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Studies on the Planktonic and Aquatic Insect Predator Succession in Carp Nursery Ponds Prior to Spawn Stocking

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Abstract

Several inland water bodies particularly fish farms in the northern and central states of India were surveyed for studying the species compositions and distribution of predatory aquatic insect fauna detrimental to polyculture. It was observed that the depth of the water affects the aquatic insects directly or indirectly. In the present study a high quantity of rotifers and cladocerans were recorded in the nursery ponds. Results of the present study have shown that *Notenecta* sp., *Limnometra* sp. and *Cybister* sp were the major aquatic insect predators of the nursery ponds and as such proper control measures should be done before stocking. Proper management of nursery ponds requires adequate knowledge of the planktonic and aquatic insect predators in them. Such a knowledge would also help in fixing the time for hatchling.

Keywords

Detrimental, Polyculture, Planktivorous, Insect.

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INTRODUCTION

Carp nursery is an area for raising the fish spawn to fry stage. Rearing of hatchlings in nursery pond is an important step in fish culture practices and as such proper preparation of nursery pond before stocking of carp hatchling is important for successful rearing of spawn, fry and fingerlings. The basic principle of nursery pond management therefore is to provide proper ecological conditions for the survival and growth of the fish, and it involves pre-stocking, stocking and post stocking management.

Carp spawn need a plentiful supply of natural food in the form of small animalcules. This spawn, being very small, feed upon planktons *of restricked sizes*, In general, the hatchlings feed on the protein rich zooplankton such as *Rotifers, Daphnia Moina,* Cyclops etc. Hence a Qualitative and Quantitative knowledge of plankton biomass in the nursery pond is essential.

The nursery pond constructed to rear the carp spawn are invariably populated with a large number of aquatic insects throughout the year. Most of the aquatic insect are carnivorous preying directly upon carp spawn and as such their mortality and recovery get affected mainly due to the quality of the insect predators available in the nursery ponds. According to Alikunhi et.al., (1952) aquatic insects which abound the nursery ponds are of the most important factors that cause large scale mortality of carp spawn in nurseries.

Different types of insects either as larvae or adults may not only prey of fish hatchlings but may also complete for food (Santhanam et.al.,1990). Among the eleven orders of class insect, three orders viz., Coleoptera, Hermiptera and Odonata are relatively important because their presence in the nursery ponds results in very poor survival of fry. The most important insects posing problems to the fish ponds include the water strider *Limnometra;* backswimmers *Notonecta* and *Anisops;* water scorpions *Laccotrephes* and *Ranatra,* giant water bugs *Diplonychus* and

Lithocerus; diving beetles *Cybister, Hydaticus. Sandracottus, Rhantaticus, Eretes, Laccophilus, Hyphoporus* and *Peschatius,* Whirlging beetles Dineutes and scavenging beetles *Hydrophilus, Sterrolophus* and *Regimbartia.* Apart from this the nymphs of dragonflies such as *Anax* and *Macromia* and *demselflies* such as *Enallagmebrium* and *Ischnura* also play a serious role in the predation of fish fry in the ponds. These aquatic insects multiply during the time of fertilization of ponds with organic and inorganic manuring. The role of predators in nursery ponds has been discussed by Alikunhi et. Al., (1957), Ibrahim (1957) and Chaudhuri (1960).

So proper management of carp nursery ponds requires adequate knowledge of the planktonic and aquatic insects' predator's development in them. Such a knowledge would also help in fixing the time (appropriate date after manuring) for hatchling stocking in the nursery pond as rich crop of Zooplankton especially rotifers and cladocerans are essential for proper fish growth (Jhingran, and Pullin (1988), Hence the present study is armed at investigating.

