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Review Article

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Role of Zooplankton in the Evaluation of Pollution

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Abstract

The increasing load of pollutant and toxicant into the aquatic ecosystem has been a matter of serious concern as the water quality is changing fast and the fauna and flora in the trophic and toxic conditions reflect a community structure, the diversity and abundance of which can be usefully assessed in a biological monitoring programme. Living organisms are capable of combating pollution and so it is in the interest of the man to protect the biological quality of fresh water resources. This paper attempts to review the research work on the possibilities and problems in using zooplankton as indicator species in the evaluation of pollution. The research on zooplankton in India and abroad can help in developing biomonitoring programme to control water pollution.

Keywords

Role,
Zooplankton,
Evaluation,
Pollution.

Zooplankton has been a subject of study by several authors in this country and abroad. Most of the investigations on Zooplankton as indicators of pollution has been carried out in cold temperate regions. The warm temperate, sub-tropical & tropical water bodies have received very little attention. The Zooplankton in the assessment of water pollution have many advantages. They are small enough to be handled in large numbers within a limited space. Samples can be collected easily and processed rapidly. Their reproductive cycle is short which enables to study their several generations in a short time. A few common genera like Daphnia, Cyclops & Branchionus etc. can be easily cultured for experimental purposes. Moreover, biologist can be trained in zooplankton taxonomy in a relatively short time. The zooplankton rapidly respond to environmental changes then fishes and they are important link in the food chain as the grazers.

The populations and the community structure of the zooplankton is limited by temperature, dissolved oxygen, salinity and various other physico-chemical factors. The pollution load in any aquatic ecosystem can further alter the species composition and the community dynamics. The role of a few categories of pollution affecting the zooplankton community is being given here.

Introduction

Some species of zooplankton, e.g., calanoid copepods, *Limnoealanu macrusus* and *Senecell calanoides* are confined to cold water. On the other hand, some other species can tolerate a temperature of averaging 37^0C. In Ghana birds sanctuary at Bharatpur. Mahajan e tal. (1981) in the peak of summer recorded ten species out of a total of 21 species found there at the ambient temperature and 80% of the total population was being dominated by single genus, Brachionus. The thermal pollution shortens the life cycle of zooplankton and thus create a disturbance in natural periodicity and community structure.

(A). Acid Stress Conditions:

The Industrial effluents may lower the pH in the area of their discharge. Sprules (1975) conducting investigation in 47 acidic lakes of Canada having a pH range of 3.627 confirmed the dominance of 3 to 4 species of crustacean zooplankton. In extreme cases only a single species *Diaptomus minutus* survived in some lakes.

(B). Eutrophication:

A number of zooplankters have been identified as indicator of eutrophication (Table 1). Crustacean species indicative of eutrophication are Diaphanosoma, Simacephalus and Ceriodaphnia. Fryer (1968), Pejler (1965) Hakkari & Ganon (9172 A & B) found *Chyclorus sphaericus*, *Daphnia cucullata*, *Ceriodaphnia quadrangula* and Diaptomussiciloides as indicators of eutrophication.

Moreover, some ciliates e.g. Coleps, Holophyra, Chilodonella, Paramecium, Colpoda and Colpidium are also indicative of eutrophication.

(C). Heavy metal pollution:

Discharges from mining and industry contain heavy metal in their effluents and create a serious water pollution problem. Zooplankton species are more susceptible to cations then fish (Anderson, 1980; Freeman and Fowler, 1953). A Summary of zooplankton senstivity to heavy metals is being presented in Table 2. A crustacean species such as Diaptomus (Juneja, 1979) is 14 times more sensitive then fish under mercury pollution.

(D). Pesticides Pollution:

In the last decade, several contributors have advocated the use of zooplankton for bioassay studies. In this connection Daphnia has been found to be a great favorite because of its worldwide distribution (Adema, 1978 and Senders and cope 1966). Table 3 and 4 shows summarized information available on comparative toxicity on zooplankton.

(E). Oil spillage and refinery waste pollution:

Tawrell (1978) and Buikema et al. (1976) have found the oil and refinery waste as much more harmful to zooplankton then to fish. A zooplankton, *Daphnia pulex* was found to be most suitable as it was most sensitive and relatively less expensive and easy to maintain.

Thus it is clear from the available evidence that zooplankton could be taken as valuable indicator of water pollution and for the assessment of the effect on the total aquatic system.

Table – 1 Zooplankton with apparent values as indicator of eutrophic condition (Mahajan et al. 1981)

Name of Species	References								
	1	2	3	4	5	6	7	8	9
Anuraeopsis fissa		+							
Brachionus anglaris	+		+	+	+	+	+		+
B. calyciflorus			+			+	+		+
B. quadridentatus		+		+		+	+		
B. ureceus		+		+		+			
Filinia branchiata						+			
F. longiseta		+		+	+	+	+	+	+
F. terminales		+		+			+		
Keratella cochlearis					+	+	+	+	
Pompholyx sulcat	+	+	+	+	+	+		+	
P. complanata		+		+					
Polyarthra euriptra	+		+		+	+			
Trichocerca birostric					+				
T. capucina		+		+					
T. cylindrica	+		+		+		+		
T. multicrinis						+		+	
T. pussilla	+	+		+	+	+			
Conochiloides dossuarius						+			
Asplanchna herricki					+				
Synchaeta grandis					+				
Ploesoma hudsoni					+				
Collothecal abera					+				
Polyarthra vulgaris								+	
Branchionus mulleri									+
Asplanchna priodonta									+

Table – 2 LC -48h values (mg/l) of some metals to Zooplankton (Baudouin and Scoppa, 1974).

