Eco. Env. & Cons. 27 (August Suppl. Issue) : 2021; pp. (S93-S98)
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ISSN 0971–765X

Effect of industrial effluents on *Cypridopsis* species (Ostracoda: Cyprididae) diversity in River Cauvery, Tamilnadu, India

N. Anandakumar[1] and N. Thajuddin[2]

[1]Department of Education, The Gandhigram Rural Institute-Deemed to be University, Gandhigram 624 302, Dindigul-Dt. Tamilnadu, India
[2]National Repository for Microalgae & Cyanobacteria – Freshwater (NRMC-F) (Sponsored by DBT, Govt. of India)
Department of Microbiology, School of Life Sciences, Bharathidasan University, Tiruchirappalli 620 024, Tamilnadu, India

(Received 22 February, 2021; Accepted 19 April, 2021)

ABSTRACT

A detailed experimental study was carried out on *Cypridopsis* species diversity in the River Cauvery, Tamilnadu, India. There are six species identified with the help of standardized literatures and manual techniques. Samples were collected in three stations of Vangal zone of Karur-District, Tamilnadu from January, 2019 to March, 2019. Species richness and species evenness were measured under the Shannon-Wiener diversity index. Highly changed industrial effluent samples of Ostracods were analyzed by every month with proper cultural techniques. From this research study, February, 2019 sample's data, Cypridopsis species diversity are highly affected by the effluents of Vangal zone of River Cauvery rather than other seasonal changes and cyclomorphosis. From this data, species richness and species evenness are highly correlated in the month of February, 2019. Hence, researchers have strongly suggested that, it is an urgent need to release the proper treatment of effluents from the industries and recommended to utilize common effluent treatment plant protocol of Government.

Key words: *River Cauvery, Cyclomorphosis, Vangal Zone, Industrial effluent samples, Periphyton and Bio-indicator.*

Introduction

Ostracods are free-living, small, bivalve crustaceans which are often found in fresh-water environments such as lakes, pools, swamps, streams, cave waters and heavily polluted waters etc. (Edmondson, 1992). It comes under the 3rd sub-class of Crustacean Phylum (Ekambaranatha Ayyar and Ananthakrishnan, 1977). In 1743, Linneaus, in his *Systema Naturae*, published a note on a species of crustacean, called as Monoculus. The following features *viz.* size and shape of the shell, characteristics features of shell surface, presence and length of the natatory setae of the second antennae, segmentation of the second antennae, number of spines of the maxillary process and shape of caudal furca are considered of primary taxonomical importance

The genus Cypridopsis caudal furca is rudimentary nature and reduced to a long setae or flagellum. Sometimes, furcal rami greatly reduced, whip-shaped, without a terminal claw at the end. Shells are tumid in nature, valves nearly equal and ulti-

mate podomere of the maxillary palp cylindrical longer than wide.

Surface of valves pitted or not pitted is also key features for identification of species. Further for identification, spines and fairly hairy structure or projection on the valves of shell used. Ostracoda, sometimes abundance in night catches. They serve as an important economic fish in Asian countries. It is also an exploration of oil resources indication. Ostracods are important representation of bio-luminous organisms. The carapace has a dorsal hinge, sometimes with teeth more or less calcified, with various patterns on the surface. Hence, carapace is also an identification procedure followed in China and Japan only. The appendages are reduced in number, usually only seven pairs. The antennule is uniramous, four to seven-segmented, with the functions of movement and sensibility nature. The antenna is biramous nature, used for swimming purpose only. In general, the protopodite is a monosegment with a small endopod, modified to form a grasping organ in the male with well-developed exopod, being mainly a locomotive organ. Most taxonomist used this procedure for species identification purpose. Some of the China's manual very particularly, mandibles are used for identification. The mandible usually has a large biramous palp, a slender exopod and an endopod of varying forms (Zhong *et al.,* 1989).

