CHAPTER - 4

DISCUSSION

The term incidence refers percentage infection of the fish host and intensity to the number of parasites found on each host (Chubb, 1977). The reports on the incidences of helminth infection in fishes are somewhat controversial. Dogiel (1958) reported that fishes have greater number and variety of helminth infection during the summer months. Besides Dogiel (1958), Awachie (1966), Kennedy (1971, 1975, 1977a, 1977b, 1997), Muralidhar (1989), Jha et.al. (1992); Rohde (1993); Rodrigues and Saraiva (1996); Chapman (2000) et.al; and Turner (2000); Wang et.al. (2001); and Poulin and Cribb (2002) recorded that the temperature is one of the important factor controlling the trematodes infections. Rodhe, (1993) and Jadhav and Bhure (2006), explained that the development of parasites need high temperature, low rainfall and sufficient moisture.

Kennedy (1971, 1975 and 1977) and Rodhe (1993) have stated that with the temperature, humidity and rainfall, feeding habits of host, availability of infective host and parasite maturation
are also responsible for influencing seasonal fluctuation of the parasitic infections. Some fishes have greater incidence and intensity of the helminth infection other than summer months (Pal, 1963; Evans, 1977a and b, 1978 and Burrough 1978). Climatic factors affect parasites directly and the temperature amongst them is the most important single extrinsic factor which influences the parasites (Noble and Noble, 1976). The seasonal cyclicity of digenetic trematodes infection in fresh water fishes is temperature dependent (Bauer, 1959a; Dogiel, 1964; Cannon, 1972; Thomas, 1957, 1958; Awachie, 1968; Pennuyuick, 1971a,b,c).

Other factors influencing the seasonal variation of trematodes are feeding habits (Pennuyuick, 1971a,b) and reproductive status of the host (Evans, 1977a), Oxygen tension, host species, behaviour, migration, immunity and interaction of both biotic and abiotic factors, (Chubb, 1979), seasonal rains and population of intermediate hosts (Madhavi, 1979; and Kalanten et al; 1987). There is meagre positive correlation between the host size and total parasitic infection. The impact of diet and feeding habits on the parasitic infection in the fish hosts were carried out by Cannon (1977); Williams and Jones (1994); Lugue et.al. (1996) and Johnson, et.al. (2004). The variation in the infection with age
group may be as younger fish have less capacity of feeding whereas older fish may be resistant and therefore do not allow new extra parasite burdens (LO et al.; 1998; Zelmer and Arai, 1998 and Johnson et al., 2004). At the same time, the parasite life span also plays role with number of parasites diminishing in the host with increasing age.

In this investigation the incidence of infection of Masenia and Genorchopsis in Channa species; Haplorchoides and Masenia in Mystus tengara; Orientocreadium in Clarias batrachus; Neopodocotyle in Heteropneustes fossilis; Neopocoelina and Allocreadium in Bagarius bagarius; Genorchopsis and Haplorchoides in Labeo bata, and Neopocoelina and Opisthorchis in Wallago attu, shows some what similar pattern. It increases in progressive manners from the month of February up to a maximum in the month of July and then decline more or less during the rainy and winter seasons. Moderate infection again appears in the months of August and September and decreases gradually in the winter season.

The temperature dependent incidence of infection of adult digeneans has been reported in Bunodera luciopercae (Dyk et al. 1954; Bauer, 1959a; Malakova, 1963; Rizvi, 1964; Mishra, 1966; Cannon, 1972; Wootten, 1973a and Andrews, 1977); in

According to Chubb (1979), the water temperature may be the most significant factor for understanding the seasonal dynamics of metacercaria in the fishes of mid latitude climatic zone of the world.

However, Bibby (1972) and Rampus (1975) are of the opinion that, temperature does not play a direct role and they have correlated the incidence and intensity of Macrolecithus pipilliger and Nicolla gallica with the availability of infective larvae, change in feeding habits and physiological conditions of the hosts.

Srivastava (1935) and Pal (1963) have reported that the incidence of infection of Sterrharus monolecithus and Fastula bravichrus remain higher in winter months with maximum in the month of September in the host fish, Hilsa ilisha and this may due to migratory habits of fishes influencing directly the parasitic fauna of the host.
Madhavi (1979) observed high incidence of *Allocreadium fasciatusi* in *Aplocheilus melastigma* during the summer months being highest in the month of September and she has considered that the seasonal cycle of trematodes depend on the availability of infective stages in Copepods (second intermediate host), which is again dependent on a number of environmental physico-chemical factors and further pointed out that temperature does not effect directly the seasonal occurrence of parasites.

**The maximum percent incidence** of *Genorchopsis* and *Haplorchoides* in *Anabas testudineus*, *Haplorchoides* and *Genorchopsis* in *Mastacembelus armatus* and *Allocreadium* in *Mystus cavasius* were recorded during September month, which supports the finding of Bibby (1972), Rampus (1975), Srivastava (1935), Pal (1963) and Madhavi (1979).

**A higher incidence of parasitization** by *Masenia* and *Genorchopsis* in *Channa species* and *Genorchopsis* and *Allocreadium* in *Rita rita* is found throughout the year that supports the findings of Kanth and Srivastava (1987) in metacercaria of *Metaclinostomum srivastavii* in *Channa punctatus*. The factor which can be considered responsible for a high incidence throughout the year is a regular entry of larvae in the host, similar observation has been made in
case of Stickle back infested by Diplostomum cercaria (Pennycuick, 1971b).

All the thirteen types of fishes selected for the study, are predatory in nature, among which Rita rita; Mystus species; Anabas testudineus; Bagarius bagarius; Wallago attu; and Notopterus notopterus; are strictly carnivorous. While, Channa species; Clarias batrachus; Heteropneustes fossilis and Mastacembelus armatus are omnivorous. However, Labeo species is herbivorous.

