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CHECKLIST OF HARPACTICOID COPEPODS (CLASS: CRUSTACEA) FROM NIZAMPATNAM BAY, BAY OF BENGAL

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ABSTRACT:
The present study provides a checklist of harpacticoid copepods from 64 subtidal sites located at Nizampatnam Bay covering an area between latitudes 15^0 28′ to 15^0 48′ N and longitudes 80^0 17′ to 80^0 47′ E. Copepoda represented by 46 species belonging to 30 genera and 11 families and constituted an overwhelming 24% of the total meiofauna in terms of numerical abundance.

KEYWORDS: *Harpacticoid copepods, Nizampatnamz Bay, Bay of Bengal.*

INTRODUCTION

Marine benthic communities have a very high diversity. This is especially true ofmeiofauna, the small metazoans living in or on sediments, other animals and plants on hard substrates such as rocks. The meiofauna is defined on a methodological basis as all metazoans retained on a sieve of 42 µm [1]. Meiofauna occur in freshwater and marine habitats, although most ecological studies on meiofauna have been performed in the marine environment. The meiofauna is defined on a methodological basis as all metazoans retained on a sieve of 42 µm [1]. Meiofauna occur in freshwater and marine habitats, although most ecological studies on meiofauna have been performed in the marine environment.

Harpacticoid copepods are a subclass of crustaceans, comprising 3000 species. They usually make up the second most abundant group of animals in marine benthic communities [2] and are a primary food source for juvenile fish [3]. Harpacticoid copepods are well suited for long term testing due to their small size and relatively short life cycle [4]. They are also relevant test species since they are abundant in many different ecosystems around the world [5]. The list of harpacticoid species from different tropical regions slightly overlap. There are several reasons for this, all of which are related to the poor knowledge about the harpacticoid fauna of the tropics. In terms of abundance, diversity, and distribution, the understanding of an ecosystem depends not only on holistic synthesis of all components, but also on how the individual components work. Therefore, the accuracy of the identification is fundamental to our understanding of ecological attributes of any organism in its environment.

Harpacticoid copepods, a significant component of the meiobenthos, prey on microalgae and bacteria, bioturbate the sediment (with burrowing activities), enhance recycling of bacterial material, and return accumulated nutrients to the benthos when they die [6]. Harpacticoid copepods are also important prey of invertebrate species and for a short time during the early life history of several fish species, the importance of these copepods to the survival of their predators may be crucial [7, 8, 9, 10, 11, 12, 13 and 14]. Seasonal and annual variation in abundance of harpacticoid copepods may be related to the growth and survival of populations of commercially important species [15 and 16]. A better understanding of meiofaunal dynamics requires a detailed study of harpacticoid assemblages.

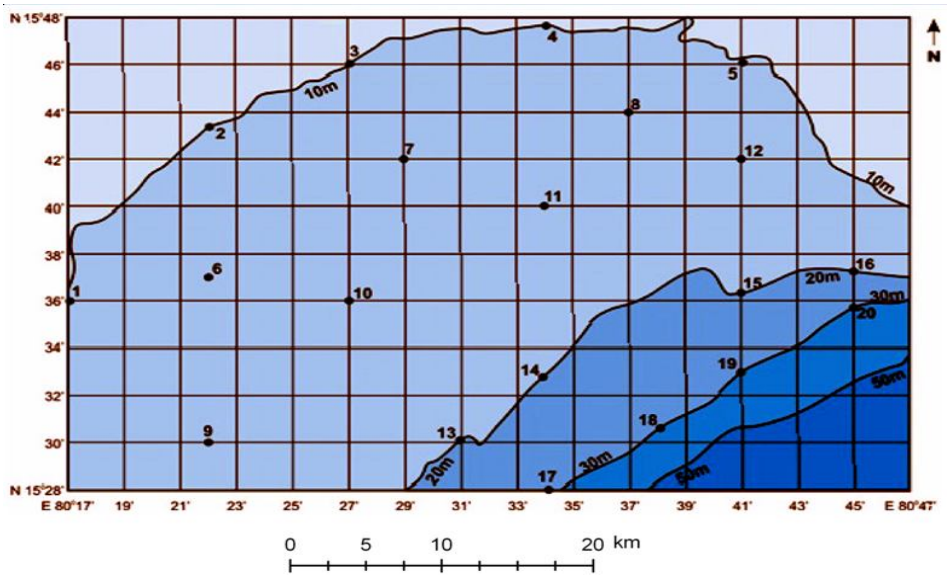
Certain papers have identified the specimens at the genus level only, or used the operational taxonomic unit, which hampers further comparison between species lists from different sources. This work aims to provide a list of harpacticoid copepods found in the Nizampatnam Bay, Bay of Bengal, which will help in expanding our knowledge on marine benthic faunal biodiversity of Indian coastlines.

