extends between MSL and MLLW (Mean Lower Low Water) and is populated mainly by *Balanus* and *Crassostrea* spp. While corresponding with Berry's (l.c.) marginal zone in having barnacles as the dominant

species, it differs because of its high tide level and the presence of bivalves.

4. *Uca* zone : Lies below MLLW and extends below LLWS (Lower Low Water of springs). Dominant species, the fiddler crabs, *Uca* spp. and important associates are *Cerithidea* spp. and hermit crabs.

5. Polychaete zone : Narrow vertical demarcation but maximum horizontal expanse. Populated by a variety of crabs, mud lobsters, gobiid fishes, but the dominant organisms are polychaete worms, distributed upto 10 cm down within the substratum.

The intertidal and the infraterrestrial fringe tend to have the distribution pattern of characteristic species, like land crabs, set by physical factors, whereas biological factors become more important in setting limits to the mid-littoral and sublittoral zones. Physical and/or biological factors do not act in isolation. Result : the final distribution pattern observed, on a small or large scale, is the result of the interactions among several factors.

Commonest epifaunal forms are gastropod molluscs, represented by a number of snails, whelks etc.: bivalve molluscs, mainly oysters; crustaceans, represented by a variety of crabs, shrimps, mud lobster and barnacles; fishes—the commonest form is the mud skipper.

In contrast, the infaunal forms, are few and are mainly represented by nematodes and polychaetes.

Higher vertebrate faunal elements are represented by marsh crocodile; fish cat and other.

Migrant forms are many, but commercially important ones are the young stages of shrimps and fishes, like the mullets which use the mangrove ecosystem as shelter and nursery grounds.

Quantitative studies on mangrove fauna are rather few. Probably, because organisms like crabs and those living on mangrove trees or burrowing among pneumatophores, are difficult to count. The infauna is slightly better known.

Paviour-Smith (1956) obtained an exceptionally high, population density, over 7 million/m<sup>2</sup>, with a total dry weight biomass of 32,436 mg/m<sup>2</sup> in a salt marsh meadow of New Zealand. Day (l.c.) has reported the faunal density to vary between 53 to 273/m<sup>2</sup> from three different mangrove localities in the Morrumbene estuary of Mozambique. Parulekar (unpublished) in a comparative study on three estuarine mangroves of Goa (India), observed the population density and biomass of infauna to vary from 9-1700/m<sup>2</sup> to 0.03-33.30g/m<sup>2</sup> respectively.

The epifauna forming the main bulk of the mangrove fauna is dominated by detritivores as against the infauna which is composed of either omnivorous and/or deposit feeders. Suspension feeders are only represented by oysters and barnacles. Pomeroy (1959) based on the study of algal productivity in salt marshes, concluded that in water less than 2m deep the benthos is the more important energy converter as against the phytoplankton—principle primary producer—in water deeper than 2 m.

Similarly, Pant et al (1980), observed no correlation between the phytoplankton biomass and either benthic animal populations or edible fish catch in the mangroves of Goa. Thus, the predominance of detritus based food-web is clearly reflected by the dominance of detritus feeders in the energetics of mangrove ecosystems.