MATERIALS AND METHODS

1. NURSERY PONDS AND THEIR PREPARATION:

Three nursery ponds of rectangular shape each of 20m×10m in size were used for the present study (Fig.1). Depths of these ponds ranged from 0.9m to 1.2. All the ponds were with sufficient embankment and gentle slopes and were of purely clay soil. 2" PVC pipes were provided as inlet and outlets to the ponds. A 160 feet deep borewell was supplying fresh water to the ponds. The ponds were subjected to the following processes before stocking of hatchlings.

i DRYING UP OF THE POND:

To mineralize the pond, the bottom of the Nursery ponds was dried by exposing them to sun for 15 days.

ii REMOVAL OF WEEDS: Some marginal weeds were removed.

iii Water Filling: Water was filled upto 75 cm height in each pond.

iv Liming: Lime was broadcasted uniformly throughout the nursery pond bottom area at the rate of 3kg/200m2.

V Manuring: The following were applied as manure after filling urea 2kg/200m^2, Potash 1kg/200m^2, Superphosphate 3kg/200m^2 and cow dung 200/kg200m^2.

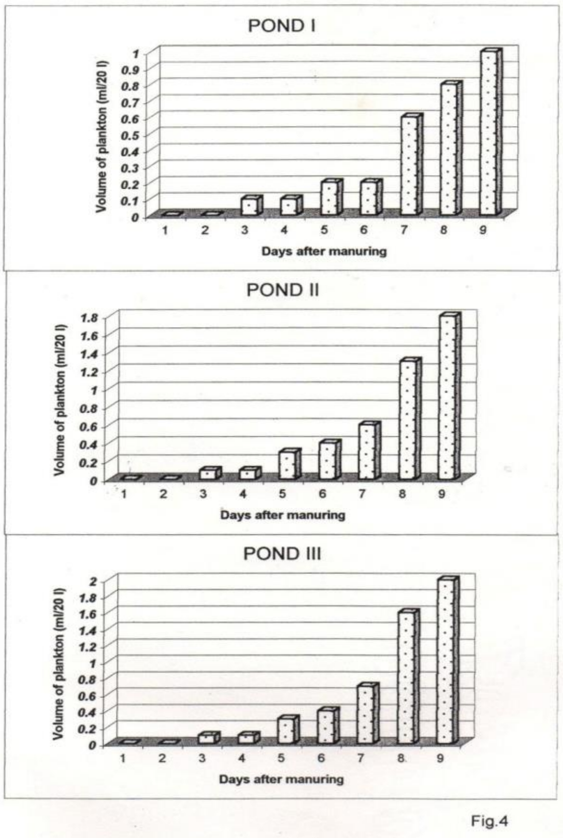


Fig 1: A view of a nursery pond used for the present study.

Fig 2: Plankton collection at a nursery pond.

Fig. 3: Aquatic insect predator collection in a nursery pond.

Fig. 4: Plankton volumes in the three nursery ponds studied during different days after manuring.

2.SAMPLING OF PLANKTON AND INSECT PREDATORS:

Plankton and aquatic insect predators were collected each day for 9 days after manuring. A 100µ mesh filter net was used for plankton collection. Twenty litres of water filtered through the plankton collection net (Fig.2) and the plankton sticking to the net were collected and preserved in 5% formalin for later identification and enumeration.

For the collection of aquatic insects' predators, a 1m 2m×1 hapa net of 1/40 size was dragged three times, across the pond (Fig.3) and the insects caught in the net were collected and preserved in 5% formalin for later identification and enumeration.

RESULTS

1. Planktonic Succession in the ponds:

Volumes of plankton available in the three ponds during different days were given in table, 1 and shown in Fig.4, Planktonic forms started to appear in the collection only on the third day and was very low (<0.1ml/ 20 Lit) up to the 4^{th} day in all the three ponds. Thereafter the plankton amounts increased steadily in ponds I and III and reached 1.0ml/20 Litre and

2.0ml/20 Litre in them. Respectively, 9 days after manuring. In pond –II the plankton bloom attained a level of 1.8 ml/20L of water 9 days after manuring.

