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The invertebrate macrofauna in some rice fields of Ranchi, Bihar

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Abstract. The invertebrate macrofauna of the rice fields of Ranchi locality were studied from rainy to winter season of 1980. A total of 14 species of macrofauna belonging to Oligochaeta, Hirudinaria, Gastropoda and Insecta were recorded. The density and biomass of all the groups of invertebrate macrofauna (per sq. meter) were maximum in September when the climatological factors were optimum and were minimum in November - December corresponding minimum temperature and minimum or nil rain fall.

Introduction

Rice fields represent a temporary aquatic ecosystem like seasonal ponds during the rainy and early winter seasons and are used for paddy cultivation cum fish culture. A considerable amount of research has been conducted on fish culture in rice fields in countries like Japan, Taiwan, Indonesia, India, China and Malaya (Hora, 1951; Schuster *et al*, 1954; Chen, 1954; Ardiwinata, 1957; Tripathi, 1963; Muddanna and Halappa, 1970). Recently special attention has been paid by the composite fish culture division of CIFRI (Barrackpore, W. Bengal) in collecting frylets and fingerlings of air breathing fishes from rice fields of different regions of India. However, a research of literature reveals that no data are available on the invertebrate macrofauna of the rice fields which occupy central position in food chain. The present study provides qualitative and quantitative spectrum of the invertebrate macrofauna of rice fields at Ranchi in Bihar.

Materials and Methods

Two sampling plots (50 × 50 m) were marked in the paddy fields near Ranchi town (situated on 22.55°N and 85.10°E, at an altitude of more than 639m ASL). These paddy fields are locally called 'Dhone' (lowerkpaddy fields retaining water for at least six months beginning from July to December). The depth of water in the selected plots varied between 10 and 25 cm. The plots contained paddy plants throughout the period of investigation. The bottom of the rice fields consisted soft black mud.

Twenty samples were taken at fortnight intervals between 8 AM to 12 Noon from different spots by using a 10 × 10 cm spade. The samples were kept in separate containers, brought to the laboratory and sieved through a metallic gauge (256 meshes/sq cm). The macrofauna were sorted out, identified, counted and afterwards their dry weight was recorded by drying at 85°C. Gastropoda were dried and weighed after removing the shell. At the time of sampling air and water temperature and pH were also recorded. Rain fall was also recorded for the study period.

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Results

Climatological conditions :

Ranchi experiences a monsoonal climate and the year is divisible into four distinct seasons namely, summer, rainy, autumn and winter. The summer season extends from mid March to mid June and the rainy season extends from mid June to September. The autumn and winter seasons extend from October to February. During the study period air and water temperatures in the sampling plots varied between 20.0°C and 31.0°C and 18.0°C and 27.0°C respectively. The maximum rainfall was noted in August and minimum in November, while no rainfall occurred in December (Table 1).

Benthic Macrofauna :

In addition to the fortnightly samples in two sampling plots, collections were also made from other paddy fields in the region to determine the whole range of macrofauna. Fourteen species of invertebrate macrofauna belonging to Oligochaeta, Hirudinea, Gastropoda and Insecta have been recorded from the rice fields studied (Table 2).

Table 1. Climatological and certain physico-chemical data of rice field.

	Jul	Aug	Sept	Oct	Nov	Dec
Temperature °C Air	28.8 ± 3.0	26.6 ± 2.0	28.0 ± 2.1	26.6 ± 1.5	22.3 ± 3.2	19.0 ± 3.16
Water	26.9 ± 5.0	25.9 ± 3.0	26.4 ± 3.6	24.7 ± 1.5	20.3 ± 3.1	17.9 ± 2.0
Rainfall (mm)	313.4 ± 16.65	461.1 ± 17.95	200.97 ± 6.83	124.8 ± 9.12	4.32 ± 1.23	
pH	8.58 ± 0.23	7.5 ± 1.3	7.9 ± 1.3	8.1 ± 0.43	7.8 ± 0.57	8.2 ± 0.23

Table 2. Invertebrate fauna occurring in the Paddy Fields in Ranchi.

Class	Family	Species / Larval forms
Oligochaeta	Aeolosomatidae	*Aeolosoma bengalensis*, Steph
	Tubificidae	*Limnodrilus hoffmeisteri*, Claperede
	Megascolecidae	*Pheretime sp.*
Hirudinae	Hirudidea	*Hirudo birmanica*. Balanchard
		Hirudinaria sp.
Gastropoda	Viviperidae	*Viviparus bengalensis* form *typica*, *Lamarck*
	Ampullaridea	*Pila globosa*, Swainson
	Hydrobidae	*Digoniostoma pulchella*, Benson
	Planorbidae	*Indoplanorbis exustus*, Deshyes
	Lymnaedae	Lymnes acuminata form *typica* Lamarck
Insecta	Calopterygidae	Damselfly nymph
	Ephemeridae	Mayfly nymph
	Anisopoteridae	Dragonfly nymph
	Zygopleridae	
	Chironcmidae	*Chironomous* larva

Table 3. Average Biomass (Dry weight mg/m2) of the benthos (mean ± SD).