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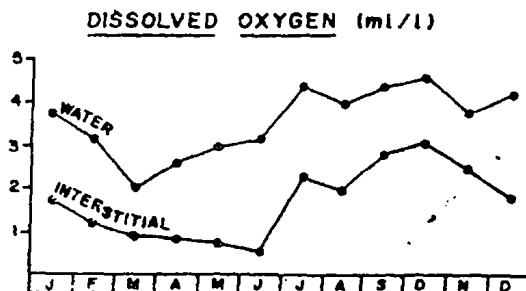
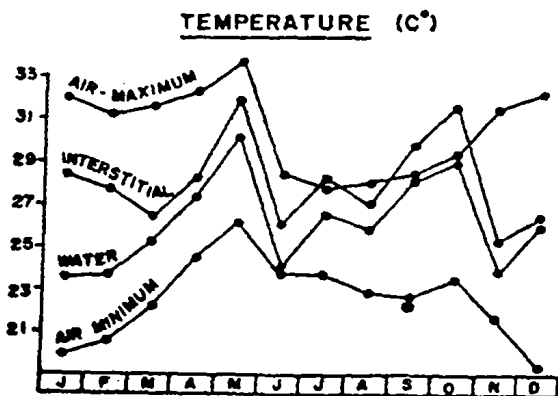
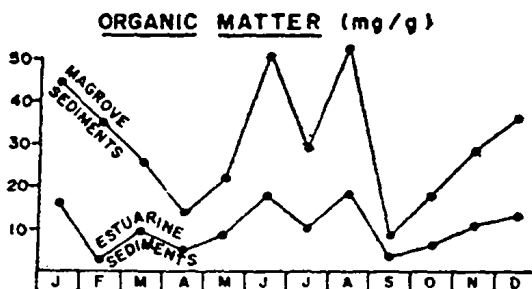
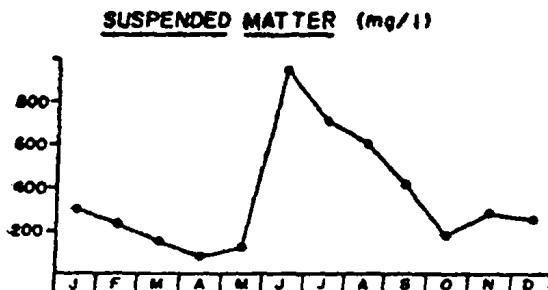
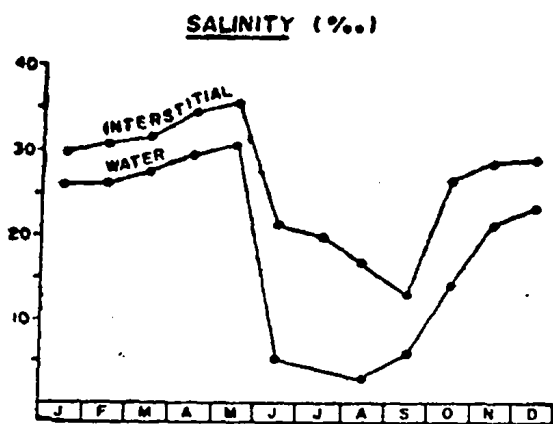
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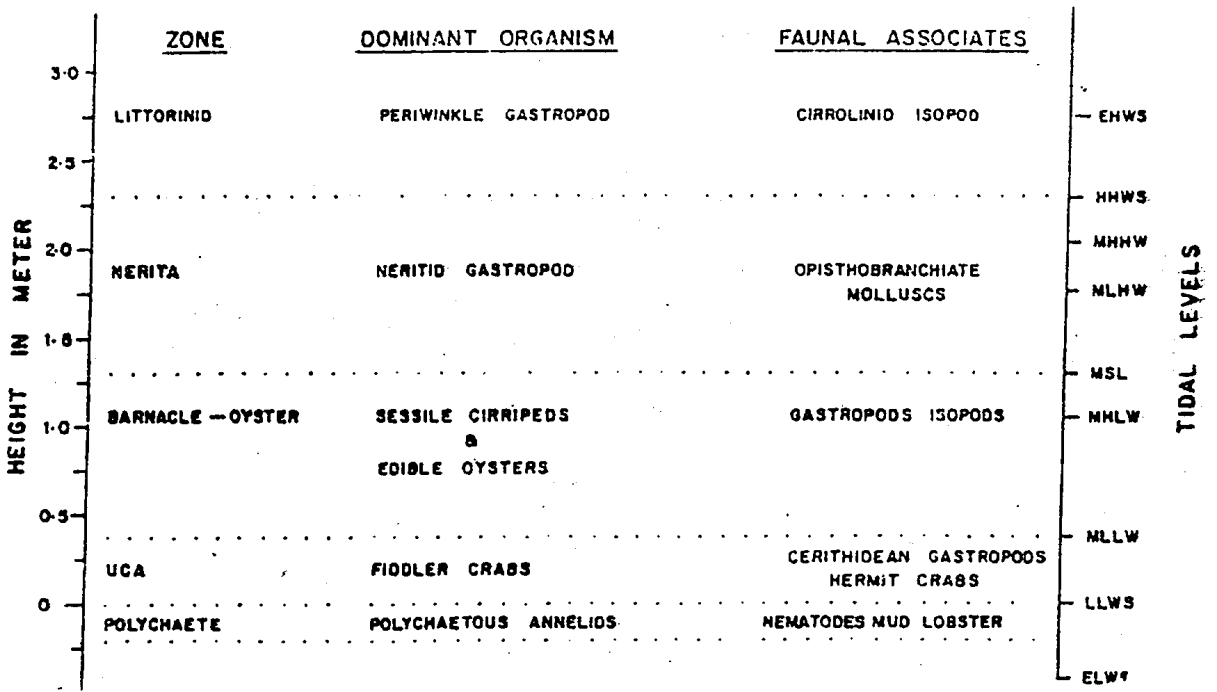
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MANGROVE FAUNA - ENVIRONMENTAL CHARACTERISTICS