Densities and relative availabilities of various plankton types in ponds I to II where given in tables 2,3, &4 and shown in Figs.5,6 and 7 respectively. Rotifers (Fig.8) were the predominant plankton types in all the ponds in all the days, followed by Daphnia (Fig.9), Cyclops (Fig.10) and Moina (Fig.11) in that order. Further, Rotifers were the first to develop in all the ponds. Daphnia could be detected after five days only in ponds I & II eventhough they were present after three days in pond III. Similarly, Cyclops could be detected comparatively later i.e., after 6 days in ponds I & II when compared to pond

Table 1: Volume of Planktons (ml/20L) in the three ponds studied in different days after manuring.

DAYS	POND - I	POND - II	POND - III
1	-----	-----	-----
2	-----	-----	-----
3	>0.1 ml	>0.1 ml	>0.1 ml
4	>0.1 ml	>0.1 ml	>0.1 ml
5	0.2 ml	0.3 ml	0.3 ml
6	0.2 ml	0.4 ml	0.1 ml
7	0.6 m	0.6 ml	0.7 ml
8	0.8ml	1.3 ml	1.6 ml
9	1.0 ml	1.8 ml	2 ml

Table – 2: Density (No/100ml and relative availability (%) of various Planktonic catagories in pond – 1 on different days after manuring the pond.

DAYS	ROTIFERS	DAPHNIA	CYCLOPS	MOINA	OTHERS	TOTAL
1	-----	-----	-----	-----	-----	-----
2	-----	-----	-----	-----	-----	-----
3	3(13.04)	-----	------	-----	20(87.0)	23
4	4(25.0)	------	-----	-----	12(75)	16
5	6(60)	3(20)	-----	-----	3(20)	15
6	16(69.6)	1(4.3)	1(4.3)	-----	5(21.7)	23
7	43(52.43)	12(14.63)	9(11.0)	3(3.7)	15(18.3)	82
8	96(53.63)	30(16.75)	30(16.75)	14(7.82)	9(5.02)	179
9	110(36.30)	87(28.71)	78(25.74)	19(6.27)	9(2.87)	303

- **Value within parentheses are relative availabilities in Percentage.**

Table – 3: Density (No/100ml) and relative availability (%) of various Planktonic catagories in pond – 2 on different days after manuring the pond.

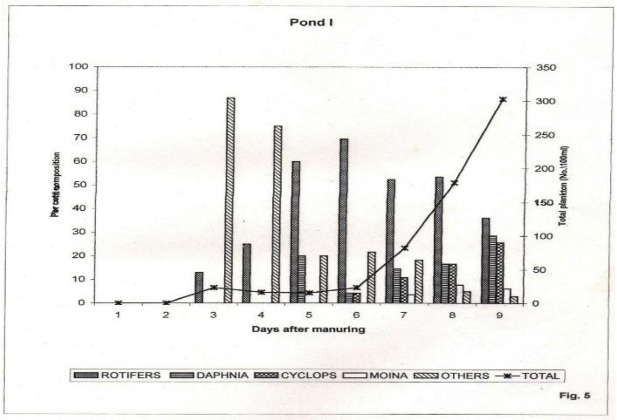
DAYS	ROTIFERS	DAPHNIA	CYCLOPS	MOINA	OTHERS	TOTAL
1	-----	-----	-----	-----	-----	-----
2	-----	-----	-----	-----	-----	-----
3	17(54.83	-----	------	-----	14(45.16)	31
4	19(61.29)	------	-----	-----	12(38.70)	31
5	30(65.21)	3(6.52)	-----	-----	13(28.26)	46
6	100(62.89)	23(14.46)	23(14.46)	4(2.51)	9(5.66)	159
7	106(49.53)	58(27.10)	27(12.61)	13(6.07)	10 (4.67)	214
8	125(42.66)	82(27.98)	56(19.11)	18(6.14)	12(4.09)	293
9	144(45.85)	88(28.02)	55(17.51)	17(5.41)	10(3.18)	314

- **Value within parentheses are relative availabilities in Percentage.**

Table – 4: Density (No/100ml) and relative availability (%) of various Planktonic catagories in pond – 3 on different days after manuring the pond.