Metallic Salt	Cyclops Eudiaptomus	Daphnia	*Obyssorumpadanus hyalina*
$CaCl_2.2H_2O$	7000	4000	3000
$MgCl_2.6H_2O$	280	180	32.0
$SrCl_2.6H_2O$	300	180	75.0
CsCl	400	135	7.4
CrCl	10.0	10.1	0.02
$CoCl_2$ $.6H_2O$	15.5	4.0	1.32
$NiCl_2$	15.0	3.6	1.90
$Pb(CH_3COO).3H_2O$	5.5	4.0	0.60
$HgCl_2$	2.2	0.85	0.055
$ZnSO_4$ $.7H_2O$	5.5	0.50	0.040
$CdSO_4$ $.8H_2O$	3.85	0.55	0.055
$CuCl_2.2H_2O$	2.5	0.50	0.055

All values have been calculated for metal contact in the Salts.

Table – 3 LC -48 values (mg/l) of some chlorinated hydrocarbon (Sanders and Cape, 1966).

Toxicants	*Simocephalus serrulatus*	*Daphnia pulex*
DDT	2.5	0.36
TDE (DDT)	4.5	3.2
Methoxychlor	5.0	0.78
Toxaphene	19.0	15.0
Chlordane	20.0	20.0
Aldrin	23.0	28.0
Heptachlor	47.0	42.0
Aramite	180.0	160.0
Dieldrin	240.0	250.0
Lindane	520.0	460.0
Chlorobenzilate	550.0	870.0

Table – 4 LC -48h values (mg/l) of some herbicides to crustaceans (Sanders 1970)

Herbicides	Daphnia Cypridopsis Gammarus Asellus Palacmonetes Drconectes manavidua fasciatus brevicaudu skadia pensisnails					
	21^0C	21^0C	15.5^0C	45.5^0C	21^0C	15.5^0C
1	2	3	4	5	6	7
2,3 Dichloro-1, 4 naphthoquinone	0.025	0.12	0.24	0.20	0.45	3.2
(Dichlone)						
Propyleneglycol butylether	0.10	0.32	2.6	2.2	2.7	>100.0
Esters of 2,4-dichlorophen						
Oxyacetic acid (2,4-D) (PGBE)	0.18	0.20	1.0	0.50	3.2	>100.0
Propylene glycol butylether						
esters of 2-(2,4,5-trichloropheroxy)	0.56	0.25	1.8	2.0	1.2	50.0
acid (Silver, PGBE)						
2,6-dinitro-N, N-n propyl-alpha	0.60	0.18	0.39	0.40	1.0	5.6
alpha, alpha-triffluro-p-toluidine						
(Triffluralin)	1.0	3.2	>100.0	>100.0	>100.0	>100.0
S. Ethyl hexahydro-1 Hazepine						
1-Carbothioate (Molinate)	1.1	0.24	20.0	5.6	1.9	24.0
2-Chloro-4, 6-bis (ethylamino)						
S-triazine (Simazine)	2.1	4.9	0.74	40.0	8.0	60.0
S-prophyl diprophylthidcabomate						
(Vernolate)						
Butoxy ethanol ester of 2-(2,4,5-						
trichlorophenoxy) acid Silver (BBE)						

Herbicides	Daphnia Cypridopsis Gammarus Asellus Palacemonetes Drconectes manavidua fasciatus brevicauduska diapensisnails					
	21^0C	21^0C	15.5^0C	45.5^0C	21^0C	15.5^0C
1	2	3	4	5	6	7
Dimethylamine Salt of 2,4 dichlorophenoxyacetic acid (2,4-D, dimethylamine Salt)	4.0	8.0	>100.0	>100.0	>100.0	>100.0
Butoxyethanolester of 2,4 dichlorophenoxyacetic acid (2,4-D) (BEE)	5.6	1.8	5.9	3.2	1.4	>100.0
2,6-Dichlorobenzonitrile (Dichlorobenil)	10.0	7.8	18.0	34.0	9.0	22.0
3 Amino-1,2,4-triazole (amitrol-T) (EC)	30.0	32.0	>100.0	>100.0	>100.0	>100.0
N,N-dimethyl-2, 2-diphenyl acetamide (Diphenamid)	56.0	50.0	>100.0	>100.0	58.0	>100.0
2 Methoxy-3,6-dichloro benzou acid (Dicamba)	>100.0	>100.0	>100.0	>100.0	>100.0	>100.0
2,3,6-Trichlorophenyl acetic acid sodium salt (WP) Fenac (Na salt)	>100.0	>100.0	>100.0	>100.0	>100.0	>100.0
2,4-Dichlorophenoxy acetic acid	>100.0	-	3.2	-	-	-

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