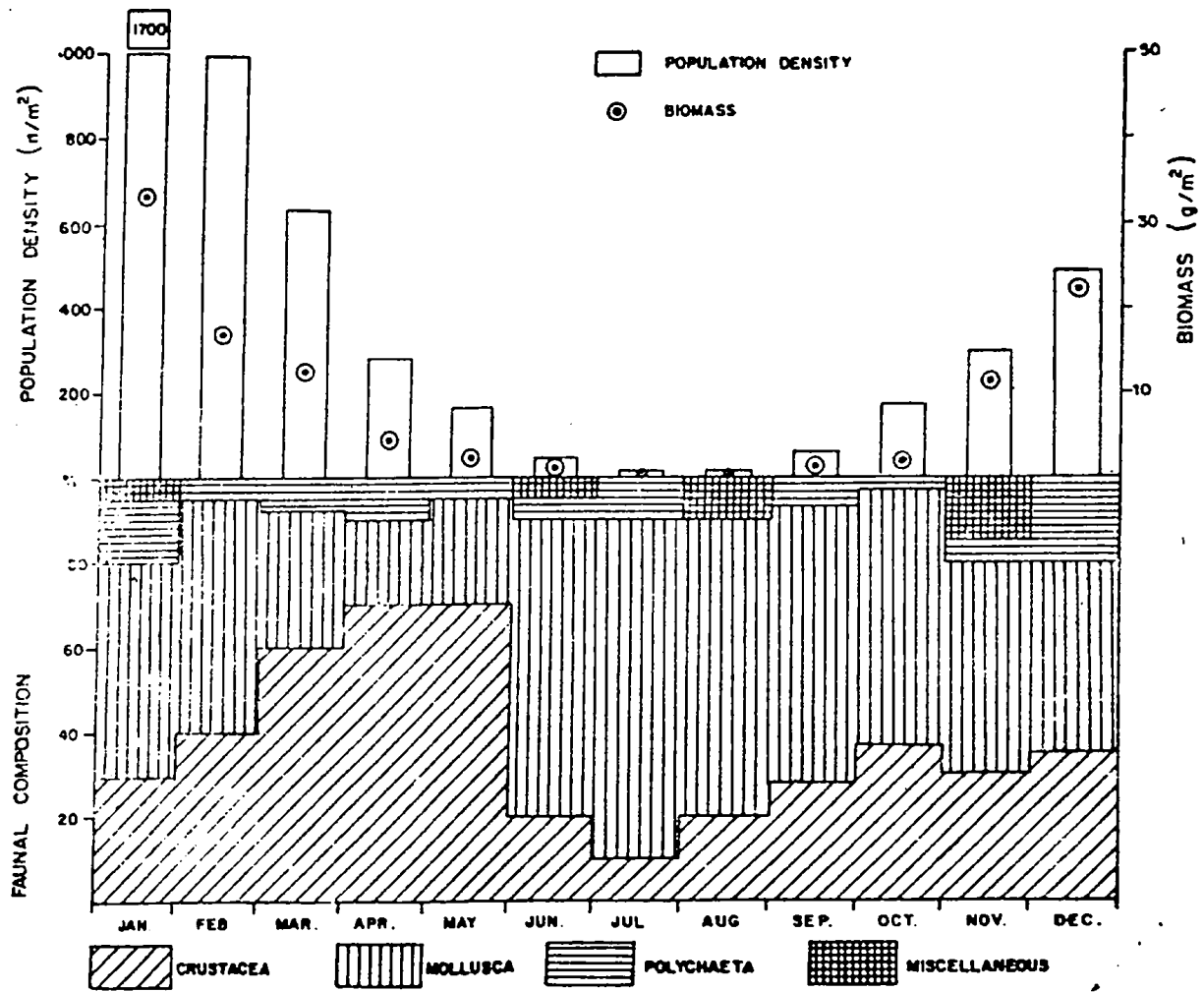


MANGROVE FAUNA — DISTRIBUTION — SCHEMATIC REPRESENTATION



# MANGROVE FAUNA