DAYS	ROTIFERS	DAPHNIA	CYCLOPS	MOINA	OTHERS	TOTAL
1	-----	-----	-----	-----	-----	-----
2	-----	-----	-----	-----	-----	-----
3	22(46.80)	9(19.14)	------	-----	16(34.04)	47
4	25(34.24)	33(45.20)	5(6.84)	-----	10(13.69)	73
5	92(56.09)	47(28.65)	8(4.87)	17(10.36)	-----	164
6	105(47.29)	71(31.98)	29(13.06)	14(6.30)	3(1.35)	222
7	117(45.88)	78(30.58)	35(13.72)	17(6.66)	8(3.13)	255
8	118(39.20)	107(35.54)	42(13.95)	31(10.24)	3(0.99)	301
9	131 (39.69)	112(33.93)	46(13.93)	35(10.60)	6(1.8)	330

Value within parentheses are relative availabilities in Percentage.



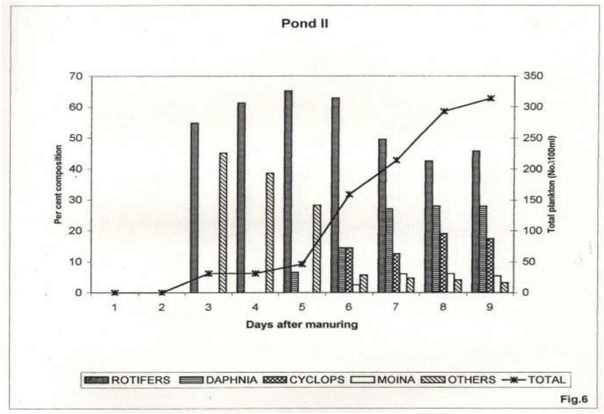
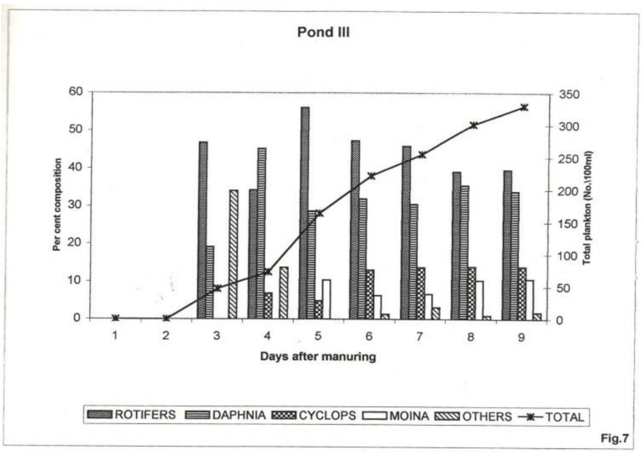
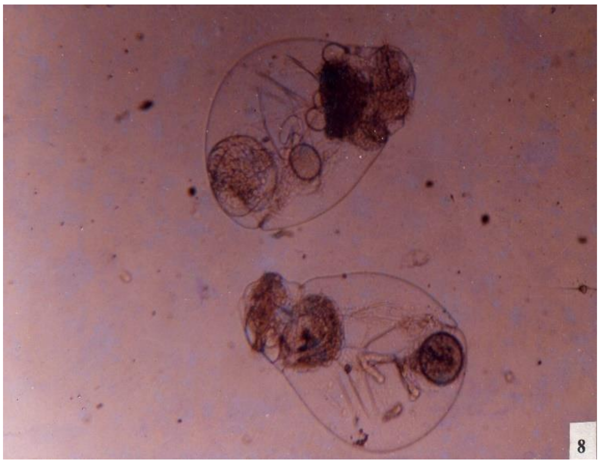
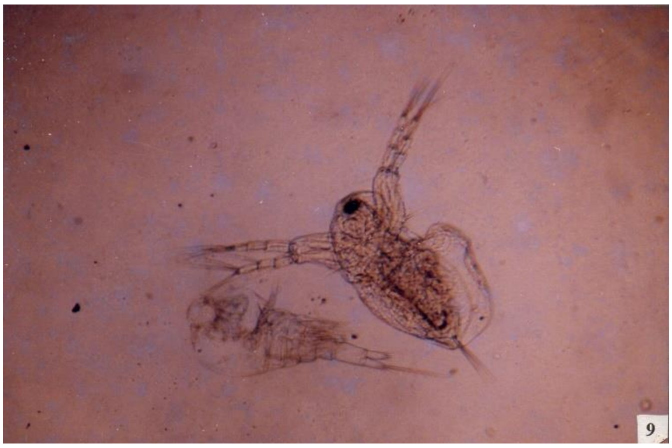
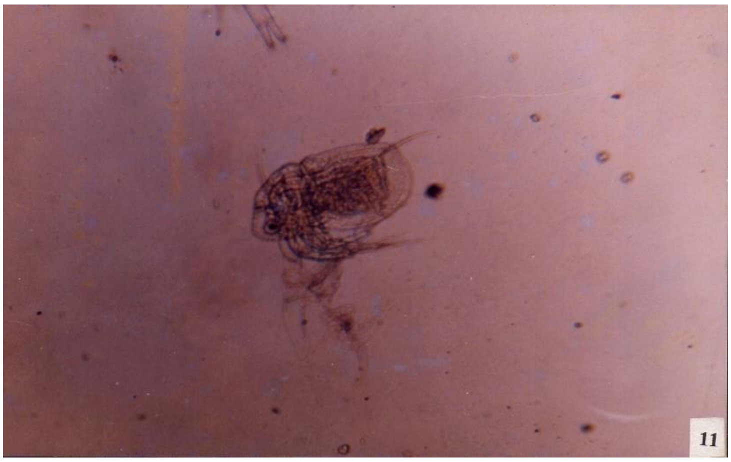


