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MICROECOLOGICAL STUDIES ON *PALLISENTIS ALLAHABADI* AGARWAL, 1958 (ACANTHOCEPHALA) A PARASITE OF FRESHWATER FISH

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INTRODUCTION

While examining the fishes of Gobindsagar Lake for acanthocephalan infections, *Channa punctatus* (Bloch) was found to be infected with *Pallisentis allahabadi* Agarwal, 1958. The present communication deals exclusively with the microecological studies of this parasite. Seasonal variations in the parasite population and its associations with the host fish have been studied.

MATERIAL AND METHODS

Living fish hosts were brought to the laboratory and examined at regular intervals. Total body length and sex of the fishes were recorded. The number of male and female parasites recovered from each fish were recorded separately. For studying the distribution of parasites the intestine was arbitrarily divided into five equal parts (Fig.1) and the number of male and female worms recovered from each part was recorded separately.

Invasion index was calculated according to Tenora and Zejda (1974) :

$$\text{Invasion Index} = \frac{\text{Total number of parasites x number of infected hosts}}{\text{Total number of hosts examined}}$$

RESULTS AND DISCUSSION

Seasonal variations in the parasite population

Monthly data indicate that the invasion intensity (percent infect) was maximum during winter months (October-December) and minimum in summer (May - July) (Table I and Fig. 2). The hormonal state of the host could be one of the factors regulating parasitic population in different seasons. Unfavourable conditions such as high temperature and scarcity of water in ponds leading to the decrease in the population of crustaceans (intermediate hosts) is thought to be the other possible factor leading to the decrease in parasite population.

Kennedy (1972) observed that in the experimentally infected Goldfish, with different population densities of acanthocephalan *Pomphorhynchus laevis* Zoega in muller, 1776, there was 30 percent decrease in the recovery after one week with 12°C rise in the water temperature. In the light of Kennedy's study the decrease in the invasion intensity during summers is supposed to be due to some physiological changes occurring in the fish host due to rise in temperature.

Amin (1975a) observed that the infections of *Acanthocephalus parksidei* Amin, 1975* in various hosts was at its peak during spring and attributed it to the availability of the source of infection (intermediate host).

Komarova (1974) observed that the helminth infection rates of fry and larvae of eight carp species in the Kremerchung reservoir, USSR is affected by different conditions of temperature and water level. Hot dry summers lead to the decrease in water level and hence decrease parasite species.

Khera and Wadhawan (1983) found that the infection of *Moniliformis moniliformis* (Bremser) in *Rattus rattus rattus* was maximum in the month of May and attributed it to the availability of intermediate host and hormonal state of the host.

From the above discussion it seems that season influences the parasitic infection in two ways. One is the influence of change in atmospheric conditions on the definitive host causing some physiological change leading to change in parasite population and the other is the influence of season on the population of intermediate host and thus controlling the parasite population.

Male to female ratio (MFR)

The present investigations indicate very high MFR in both male and female fish hosts (Table I). It was also observed that the MFR was very high in the anterior part of the intestine and pyloric caeca but less than unity in the posterior parts of the intestine (Table II). This is because the male worms when once established survive better and longer than females (Kennedy, 1972). So the MFR increase in the anterior part of the intestine which is the most favourable site while in posterior region, which receives the discarded worms, more females were found. No significant seasonal changes in the sex ratio, as observed by Amin and Burrow (1977), were observed during present investigations. Amin and Burrow (1977) observed that the sex ratio in *Echinorhynchus salmonis* Muller, 1784 in the Smelt was nearest to unity (even) during spring season and increase in favour of females towards autumn. A similar trend was observed by Kennedy (1972) for *P. laevis* in Gold fish, *Carassius auratus*. Khera and Wadhawan (1983) reported the sex ratio for *M. moniliformis* in *Rattus rattus rattus* in favour of female worms.

Kennedy (1972) reported that for *P. laevis* there are no separate zones of attachment for male and female parasites as there was no consistent difference in sex ratio along the length of intestine.