MATERIALS AND METHODS

Study site

The present study is aimed at obtaining a comprehensive account of meiobenthos off Nizampatnam Bay located in Southern vicinity of Andhra Pradesh in terms of species composition representing sub-tidal (<50 m) area from 10-30 m depth of the shallow bay. During the investigation, four cruises were conducted onboard using fishing trawler FKKD *Koti* through two successive Post-Monsoon seasons (October 2006 and November 2007) and two Pre-Monsoon seasons (March 2007 and 2008) between latitudes 15° 28' to 15° 48' N and longitudes 80° 17' to 80° 47' E in the province of Nizampatnam Bay (Figure 1)

Figure 1: Sampling locations along Nizampatnam Bay



Sediment samples were collected during four seasons, pre – monsoon I , October ,2006 (N=80),post- monsoon I, March 2007(N = 48),pre-monsoon II,November , 2007(N =60) and post- monsoon II,March 2008(N=60)

between latitudes 15° 28' to 15° 48' N and longitudes 80° 17' to 80° 47' E in the province of Nizampatnam Bay were used in the study. GARMIN E-Trex GPS (Global Positioning System), USA was used for navigation onboard.

Data Collection

Biological observations included collection of quantitative meiobenthic samples. A van Veen grab (0.1 m^2 Hydrobios, Kiel, Germany) was used to collect the infaunal samples. At each station, a glass corer (3.6 cm inner diameter) was used for collecting sediment samples of 10 cm long cores from grab (van Veen grab, 0.1m²) hauls. The van Veen grab has an opening lid at the top, which facilitates the core sample to be taken out without disturbing the sediment. Replicate sub samples were collected from each haul. The samples were in Toto transferred to polythene containers, labeled and material preserved in 70% alcohol for further examination.

Sample processing

The sediment samples were then processed through a set of two sieves with 500 µm and 42 µm mesh size. The residue retained on the 42 µm sieve was stored in glass container and preserved in 4% buffered formalin. Rose Bengal was used as stain prior to sorting and enumeration. Meiobenthos was counted on higher taxonomic level using a binocular microscope. The total number of organisms in the sample represented by different phyla was expressed in individuals per 10 cm^{-2}. Taxonomic classification of constituent species was carried out based on standard literature [5 and 17].

Results and Discussion

Copepoda represented by 46 species belonging to 30 genera and 11 families and constituted 24% of the total meiofauna in terms of numerical abundance.

During post-monsoon I, the most dominant families were Diosaccidae, Thalestridae, Tetragonicepitidae, Ameiridae, Cylindropsyllidae and Ectinosomidae accounting more than 50% of the copepod population. During pre-monsoon I, the most dominant families were Diosaccidae, Thalestridae, Tetragonicepitidae, Ameiridae and Ectinosomidae accounting for more than 50% of the copepod population. Canthocamptidae was exclusively found in this season .During post-monsoon II, the most dominant families were Diosaccidae, Thalestridae, Tetragonicepitidae, Ameiridae, Ectinosomidae and Cylindropsyllidae accounting more than 50% of the copepod population. Paramesochridae was exclusively found in this season. During pre-monsoon II, the most dominant families were Diosaccidae, Thalestridae, Tetragonicepitidae, Ameiridae and Ectinosomidae accounting more than 50% of the copepod population. Two families were found to be depth specific- Canthocamptidae was restricted to <15m depth followed by Paramesochridae at >15m depth. During post-monsoon I, altogether 672 individuals belonging to 34 species and 22 genera dominated by *Diarthrodes dissimilis*, *Amphiascopsis cinctus*, *Phyllopodosyllus stigmosus*, *Stenhelia latipes*, *Diarthrodes unisetosus*, *Stenhelia* sp. accounting for more than 50% of the copepod population. *Arenosetella kaiseri, Stenhelia* sp., *Paramaphiascopsis ekmani, Ameira longipes, Arenopontia* sp., *Cletodes hartmannae, Stylicletodes* sp., and *Afrolaophonte* sp. were exclusively found (Table 1b).

Table 1b. List of copepod species collected at four seasons (1=post monsoon I (October 2006), 2 = pre monsoon I (March 2007), 3= post monsoon II (November 2007), 4 = pre monsoon II, March 2008; x- present, - absent).