	July	August	Sept	Oct	Nov	Dec
A. bengalensis	7.10 ± 3.75	3.60 ± 0.14	21.30 ± 6.25	28.40 ± 11.25	3.45 ± 1.65	
Pheretima sp	28.85 ± 2.22	23.5 ± 1.66	27.25 ± 1.75	35.33 ± 2.5	32.1 ± 2.22	15.7 ± 2.44
L. hoffmeisteri		4.64 ± 0.32	9.28 ± 1.28	7.04 ± 1.04	4.96 ± 0.48	2.16 ± 0.16
Hirudo birmanica	24.13 ± 13.38	48.37 ± 13.39	24.18 ± 1.85	23.71 ± 12.45	12.9 ± 1.8	
Hirudinaria sp	67.18 ± 3.87	44.62 ± 8.64	86.25 ± 17.8	65.18 ± 11.33		
V. bengalensis		118.12 ± 62.43	313.54 ± 62.62	397.24 ± 21.4	94.62 ± 31.33	
P. globosa	325.4 ± 37.46	888.16 ± 179.56	1254.16 ± 179.16	940.65 ± 133.56		
D. pulchella			124.22 ± 31.0	179.0 ± 31.0	315.22 ± 31.75	
I. exustus	241.87 ± 80.62	483.22 ± 68.12	589.62 ± 73.40	635.62 ± 90.0	755.0 ± 46.87	171.33 ± 10.77
L. acuminata		85.71 ± 18.90	123.44 ± 37.81	139.31 ± 21.94	64.59 ± 21.40	32.30 ± 10.70
Damselfly nymph		37.77 ± 13.34	75.53 ± 19.99	94.33 ± 26.47		
Mayfly nymph		20.16 ± 6.72	40.31 ± 13.44	30.23 ± 7.58	35.27 ± 11.37	
Dragonfly nymph		24.18 ± 8.18	17.3 ± 1.81	68.12 ± 3.62	48.37 ± 1.62	
Chironomous larva	53.75 ± 10.75	59.12 ± 5.38	56.44 ± 2.19	64.5 ± 10.75	86.0 ± 10.75	48.38 ± 16.12
Total Biomass	778.28 ± 180 00	1821.22 ± 386.79	2762.82 ± 450.35	2726.66 ± 385.39	1452.48 ± 161.24	269.87 ± 40.19

Variation in macrofauna :

A wide variation in numbers of macrofauna was noted in both the rice fields under investigation which is evident by the variation in biomass as shown in Table 3.

The maximum number of Oligochaetea was recorded in October and that of Hirudineans in September-October, Oligochaetea and *Hirudo birmanica* were minimum in November-December. The greatest number among the annelidan species was recorded for *Pheretima* sp. from July to December.

Gastropoda exhibited greatest numbers in October. *I. exustus* was dominant within the gastropoda group throughout the period of investigation, having a peak population in November. The population of *D. pulchella* and *P. globosa* was minimum in September-October and that of remaining species in November-December.

Among the insects, *Chironomous* larvae showed the maximum population density and predominated over other insects throughout the period of investigation with a peak in November. The lowest population number was recorded in July for *Chironomous* larvae and in August for other insect species.

The total average number of all groups of fauna was highest in September and lowest in December, the average number was 722m-², the group-wise composition was Oligochaetea 178 m-², Hirudineans 80 m-², Gastropoda 256 m-² and Insecta 280 m-².

It was further observed that the annelid species were more or less equal in number in all the sampling plots and the Gastropoda were maximum in number in the peripheral spots of the rice fields whereas the insects were abundant in the relatively inner spots.

Biomass :

The biomass of different species recorded during the study period are set in Table 3. The total biomass of macrofauna was maximum in September and minimum in December, corresponding to the maxima and minima of their population density. Maximum of the biomass was contributed by *Pheretima* sp., *Hirudinaria* sp., *P. globosa*, *I. exustus* and *Chironomous* larvae (Table 3).

Discussion

The macrofauna composition in the rice field is more diverse as compared to the benthos of pond of the same locality (Bose *et al*, 1978), probably due to more light penetration upto bottom of the paddy fields in comparison to the pond owing to low column of water, which in turn, facilitates the accumulations of relatively more amount of choiceable food material for the particular macrofaunal species in the fields.

The *Hirudo birmenica, Hirudinaria* sp., *Pheretima* sp., *Pila globosa, Indoplanorbis exustus* and Damselfly nymph are exclusive to the rice fields while the other species as mentioned in Table 2 are common in both the aquatic ecosystems.

The presence of leeches only in the fields can be attributed to the basal shoots of paddy crop serving as submerged vegetarian which has been regarded as one of the important factors for their distribution (Bennike and Boisen, 1943; Sawyer, 1974), giving them protection, solid substrate for locomotion and deposition of cocoon (Nozley, 1932; Mann, 1955).

Regarding distribution of macro benthic fauna, as has been observed, Sawyer (1971, 1974) pointed out that the fresh water organisms are usually determined by two or more physical, chemical or biological characteristics of the environment. The most

important of these environmental factors, in approximate order of significance, are food, nature of substrat, depth of water, water current, temperature, pH, siltation, hardness and turbidity, which obviously are operative in presenting the present fauna spectrum.

The total average number of different group of macrofauna of rice fields per sq. meter was several times less (nearly eight times) in contrast to the ponds benthos. The lesser number of faunal population in field than that of pond may be attributed to temporariness of rice field habitat in contrast to permanence of pond habitat. Further unlike the bottom of pond the bottom of rice field is compartmented by paddy plantation providing insufficient space to macrofauna for their proper development, may be a probable reason.

The average number of insects per sq. metre was one and half times more in the field than that of the pond may probabiy be due to availability of a more protected habital niche by paddy plants to the insect to thrive.

The Gastropoda and Oligochaeta were 2.5 and 30 times less than that of pond. The relative less number of Gastropoda seen to be an effect of substrate of the rice field, as substrate characteristics have been found to influence the distribution of gastropoda in particular (Baker, 1928; Houp, 1970; Harman, 1972, 1974). Oligochaeta particularly grow heavily in high organically polluted condition where high bacterial activities are found. Conversely, a low bacterial activity area possesses less nnmber of Oligochaeta (Brinkhurst, 1972; Brinkhurst and Cook, 1966, 1974), which seems probable in the present study.

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