High MFR observed during present investigations seems to be a natural way of parasite population control. Grundmann, Warnock and Wassom (1976) reported that "constant conditions occur in some parasite species where mating pairs in a host occur only in limited

*Amin, 1975b

number" This type of state is considered important in population control. Of the 132 fish hosts examined 33 were found infected with male parasites only and three with female parasites. Where the male and female worms coexist the MFR was very high. So the actual number of mating pairs is quite less leading to a controlled production of infective acanthors.

Sex of host and parasites

Exept in summers (May - July) the invasion intensity (Percent infect) of the worms was more in male fish than in the female fish. Of the total fishes examined 68 out of 92 males (73.91 Percent) were found infected in comparison to 22 out of 40 (55 Percent) females (Table I).

Amin (1975a) observed that more males (76 Percent of 17) of *Semotilus atromaculatus* were infected with *A. parksidei* than females (47 Percent of 17) in the late autumn and male fishes had a relatively higher mean of 3.4 worms per host fish as compared to 3.0 in female hosts. Later in spring he reported increased parasitic load to a mean of 6.13 per fish in male hosts whereas the corresponding mean of 2.68 in females showed a slight decline. The observations of Thomas (1964a) for *Neoechinorhynchus rutili* (Muller, 1780) Yamaguti, 1963, in brown trout and of Amin and Burrow (1977) for *Echinorhynchus salmonis* were reverse. These authors reported more invasion intensity in the female hosts than the males.

The overall data of present investigations indicate that MFR was more (5.21) in male fishes as compared to (3.46) in female fishes (Table I). This low MFR in female fishes is considered to be due to the hormonal compatibility of the host and the parasite.

Host's size (age) and parasite

During present investigations 132 fish hosts ranging from 6-26 centimetres in size were examined and placed in seven groups with respect to their size. The mean number of worms infecting single fish host and invasion index for each group was calculated. It was observed that increase in the size of fish host was accompanied with an increased parasitic infection. The larger fishes were more heavily infected than the smaller fishes (Fig.3).

The increase in the invasion index and mean number of parasites per infected fish with the increase in size (age) of the host is attributed to two factors. One is the increased volume of food ingested by large fishes including the intermediate hosts. A study by Hart (1931) on Lake White fish, *Coregonus clupeaformis* in Ontario gives an example of this type. The amphipod contents (including *Pontoporeria hoyi*) in the diet of the White fish infected with *Echinorhynchus* sp. notably increased with the increase of fish size(13-55 cms. long fishes in five size groups). Similarly using eight age classes of White fish (2-9 years) from Cold Lake, Seng (1975) showed that a similar increase in the prevalence of *P. affinis* in the diet of older fishes corresponded with the heavier infection of *E. salmonis*. The other factor is as reported by Thomas (1964b) for trout, *Salmo trutta*, that the larger surface area of the gut in older fishes than that in younger fishes makes more space available to accommodate greater number of parasites.

TABLE - I

HOST					PARASITE			
Month	Sex	Examined	Infected	% infect	Total	Male	Female	MFR
	M	9	4	44.44	10	9	1	9.00
June	F	4	2	50	5	4	1	4
	T	13	6	46.15	15	13	2	6.5
	M	7	3	42.85	10	9	1	9
July	F	4	3	75.00	8	6	2	3
	T	11	6	54.54	18	15	3	5
	M	8	6	75.00	20	16	4	4
August	F	4	2	50.00	6	4	2	2
	T	12	8	66.66	26	20	6	3.33
	M	8	6	75.00	37	30	7	4.28
September	F	3	2	66.66	9	8	1	8
	T	11	8	72.72	46	38	8	4.75
	M	9	9	100	57	47	10	4.7
October	F	3	2	66.66	3	3		
	T	12	11	91.66	60	50	10	5
	M	5	5	100	30	24	6	4
November	F	3	2	66.66	5	4	1	4
	T	8	7	87.50	35	28	7	4
	M	8	8	100	69	58	11	5.27
December	F	2	1	50.00	2	2		
	T	10	9	90.00	71	60	11	5.45
	M	7	7	100	71	58	13	4.45
January	F	3	1	33.33	3	1	2	0.5
	T	10	8	80.00	74	59	15	3.93
	M	9	8	88.88	105	97	8	12.12
February	F	3	2	66.66	7	6	1	6
	T	12	10	83.33	112	103	9	11.44
	M	8	5	62.50	19	13	6	2.16
March	F	3	1	33.33	2	2		
	T	11	6	54.54	21	15	6	2.5
	M	7	5	71.42	11	9	2	4.5
April	F	4	1	25.00	1		1	
	T	11	6	54.54	12	9	3	3
	M	7	2	28.57	3	1	2	0.5
May	F	4	3	75.00	7	5	2	2.5
	T	11	5	45.45	10	6	4	1.5
	M	92	68	73.91	442	371	71	5.22
Total	F	40	22	55	58	45	13	3.46
	T	132	90	68.18	500	416	84	4.95