Fig. 5: Population fluctuation of different planktons in pond – I during different days after manuring. **Fig. 6:** Population fluctuation of different planktons in pond – II during different days after manuring. **Fig. 7:** Population fluctuation of different planktons in pond – III during different days after manuring. **Fig. 8:** *Rotifers* collected from a nursery pond. **Fig. 9:** *Daphnia* collected from a nursery pond. **Fig. 10:** *Cyclops* collected from a nursery pond. **Fig. 11:** *Moina* collected from a nursery pond.









III Where they could be found after 14 days. Moina species appeared after 7 days in pond I after 6 days in pond II and after 5 days in pond III. Rotifer population density was 3/100ml. after 3 days and reached a level a of 110/100ml after 9 days in pond,17/100ml. after 3 days and 144/100ml in pond II and 22/100 ml after 3 days and 131/100ml after 9 days in pond III. Daphnia densities were 3/100ml after 5 days and 87/100 ml after 9 days in pond I, 3/100ml after 5 days and 88/100 ml after 9 days in pond II and 9/100 ml after 3 days and 112/100 ml after 9 days in pond III. Cyclops densities were 1/100 ml after 6 days and 78/100ml after 9 days in pond I, 23/100ml after 6 days and 55/100ml after 9 days in pond II, and 5/100 ml after 4 days and 46/100ml after 9 days in pond III. Moina which appeared comparatively later in the ponds were 3ml/100 after 7 days and 19ml/100ml after 9 days in pond I, 4ml/100 ml after 6 days and 17ml/100ml after 9 days in pond II and 17ml/100ml after 5 days and 35ml/100 after 9 days in pond III.

2. Aquatic Insect – Predator development:

Fig. 12: *Notonecta* collected from a nursery pond.

Fig. 13: *Limnometra* collected from a nursery pond.

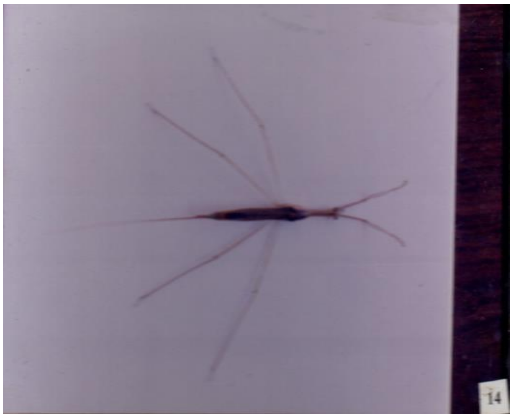


Fig. 14: *Ranatra* collected from a nursery pond.