A wide variety of inorganic and organic pollutants are present in the effluents from dying textiles, paper mills and sugar factories in River Cauvery, Karur District (Shanmugapriya *et al.,* 2017). For example, every day, about 180 million liters of toxic effluents are discharged into the Periyar River by the industrial units from Cochin areas. The toxicants pumped into the river are acids, alkalies, fluorides, free ammonia, insecticides, dyes and mercury. Continuously, BOD of river has gone up to 16.2 as against the normal value of 5 (Sharma, 1999). In general, there are three main sources of aquatic pollution such as industrial wastes, municipal wastes, and agricultural run-off in Karur areas. In that, certain important industrial effluents such as paper mill discharges, pharmaceutical waste products, dying textiles wastes and sugar mill wastes always entered in the River Cauvery in Vangal zone of Karur. Pollutants, affect the species composition of the plankton community, particularly in river system. Such as mainly chemical pollutants block the effect of light on the photosynthetic mechanism and inhibit growth (Walsh, 1972). Certain fresh water algae were very sensitive to cadmium, methylmercury and lead (Overnell, 1975). Nitrogen, iron and phosphorus has a great effect on the rate of primary productivity related plankton community (Goldman, 1974), also few of phytoplankton groups, such as cyanobacterial species diversity increased by the effluents due to the favorable contents of oxidizable organic matter, rich calcium and abundant nutrients such as nitrates and phosphates with less DO (Vijayakumar *et al.,* 2007).

There are several mathematical indices used in the field of species diversity for bio-monitoring processes. A widely used one such method is the Shannon-Wiener Index. This general, diversity index is sensitive to both species richness and relative species abundance. It calculates, by taking the number of each species and its proportion to each species variation.

In the present study, the species diversity has been verified by standard indices for detailed understood the effluent's effects in the Vangal Zone of River Cauvery, Karur-District, Tamil Nadu.

Materials and Methods

Effluent samples were collected in the three important places in the Vangal Zone of Karur District, Tamilnadu, India, such as Moganoor, Pugalur and Vangal local discharges. Samples collected in early morning with double net procedures of plankton techniques were followed. Sedgwick rafter counting cell techniques were adopted for quantitative analysis. Lugol's staining tools were also implemented. The part of another sampling techniques such as culture-based methods were used for identification of species (Newell and Newell, 1963 and Frank and Terry, 1987). With the regular interval, monthly twice from January, 2019 to March, 2019 samples were collected. Species identification and body size (Length) were measured with the help of standardized manuals (Ekambaranatha *et al.,* 1977, Edmondson 1992 and Santhanam and Srinivasan, 1993). Further, species diversity was calculated by Shannon-Wiener Index with the help of SPSS package (Ronald and Bartha, 2005 and Verma and Agarwal, 2010). Certain seasonal morphological changes were recorded with the help of very old literatures (James and Paul, 1941 and Rastogi and Jayaraj, 1999).

Results

Totally, there are six species identified in the River Cauvery, Vangal Zone of Karur District. Within the six species, three of them may new strains to this area, because it is slightly differed from the *Cypridopsis aculeate* varieties (Fig. 1) (De Deckker and McKenzie, 1981).

Fig. 1. Shows the details of left lateral view of *Cypridopsis sp*. (Lugol's staining)

The following *Cypridopsis species* were identified:

1. ***Cypridopsis niagrensis*:** Terminal claw of thirdleg, approximately straight with tip has bended. The body length is 540-547µm. The surface of valves are smooth with short hairs. Natatory setae are extending the claws. Maxillary spines are lucid appearance. Caudal furca is clearly visible.
2. ***Cypridopsis viduella*:** Terminal claw of third leg, strongly pectinate. Surface of valves also smooth. The body length is 580-585 µm. Natatory setae extend slightly. Maxillary spines were observed. No indication of caudal furca presence.
3. ***Cypridopsis mexicana*:** Surface valves with angulated dorsal margin. Natatory setae of second antenna extend beyond tips of terminal claws. The body size is very less 379-382 µm than other species of Cypridopsis. No indication of hairs on the surface. Caudal furca is prominently observed.
4. ***Cypridopsis yucatanensis*:** Surface valves pitted and smoothly arched dorsally. Natatory setae of second antenna barely extend the terminal claws. The body size is 356-372 µm. Longer flagellum of furca is observed.
5. ***Cypridopsis vidua*:** It is variable in shape, size and colour. The anterior margin of the right valve to show the tubercles structure (Hoff, C. Clayton, 1942). The natatory setae of second antenna barely extend beyond tips of terminal claws. The body size is 583-585µm. Surface valves have number of bands were observed. This is most commonly observed in Pugalur areas of river Cauvery.