M : Male ; F : Female ; T : Total ; MFR : Male to Female Ratio

TABLE -II: Month wise data of *Pallisentis allahabadi* Agarwal, 1958 in different parts of host's intestine

Month	Sex	Number of fishes examined		Number of fishes infected		Total number of worms		worms in different parts of intestine									
								I		II		III		IV		V	
						M	F	M	F	M	F	M	F	M	F	M	F
	M	9		4													
June			13		6	13	2	8		5	1		1				
	F	4		2													
	M	7		3													
July			11		6	15	3	8	1	7			2				
	F	4		3													
	M	8		6													
August			12		8	20	6	14	3	4		2	2		1		
	F	4		2													
	M	8		6													
September			11		8	38	8	22	2	11		3	5	2	1		
	F	3		2													
	M	9		9													
October			12		11	50	10	20	4	24	1	4	5			2	
	F	3		2													
	M	5		5													
November			8		7	28	7	16	2	9		3	5				
	F	3		2													
	M	8		8													
December			10		9	60	11	36	3	21	3	3	3		2		
	F	2		1													
	M	7		7													
January			10		8	59	15	39	5	16	4	3	2	1	4		
	F	3·		1													
	M	9		8													
February			12		10	103	9	64	3	27	3	8	3	3		1	
	F	3		2													
	M	8		5													
March			11		6	15	6	12	2	1	2		2	2			
	F	3		1													
	M	7		5													
April			11		6	9	3	7		2	1		1		1		
	F	4		1													
	M	7		2													
May			11		5	6	4	2	2	4	1		1				
	F	4		3													
	M	92		68													
Total			132		90	416	84	248	27	131	16	26	32	8	9	3	
	F	40		22													
MFR						4.95		9.18		8.18		0.81		0.89			

Amin (1974) and Amin and Burrow (1977) also reported increase in parasite infection with the increase in host's size (age). Amin (1974) observed only partial overlap of generations and concluded that the effect of cumulative infections is important in determining worm density but only within one worm generation.

Distribution of the parasite in the host's intestine

No parasite was recovered from the pre-caecal part of the alimentary canal. The rest of the alimentary canal was divided into five equal parts (Fig. 1) arbitrarily and the number of male and female parasites recovered from each part was recorded separately. The parasites recovered from the pyloric caeca were included in those recovered from the first part (inter-caecăl part) of the intestine.