Fig. 15: *Cybister* collected from a nursery pond.

Fig. 16: *Dytiscus* collected from a nursery pond.

Notonecta (Fig. 12) Limno metra (Fig. 13), Ranatra (Fig.14), Cybister (Fig.15), Dytiscus (Fig.16) were the auatic insect predators that could be indentified in the collections from the nursery ponds. Their densities and relative availabilities on different days after manuring at the three ponds were given in tables 5-7 and shown in Fig. 17-19. *Notonecta* were the predominant aquatic insect predators in all the days of observation followed by *Limnometra* in all the three ponds. *Ranatra* could be observation sporadically in ponds I and II while they were completely absent in pond II. Population of *Cybister* also fluctuated widely in the ponds. *Dytiscus* was found in pond III only 9th days (8/3 sweeps) after manuring (Table 7). *Notonecta* population fluctuated between 147/3 sweeps (after 8 days) and 152/3 sweeps (after one day) and 108/3 sweeps (after 9 days) in pond II and between 45/3 sweeps after one day and 183/3 sweeps (after 9 dyas) and in pond III. *Limnometra* population varied between 1/3 sweeps (after 2 days and 22/3 sweeps (after 6 days) in pond I, between 3/3 sweeps (after 1 day) and 27/3 sweeps (after 9 days) in pond II and between1/3 sweeps (after 2 days) and 38/3 sweep (after 9 days) in pond III. *Ranatra* could be observed only after 2 days (3/3 sweeps) and after 9 days (2/3 sweeps) and after 4 days (1/3 sweeps) in pond I and after 2days (3/3 sweeps) and after 9 days (2/3 sweeps) in pond III. *Cybister* was found after days 7 (3/3 sweeps) and after 8 days (1/3 sweeps) in pond II and after 3 days (1/3 sweeps) 4 days (1/3 sweeps) 8 days (3/3 sweeps) and 9 days (3/3 sweeps) in pond III.

Table – 5: Density and relative availability of different predators at Pond 1 on different days after manuring the pond.

DAYS	NOTONECTA	LIMNOMETRA	RANATRA	CYBISTER	DYTISCUS	OTHERS	TOTAL
1	46(54.76)	5(5.95)	2(2.38)	-----	-----	31(36.90)	-----
2	54(63.52)	1(1.17)	-----	-----	-----	30(35.29)	-----
3	92(71.87)	13(10.15)	------	-----	-----	23(17.96)	31
4	112(76.71)	15(10.27)	1(0.68)	-----	-----	18(12.32)	31
5	120(80)	18(12)	-----	-----	-----	12(8)	46
6	127(80.89)	22(14.01)	-----	-----	-----	8(5.09)	159
7	132(86.84)	13(8.55)	-----	3(1.97)	-----	4(2.63)	214
8	147(96.07)	------	-----	-----	-----	6(3.92)	293
9	152(83.97)	2(1.10)	------	1(0.55)	-----	26(14.36)	314

- **Densities are no. of insects caught during 3 sweeps of dragnet across the pond, and Relative availabilities in percentages and given within parentheses.**

Table – 6: Density and relative availability of different predators at Pond- 2 on different days after manuring the pond.