Copepods	1	2	3	4
Ectinosomidae Sars, 1903	x	x	x	x
Ectinosoma breviarticulatum (Lang, 1965)	x	-	x	x
Ectinosoma melaniceps (Boeck, 1865)	x	x	x	x
Halectinosoma ornatum (Lang, 1965)	x	-	-	-
Halectinosoma kunzi (Lang, 1965)	x	-	-	-
Arenosetella kaiseri (Lang, 1965)	x	-	-	-
Hastigerella (Glabrotelson) *abbotti* (Lang, 1965)	x	-	x	x
Harpacticidae Dana, 1846				
Harpacticus spinulosus (Lang, 1965)	-	x	-	-
Harpacticus pacificus (Lang, 1965)	-	-	-	x
Thalestridae Sars, 1905				
Diarthrodes dissimilis (Lang, 1965)	x	x	x	x
Diarthrodes unisetosus (Lang, 1965)	x	x	x	x
Diarthrodes sp. (Lang, 1965)	x	-	-	-
Dactylopodia (Dactylopusia) *paratisboides* (Lang, 1965)	x	x	x	x
Miraciidae Dana, 1846				
Stenhelia peniculata (Lang, 1965)	x	x	x	x
Stenhelia (Delavalia) *latipes* (Lang, 1965)	x	x	x	x
Stenhelia (Delavalia) *oblonga* (Lang, 1965)	x	x	x	x
Stenhelia (Delavalia) *hirtipes* (Wells and Rao, 1987)	-	x	x	x
Stenhelia (Delavalia) *longipilosa* (Lang, 1965)	-	x	-	-
Stenhelia sp.	x			
Amphiascus minutus (Claus, 1863)	x	x	x	x
Amphiascopsis cinctus (Claus, 1866)	x	x	x	x
Paramphiascopsis (Amphiascopsis) *ekmani* (Lang, 1965)	x	-	-	-
Typhlamphiascus unisetosus (Lang, 1965)	x	x	x	x
Typhlamphiascus pectinifer (Lang, 1965)	x	x	-	x
Robertgurneya diversa (Lang, 1965)	x	x	x	x
Robertgurneya brevipes (Wells and Rao, 1987)	-	x	-	x
Robertsonia robusta (Wells and Rao, 1987)	-	x	-	-
Amphiascoides lancisetiger (Lang, 1965)	x	x	x	x
Amphiascoides dimorphus (Lang, 1965)	x	x	-	-
Schizopera californica (Lang, 1965)	x	x	x	x
Ameiridae Boeck, 1865				
Ameira longipes (Boeck, 1865)	x	-	-	-
Ameira parasimulans (Lang, 1965)	x	x	x	x
Nitocra (Nitokra) *affinis affinis* (Gurney, 1927)	x	x	x	x

Paramesochridae Lang, 1944				
Apodosyllus sp.	-	-	x	-
Phyllopodosyllus stigmosus (Wells and Rao, 1987)	x	x	x	x
Phyllopodosyllus tenius (Wells and Rao, 1987)	x	x	x	x
Canthocamptidae Brady, 1880				
Orthopsyllus illgi (Chappuis, 1958)	-	x	-	-
Leptastacidae Lang, 1948				
Leptastacus constrictus (Lang, 1965)	x	-	x	-
Leptastacus incurvatus (Lang, 1965)	x	x	x	-
Arenopontia sp	x	-	-	-
Cletodidae Scott, 1904				
Cletodes hartmannae (Lang, 1965)	x	-	-	-
Enhydrosoma hopkinsi (Lang, 1965)	-	-	-	x
Stylicletodes sp.	x	-	-	-
Laophontidae Scott, 1904				
Pseudonychocamptus paraproximus (Lang, 1965)	-	x	-	-
Heterolaophonte (Quinquelaophonte) *longifurcata* (Lang,1965)	-	x	-	-
Raowellsia sp.	-	-	-	x
Afrolaophonte ensiger (Wells and Rao, 1987)	x	-	-	-

During pre-monsoon I, altogether 500 individuals belonging to 29 species were encountered. The most dominant species, *Amphiascopsis cinctus*, *Diarthrodes dissimilis*, *Phyllopodosyllus stigmosus*, *Stenhelia latipes*, *and Diarthrodes unisetosus* were accounting for more than 50% of the copepod population. *Harpacticus spinulosus, Stenhelia longipilosa*, *Robertsonia robusta, Orthopsyllus illgi, Pseudonychocamptus paraproximus* and *Heterolaophonte* sp. were exclusively found.

During post-monsoon II, altogether 179 individuals belonging to 24 species and 17 genera were encountered. The most dominant species, *Stenhelia latipes*, *Diarthrodes dissimilis*, *Ameira parasimulans*, *Phyllopodosyllus stigmosus*, *Amphiascopsis cinctus*, *Dactylopusia paratisboides*, *Amphiascoides lancisetiger* were accounting more than 50% of the copepod population (Table 1b) and the observation of highest number of copepod species (39 species) at <15m depth followed by (31 species) at >15m depth, decline in abundance and increase in number families decreasing depth in the present study are in agreement with the earlier reports [18].