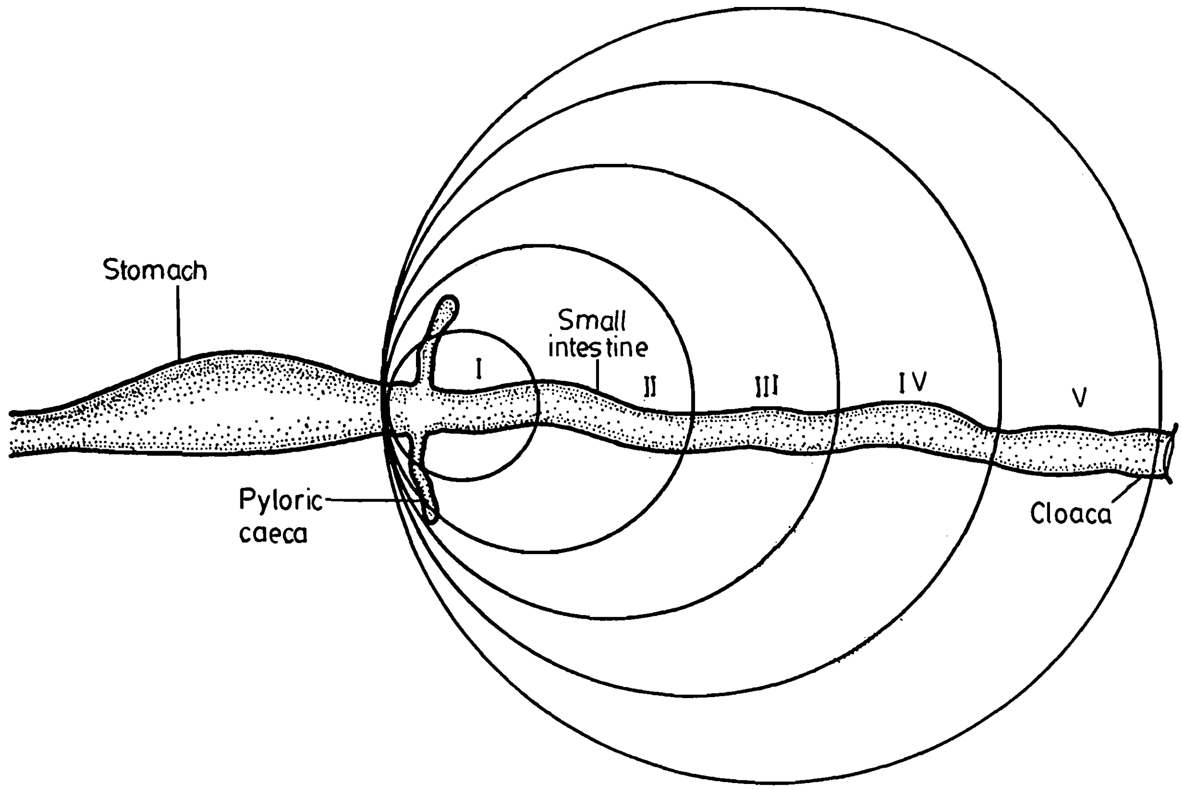
The data indicate that the number of parasites is maximum in the anterior - most region of the intestine and there is gradual decrease in the percentage distribution antero-posteriorly (Table II and Fig. 4). This preference for the anterior region of intestine is due to the availability of required nutrients in that region. Zone in which the acanthocephalans are usually found is known as "Zone of viability" (Burlingame and Chandler, 1941).

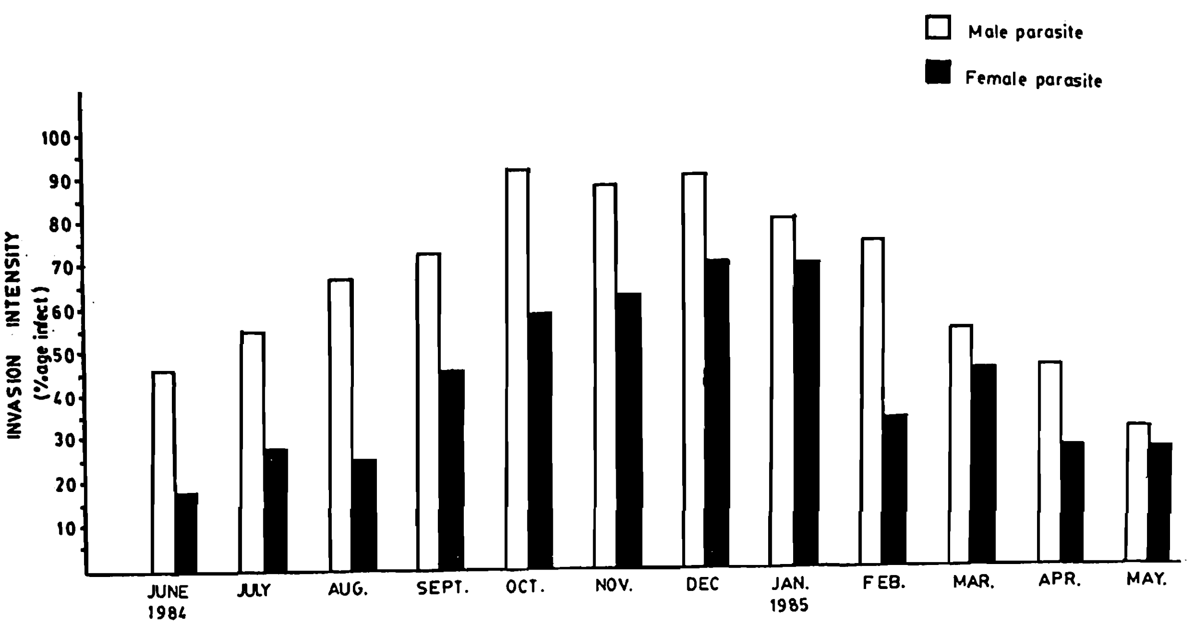
The evidence from the studies of uptake of substances by acanthocephalans in vivo and in vitro has shown that nutrition in acanthocephalans depends upon the absorption of nutrients present in the lumen of host's intestine through trunk region (Edmonds, 1965; Hammond, 1968; Hibbard and Cable, 1968). Edmonds (1965) using ^{14}C-labelled leucine and ^{32}P-labelled sodium phosphate has shown that in vivo these substances pass into *Moniliformis dubius* Meyer, 1932 and are obtained from the host's gut contents rather than its gut mucosa. So the possibility of the role of proboscis in nutritions was discarded by him. This interpretation of activity of nutrition fits with the observed distribution of acanthocephalans in the alimentary canal. The decrease in the number of parasites from anterior to posterior regions of the alimentary canal corresponds to the graded decrease in the concentration of useful nutrients.