DAYS	NOTONECTA	LIMNOMETRA	RANATRA	CYBISTER	DYTISCUS	OTHERS	TOTAL
1	30(73.17)	3(7.31)	-----	-----	-----	8(19.51)	41
2	35(47.94)	5(6.84)	-----	1(1.36)	-----	32(43.83)	73
3	47(81.03)	7(12.06)	------	-----	-----	4(6.89)	58
4	59(71.08)	16(19.27)	-----	-----	-----	8(9.63)	83
5	72(70.58)	18(17.64)	-----	-----	-----	12(11.76)	102
6	87(75.65)	20(17.39)	-----	3(2.62)	-----	5(4.34)	115
7	91(78.44)	22(18.96)	-----	1(0.86)	-----	2(1.72)	116
8	99(75.57)	26(19.84	-----	1(0.67)	-----	5(3.81)	131
9	108(67.92)	27(16.98)	------	-----	-----	24(15.09)	159

- Densities are no.of insects caught during 3 sweeps of dragnet across the pond, and Relative availabilities in percentages and given within parentheses.

Table – 7: Density and relative availability of different predators at Pond - 3 on different days after manuring the pond.

DAYS	NOTONECTA	LIMNOMETRA	RANATRA	CYBISTER	DYTISCUS	OTHERS	TOTAL
1	45(55.55)	4(4.93)	-----	-----	-----	32(39.50)	81
2	96(76.8)	1(0.8)	3(2.4)	-----	-----	25(20)	125
3	109(80.74)	23(17.03)	------	1(0.74)	-----	2 (1.48)	135
4	115(79.31)	27(18.62)	-----	1(0.68)	-----	2(1.37))	145
5	122(77.70)	29(18.47)	-----	-----	-----	6(3.82)	157
6	133(78.23)	33(19.41)	-----	-----	-----	4(2.35)	170
7	147(76.56)	35(18.22)	-----	-----	-----	10(5.20)	192
8	163(97.02)	------	-----	3(1.78)	-----	2(1.19)	168
9	183(72.04)	38(14.96)	2(0.78)	3(1.18)	8(3.14)	20(7.87)	254

- **Densities are no.of insects caught during 3 sweeps of dragnet across the pond, and Relativie availabilities in percentages and given within parentheses.**

Fig. 17: Fluctuations in the populations of different aquatic insects in pond – I during different days after manuring, Fig. 18: Fluctuations in the populations of different aquatic insects in pond – II during different days after manuring and Fig. 19: Fluctuations in the populations of different aquatic insects in pond – III during different days after manuring.