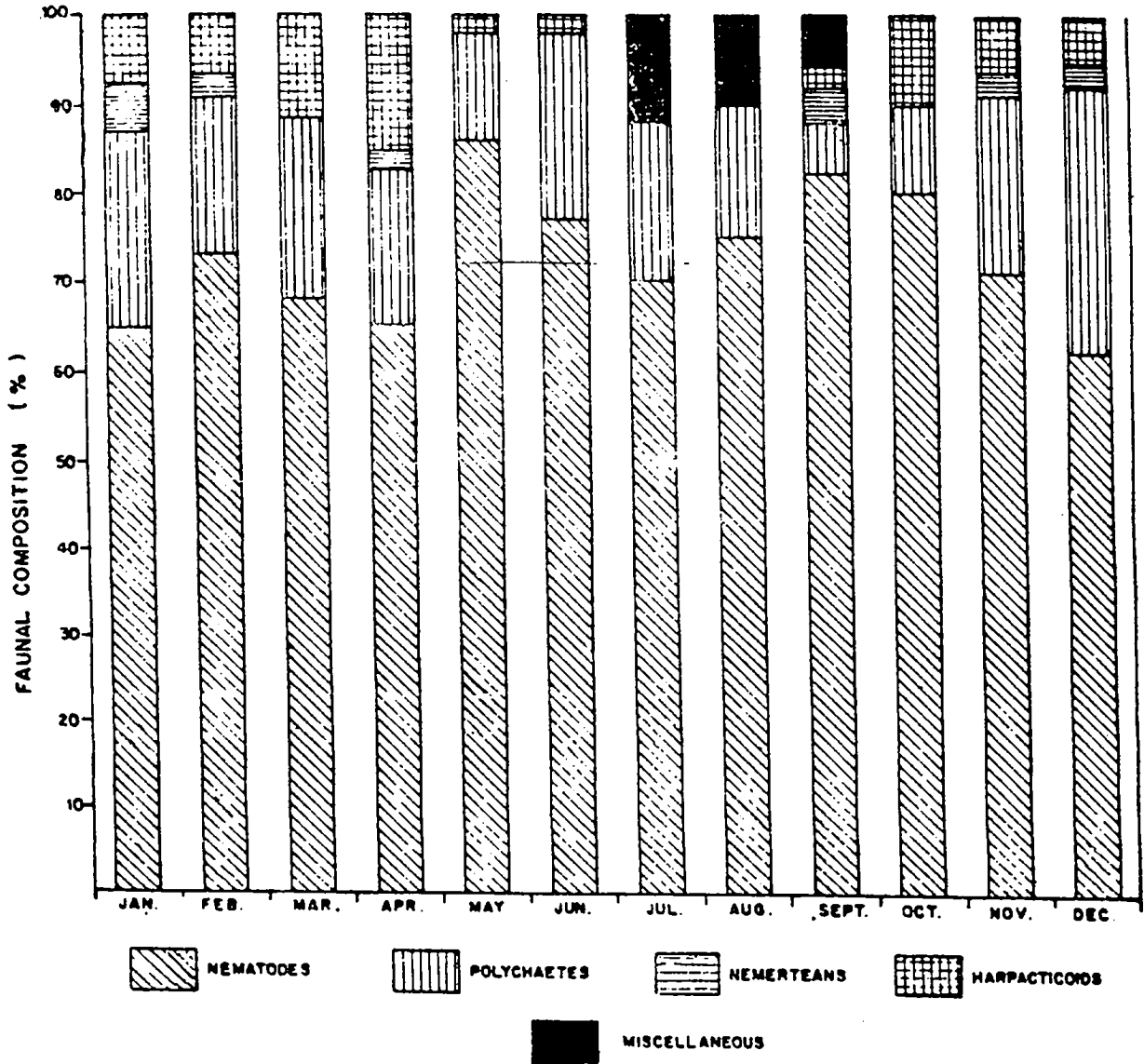
## COMPOSITION, POPULATION, DENSITY & PRODUCTION





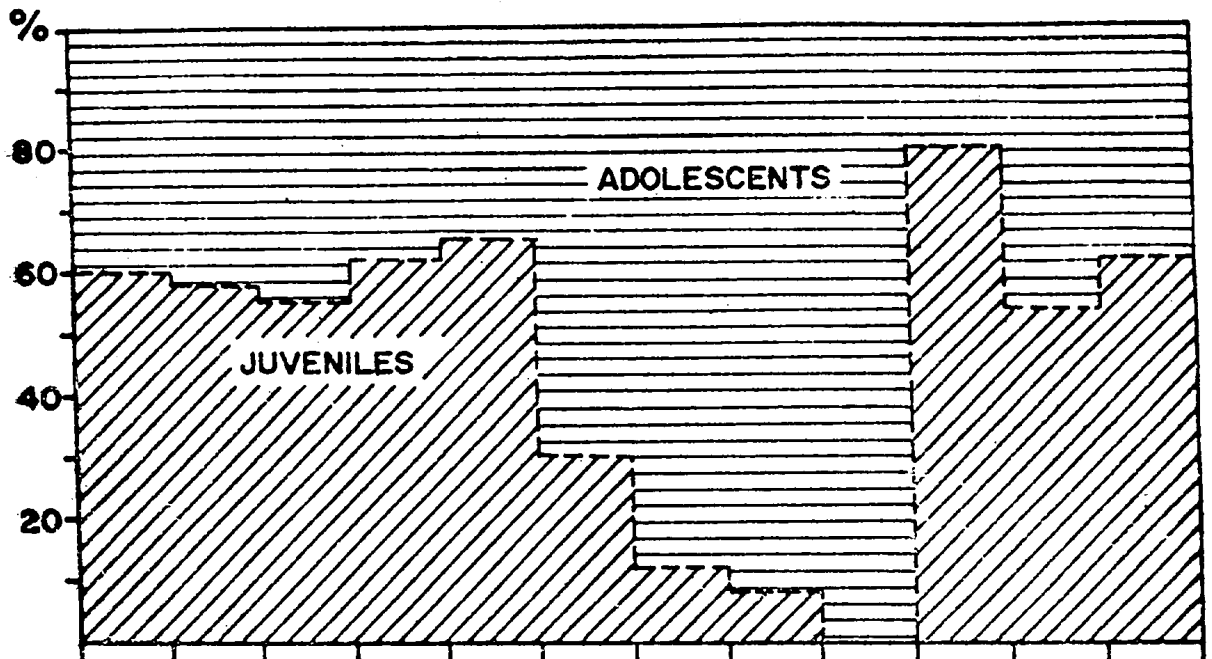
# MANGROVE FAUNA

## COMPOSITION OF INTERSTITIAL FAUNA



# MANGROVE FAUNA - SHRIMP NURSERY

## Penaeus merguensis



## Metapenaeus dobsoni