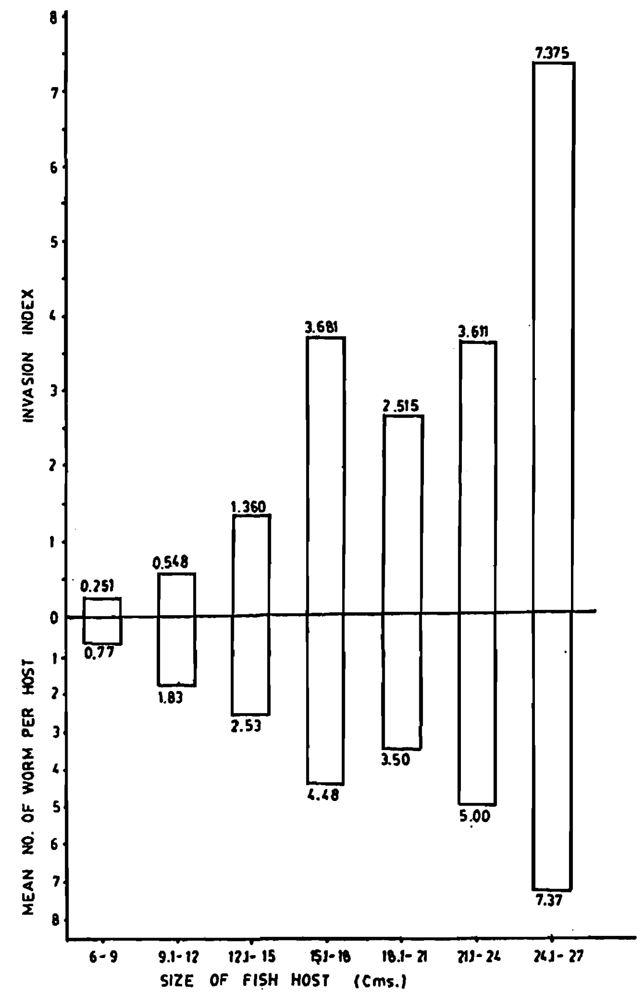
Similar pattern of distribution of parasite in the intestine was observed by Crompton (1973) and Amin (1975a).