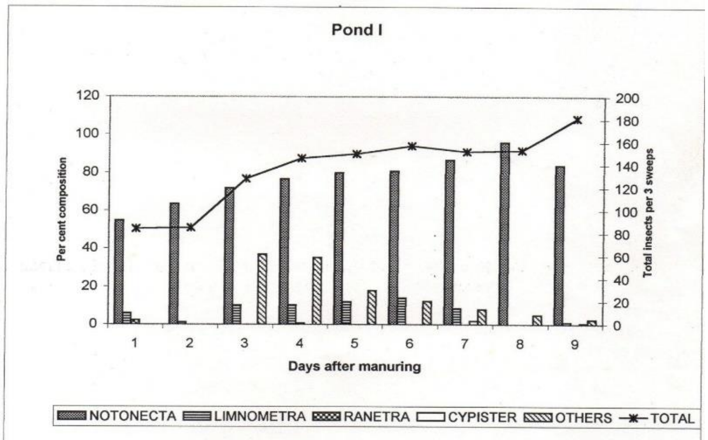


Fig. 17

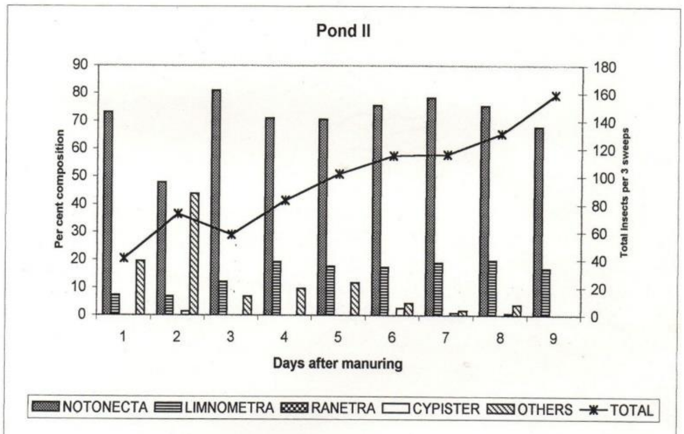


Fig. 18

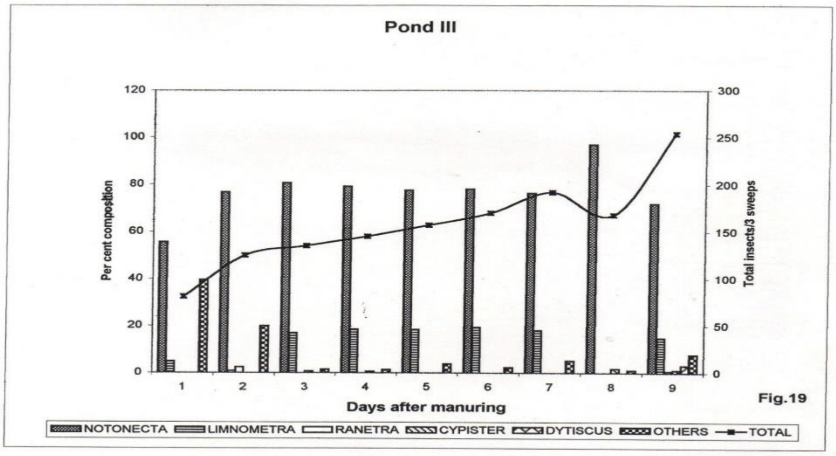


Fig.19

DISCUSSION

According to Alikunhi (1957) a minimum of 1.5 to 2.0ml of Zooplankton in 54.5 ml water is essential for satisfactory stocking of pond and so 8th day after manuring might be a suitable day for stocking of hatchlings stocking as the plankton volumes were 0.8ml/20L (pond) to 1.8ml/20 l (pond II) and 2.0ml and 2.0ml/20l (pond III), on that day and the highest densities of plankton were also observed. (vide tables 2.4). Alikunhi et al., (1952) also observed a high quantity or rotifers and cladocerans on 8-10 days after cow dung manuring in the nursery ponds. Mitra and Mohapatra (1956) have also stressed that the optimum concentration of Zooplankton in a nursery pond is essential for spawn, stocking, according to Jhingran and Pullin (1988) also the most appropriate time for stocking nursery pond is when it abounds with Zooplankton, especially rotifers and cladocerans in adequate density (preferably rotifer only).

Resuts of the present study have shown that Notenecta, Limnometra and Cybister were the major aquatic insect predators of the nursery ponds and as such proper control measures should be done before stocking. Santhanam et al., (1990) also stressed the importance of controlling the predatory insects in the fish ponds. However, one problem difficult to solve is that chemical treatment or mechanical removal after stocking might also affect the fish hatchlings.

The recent studies have shown that the plankton and predator number increase, during the nine days in the carp nursery ponds. The Plankton in water was enough for stocking spawn in the nursery pond during the day 8 and day 9. Simultaneously the insect population was above high during the day 8 and day 9. Hence to present study has enlightened the significance of plankton and predator populations in the carp nursery pond for making decisions about successful stocking

CONCLUSION

Proper management of nursery ponds requires adequate knowledge of the planktonic and aquatic insect predators in them. Such a knowledge would also help in fixing the time for hatchling. Stocking and so the planktonic and aquatic insect predator's development during the first nine days after manuring was studied in the Maheshwari fish seed farm, Nalladai, Tranquebar Taluk, Nagai District, Tamilnadu. Plankton density was highest during the 9th day after manuring. Aquatic insect predator population in the nursery ponds also increased along with the plankton population and reached highest numbers on the 9th day after manuring *Rotifers, Daphnia, Cyclops* and *Moina* were the important planktonic form observed *Notonecta, Limnometra, Ranatra, Cybister* and *Dytiscus* were the important aquatic insect predators collected.

The results obtained were discussed in the light previous Litrature and management suggestions and suggestions for future research were also given.

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Conflict of interest

The authors declare no conflict of interest.

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