The copepod generic composition in the Nizampatnam Bay showed the presence of all depths genera like *Enoploides, Phanoderma, Setosabatieria, Neotonchus, Nannolaimoides, Desmodora, Ceramonema, Monoposthia, Onyx, Diarthrodes, Stenhelia, Apodosyllus, Arenopontia, Stylicletodes,* and *Raowellsia* were found in various sediments [19, 20, 21 and 22].

Table 2b. List of copepod species collected at at two depths < 15m and > 15m; x- present, -absent).

Copepods	< 15m	>15m
Ectinosomidae Sars, 1903	**x**	**x**
Ectinosoma breviarticulatum (Lang, 1965)	**x**	**-**
Ectinosoma melaniceps (Boeck, 1865)	**x**	**x**
Halectinosoma ornatum (Lang, 1965)	**x**	**-**
Halectinosoma kunzi (Lang, 1965)	**x**	**-**
Arenosetella kaiseri (Lang, 1965)	**-**	**x**
Hastigerella (Glabrotelson) *abbotti* (Lang, 1965)	**x**	**-**
Harpacticidae Dana, 1846		
Harpacticus spinulosus (Lang, 1965)	**-**	**x**
Harpacticus pacificus (Lang, 1965)	**x**	**-**
Thalestridae Sars, 1905		
Diarthrodes dissimilis (Lang, 1965)	**x**	**x**
Diarthrodes unisetosus (Lang, 1965)	**x**	**x**
Diarthrodes sp. (Lang, 1965)	**x**	**-**
Dactylopodia (Dactylopusia) *paratisboides* (Lang, 1965)	**x**	**x**
Miraciidae Dana, 1846		
Stenhelia peniculata (Lang, 1965)	**x**	**x**
Stenhelia (Delavalia) *latipes* (Lang, 1965)	**x**	**x**
Stenhelia (Delavalia) *oblonga* (Lang, 1965)	**x**	**x**
Stenhelia (Delavalia) *hirtipes* (Wells and Rao, 1987)	**x**	**x**
Stenhelia (Delavalia) *longipilosa* (Lang, 1965)	**x**	**x**
Stenhelia sp.	**x**	-
Amphiascus minutus (Claus, 1863)	**x**	**x**
Amphiascopsis cinctus (Claus, 1866)	**x**	**x**
Paramphiascopsis (Amphiascopsis) *ekmani* (Lang, 1965)	**x**	**-**
Typhlamphiascus unisetosus (Lang, 1965)	**x**	**x**
Typhlamphiascus pectinifer (Lang, 1965)	**x**	**x**
Robertgurneya diversa (Lang, 1965)	**x**	**x**
Robertgurneya brevipes (Wells and Rao, 1987)	**-**	**x**
Robertsonia robusta (Wells and Rao, 1987)	**-**	**x**
Amphiascoides lancisetiger (Lang, 1965)	**x**	**x**

Amphiascoides dimorphus (Lang, 1965)	x	x
Schizopera californica (Lang, 1965)	x	x
Ameiridae Boeck, 1865		
Ameira longipes (Boeck, 1865)	-	x
Ameira parasimulans (Lang, 1965)	-	x
Nitocra (Nitokra) *affinis affinis* (Gurney, 1927)	x	X
Paramesochridae Lang, 1944		
Apodosyllus sp.	-	x
Tetregonicipitidae Lang, 1944		
Phyllopodosyllus stigmosus (Wells and Rao, 1987)	x	x
Phyllopodosyllus tenius (Wells and Rao, 1987)	x	x
Canthocamptidae Brady, 1880		
Orthopsyllus illgi (Chappuis, 1958)	-	x
Leptastacidae Lang, 1948		
Leptastacus constrictus (Lang, 1965)	x	-
Leptastacus incurvatus (Lang, 1965)	x	x
Arenopontia sp	x	-
Cletodidae Scott, 1904		
Cletodes hartmannae (Lang, 1965)	x	-
Enhydrosoma hopkinsi (Lang, 1965)	-	x
Stylicletodes sp.	x	-
Laophontidae Scott, 1904		
Pseudonychocamptus paraproximus (Lang, 1965)	x	-
Heterolaophonte (Quinquelaophonte) *longifurcata* (Lang,1965)	x	-
Raowellsia sp.	x	-
Afrolaophonte ensiger (Wells and Rao, 1987)	x	-

CONCLUSIONS:

Biodiversity investigations aim to integrate species checklists and the compilation of databases that represent a regional and global benefit for researchers worldwide. Furthermore, the monitoring of biodiversity over time is of great importance for planning conservation actions, which seems to be more urgent these days, especially in vulnerable coastal systems. This study represents the first survey of the harpacticoid copepods in the Nizampatnam Bay, Bay of Bengal.

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