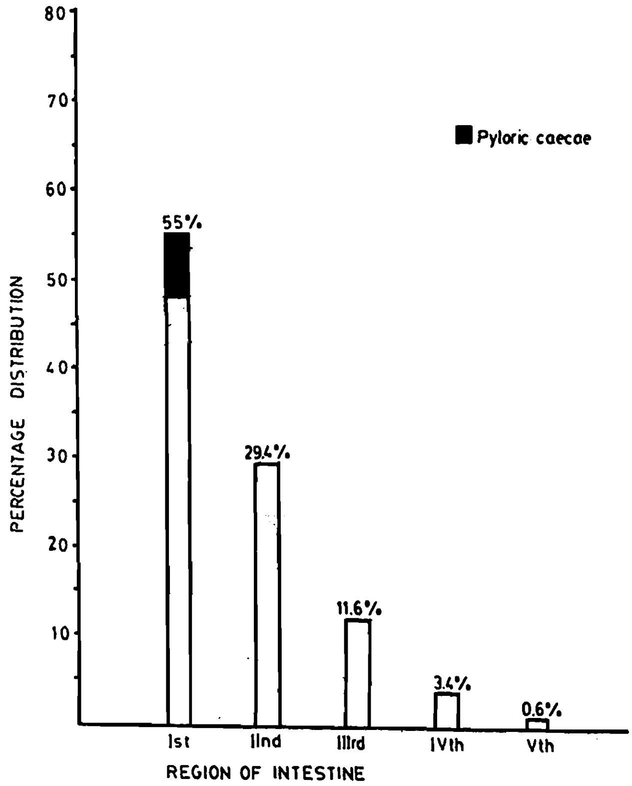
Intraspecific reaction

It is observed that as the number of parasites increase they go on spreading in posterior region of the intestine. In case the parasite number is small then the infection is confined to the anterior region of the intestine only (Fig. 1). This indicates that a sort of intraspecfific competition or reaction exists among the worms for restricting to the favourable site in the intestine of the host fish. Moreover the worms found in the posterior- most (cloacal) region were either dead or very sluggish in their movements and were not attached to the cloacal wall. These are the worms which are either discarded from the anterior regions of the intestine as a result of intraspecific reaction or had died their natural death and were on their way to being discarded.


Stomach
Small
intestine
I
II
III
IV
V
Pyloric
caeca
Cloaca


Male parasite
Female parasite
INVASION INTENSITY
(%age infect)
100
90
80
70
60
50
40
30
20
10
JUNE
1984
JULY
AUG.
SEPT.
OCT.
NOV.
DEC
JAN.
1985
FEB.
MAR.
APR.
MAY.


INVASION INDEX
MEAN NO. OF WORM PER HOST
7.375
3.681
3.611
2.515
1.360
0.548
0.251
0.77
1.83
2.53
4.48
3.50
5.00
7.37
6-9
9.1-12
12.1-15
15.1-18
18.1-21
21.1-24
24.1-27
SIZE OF FISH HOST (Cms.)


PERCENTAGE DISTRIBUTION
Pyloric caecae
55%
29.4%
11.6%
3.4%
0.6%
Ist
IInd
IIIrd
IVth
Vth
REGION OF INTESTINE

In experimental infections by acanthocephalan, *M. dubius* the site was extended posteriorly when more individuals, than as could be accommodated at the normal site, were present in the rat's intestine (Burlingame and Chandler, 1941, Holmes, 1961). The site of *Echinorhynchus truttae* Schrank, 1788 was more extended in the small intestine of trout when 30 cystacanths were ingested rather than 15 (Awachie, 1966). "One interpretation of the distribution of *P. minutus* in natural infections in Mallard is that the site of the parasite extends posteriorly when many individuals are present" (Crompton and Harrison, 1965).

Amin (1975a) observed similar pattern for the distribution of the parasite, *E. salmonis* in the host's intestine in relation to the intensity of infection.

According to Crompton (1973) the apparent restriction of many species of helminths to precise region of the tract means that a population may be confined to relatively constant space and thus that the population density at which individuals interfere with each other may soon be reached.

SUMMARY

Pallisentis allahabadi Agarwal, 1958 has been studied with regard to its seasonal variations and its associations with the host fish, *Channa punctatus* (Bloch). During the period June, 1984 to May, 1985 as many as 132 fish hosts were examined at monthly intervals. Of these 90 hosts (68.8 per cent) were found infected with *P. allahabadi* (Table I). Of the 500 parasites recovered 416 were males and 84 females. The data collected were analysed and studied for seasonal variations in parasite population, male to female ratio (MFR), distribution of parasite in the host's intestine and the effect of host's size (age) and sex on parasitic infections.

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