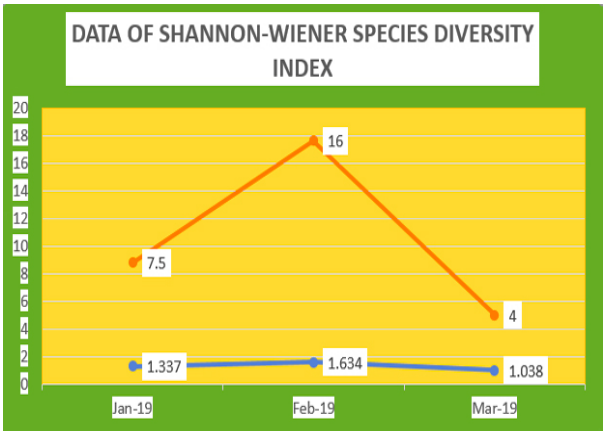

Fig. 2. Details of month-wise data of *Cypridopsis species* diversity

Table 1. Shows the Ostracods collection from the Vangal-Zone of River Cauvery, Tamilnadu. India in the Month of January, 2019

S. No.	Species name	Place	Body Size (Length)	Total number of Specimens	p-Value	Natural log.	Total proportion value
1.	*Cypridopsis niagrensis*	Pugalur	545-547µm	4/.1ml	0.266	-1.324	0.352
2.	*Cypridopsis viduella*	Pugalur	582-585µm	5/.1ml	0.333	-1.099	0.365
3.	*Cypridopsis mexicana*	Moganoor	382-385µm	2/.1ml	0.133	-2.017	0.268
4.	*Cypridopsis yucatanensis*	Vangal Local Discharges	360-365µm	4/.1ml	0.266	-1.324	0.352

Table 2. Shows the Ostracods collection from the Vangal-Zone of River Cauvery, Tamilnadu. India in the Month of February, 2019

S. No.	Species name	Place	Body Size (Length)	Total number of Specimens	p-Value	Natural log.	Total proportion value
1.	*Cypridopsis niagrensis*	Moganoor	540-542µm	3/1 ml	0.093	-2.375	0.220
2.	*Cypridopsis vidua*	Pugalur	583-585µm	8/1 ml	0.250	-1.386	0.346
3.	*Cypridopsis viduella*	Pugalur	580-585µm	6/1 ml	0.187	-1.676	0.313
4.	*Cypridopsis mexicana*	Vangal Local Discharges	380-382µm	2/1 ml	0.062	-2.780	0.172
5.	*Cypridopsis yucatanensis*	Moganoor	356-358µm	3/1 ml	0.093	-2.375	0.220
6.	*Cypridopsis aculeata*	Pugalur	595-598µm	10/1 ml	0.312	-1.164	0.363

Table 3. Shows the Ostracods Collection from the Vangal-Zone of River Cauvery, Tamilnadu. India in the Month of March, 2019

S. No.	Species name	Place	Body Size (Length)	Total number of Specimens	p-Value	Natural log.	Total proportion value
1.	*Cypridopsis viduella*	Moganoor	580-582µm	2/1 ml	0.250	-1.386	0.346
2.	*Cypridopsis mexicana*	Pugalur	379-381µm	2/1 ml	0.250	-1.386	0.346
3.	*Cypridopsis yucatanensis*	Vangal Local Discharges	370-372µm	4/1 ml	0.500	-0.693	0.346

Table 4. Shows the details of month-wise data of *Cypridopsis species* diversity

S.No.	Month/Year sample	S-W Diversity Index	Total specimens in the sample.
1.	January-2019	1.337	7.5
2.	February-2019	1.634	16
3.	March-2019	1.038	4

6. ***Cypridopsis aculeate*:** Surface of valves with spines between the pits, sometimes appeared as rounded pit structure. This is an important key feature forthis species identification. The body is too large 595-598µm. This is not very commonly occurred in River Cauvery.

The following data were analyzed through Shannon-Wiener Index with SPSS calculation:

Conclusion and Discussion

Ostracoda is one of the important economic resources inthe in-land fisheries. This plankton species, China and Japan often used for early-stage culture of fish larvae. It is also a good bio-indicator. From this data, species richness and species evenness are highly correlated in the month of February, 2019. Highest diversity values were recorded in the Pugaloor station. In Pugaloor station, paper mill effluents, mainly increasing the species diversity due to the effect of some physio-chemical changes. Some other common species of ostracods, such as Candona, Cypria and Cyclocypris strictly disappeared in this zone due to the effects of industrial effluents. This study was highly matched with previous report of Negi and Rajput, (2013). Khan, (1991), study is, the effect of urban and industrial effluents on species diversity of the phytoplankton community in a tropical river Malaysia. He stated that due to the rubber effluents and palm oil waste discharges, species diversity of diatom community reached highest level in the river ecosystem, and also community structure severely affected. Further he pointed out, urban sewages and severe organic loadings also effect the community structure of phytoplankton in the tropical river system. Mathivanan *et al.* (2007), report stated that highly polluted by direct contamination of sewage and other industrial effluents affect the plankton community groups. In general, periphyton, benthic macroinvertebrates

and fishes are the most common bio-indicators in the river system. Bio-indicator means, it is an organism that contains information on the quality of the environment. It has some common characteristics, such as taxonomic soundness, wide distribution, low mobility, well-known ecological characteristics, numerical abundance, suitability for laboratory experiments and high sensitivity to environmental stressor. They have the ability to integrate the effects of short-term environmental variations. Take for example, three categories, such as reduction in diversity, retrogression to dominance by opportunistic and reduction in individual size of dominating species are key indicator features. Due to the effect of river pollution, the species richness and diversity strongly reduced. Shannon-Wiener Index is commonly used to evaluate the environmental health of river system (Li *et al.,* 2010). Cypridopsis species richness value is 16, whereas species evenness value is 1.634 in the month of February, 2019 (Table 2). Islam and Huda (2016), report stated that, Chlorophyceae indicates more sensitivety to the pollutant's discharges. Due to the effect of effluents, the species diversity is reduced. Some other species such as phytoplankton of Bacillariophyceae appear to be best adapted in the polluted habitats.

Next, moderate level of species diversity were recorded in the Moganoor areas in the month of January, 2019 (Table 1). Moganoor have sugar mill discharges and additionally high level of sludge and local discharges also. Blue-green algae are often abundant in summer when mineral salt least, because they can utilize gaseous nitrogen from the air.

Finally, lowest diversity (species richness only) was recorded in local discharges of Vangal Zone areas in the month of March, 2019 (Table 3). Local discharges have, high level of dyeing effluents. In this zone, species evenness is moderate level observed. It is clear indication that the effects of organic matter and other sewages for this change. Venkatachalapathy and Karthikeyan (2013), pointed out that highly polluted direct contamination of sewage and other industrial effluents, such as dyeing factory effluents change the community structure of living organisms. Kushwaha and Agrahari (2014), also indicated that low sewage water has high abundant of protozoan groups.

Destruction of aquatic organisms is a well-known consequence of pollution. Type of aquatic organisms destroyed and the extent of destruction are a reflection of the character and quantity of wastes entering waterway (John, Cairns *et al.,* 1971). From this report, overall, three stations have somewhat severely affected by industrial effluents and changed the community structure of *Cypridopsis* species diversity (Table 4 and Fig. 2). Another parameter such as BOD is also raised. Some of the reports from the high expert committees, might not release the highly pollutants rich effluents into the river system. In the bio-magnifications processes, all the physiological activities are affected. Hence, the researchers have recommended to the release after proper treatment of effluents from the industries. It is an urgent and need of the hour.

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