They feed voraciously during the months of March, April, May and June and their feeding activity is correlated with gonadal recrudescences, subsequently during July and also in parts of August (spawning phase). They resume their moderate feeding activity in the months of September and October, before it decline in winter months (Khanna, 1986; and Singh, 1988). The incidence of infection in three types of host indicates that fishes have higher susceptibility for their respective trematodes when they are under gonadal development and maturation.

Monthly changes in the incidence of infection of digenean in the seasonal cycles are due to the temperature variation in the environment. However, a peak infection during the end of a rainy season was recorded for Genorchopsis and Haplorchoides in Anabas
testudineus, Haplorchoides and Genorchopsis in Mastacembelus armatus, Opisthorchis in Notopterus notopterus and Allocreadium in Mystus cavasius supports the finding of Clinostomum complanantum in Tilapia spp. by Paperna (1980), in Trichogaster fasciatus by Siddiqui and Nizami (1982) and in Aphanius desper by Kalanten et.al. (1987). They have correlated the peaks of incidence with the availability of snail hosts, environmental temperature and also with frequency visits of final hosts.

The maximum percent incidence of Allocreadium and Genorchopsis in Rita rita, Haplorchoides and masenia in Mystus tengara, Neopodocotyle in Heteropneustes fossilis and Haplorchoides in Labeo calbasu was recorded during the end of summer months and rainy season which may be due to high temperature, low rainfall, sufficient moisture and feeding habits of host.

Gupta et.al. (1984), while observing the helminth parasites in Channa punctatus found that the incidence and intensity of encysted metacercaria of Euclinostomum heterostomum and that of adult of Clinostomum giganticum, Allocreadium species and Isoparorchis hypselobagri were high during summer months and low in the months of September to December and further pointed out that fishes are more susceptible to endohelminths during spawning time.
Agarwal (1986) under a comparative study found higher incidence of infection of helminths during summer months in *Channa punctatus, Colisa lali* and *Clarias batrachus* and correlated this with breeding cycle of the host.

The intensity of *Masenia* and *Genorchopsis* in both the sexes of *Channa* Species, *Genorchopsis* and *Allocreadium* in both the sexes of *Rita rita, Genorchopsis* and *Hablorchoides* in female *Anabas testudineus* and *Haplorchoides* in female *Labeo calbasu* is maximum in the month of September. Thus, a sharp increase of intensity in the month of September may be due to increased population of snail, and ‘Ostracods (intermediate host) and feeding behaviour of fishes (Madhavi, 1979).

Intensity of *Neopodocotyle* in female *Heteropneustes fossilis* is higher in the months of April, May, June, and August and maximum in the month of march supports the finding of (Kanth and Srivastava 1987).

Intensity of *Haplorchoides* and *Genorchopsis* in female *Mastacembelus armatus* higher during the months of May, June, and August and it is maximum in the month of July and *Neopecoelina* and *Opisthorchis* in female of *Wallago attu* is maximum in the month of
July. Thus, a higher worm burden is noticed in female fishes during the breeding seasons (ie. June & July)

The intensity of Orientocreadium in female Clarias batrachus, Opisthorchis in Notopterus notopterus, Allocreadium in Mystus cavasius and Genorchopsis and Haplorchoides in Labeo bata is maximum in the month of August may be due to Spawning phase.

Kalanten, et al. (1987) Suggested that environmental temperature and availability of snails may be responsible factor which cause the seasonal variation in the intensity, as they get the peak intensity of metacercaria of Clinostomum Complanatum in the months of October, December, March and July and low in other months.

The intensity of Haplorchoides and Genorchopsis in female Mastacembelus armatus and Neopecoelina and opisthorchis in Wallago attu is maximum in the month of July. While, intensity of Opisthorchis in female Notopterus notopterus, and Allocreadium in Mystus cavasius is higher in both the sexes during the month of October and December. Thus, our findings are in the support of Kalanten, et al. (1987).

Intensity of Opisthorchis in male and female Notopterus notopterus is more in the months of September and August in
Comparison to other months, however the intensity of *Neopecoelina* and *Opisthorchis* occure maximum in the months of November and July in male and female respectively, similar results were reported by *Agrawal (1986)* and *Golder and Chandra (1987)*.

The density of *Masenia* and *Genorchopsis*, and *Opisthorchis* increase in progressive manners form the month of February up to a maximum in the month of September. It occurs maximum in the month of September in male of *Channa Species* and *Notopterus notopterus*. Where as the density of adult worms has shown variation during different months as well as with the sex of host. The digenetic trematodes of *Channa punctatus* have similar trend of density *(Gupta, et.al; 1984)*.

The trend of density fluctuation of *Haplorchoides* and *Genorchopsis* in male and *Neopodocotyle* in female sex also increased in progressive manner from the month of March up to a maximum in the month of August of both the hosts, Which acquires more or less similar pattern of intensity.

The density of *Haplorchoides* and *Masenia*, and *Allocreadium*, increases in progressive manners from the month of January to the month of July and is higher during the months of July,
August, and September in both the sexes. But it is maximum in the month of August in female of both the hosts

**Density of** *Genorchopsis* and *Haplorchoides*, *Orientocreadium Neopodocotyle, Haplorchoides* and *Genorchopsis* and *Haplorchoides* remain low throughout the year except the months of June, July, August and September in both the sexes. The female hosts have more parasites density in comparison to male except few months, and gets more or less similar to the incidence of infection and intensity.

**The trend of density fluctuation of** *Masenia* and *Genorchopsis, Haplorchoides* and *Masenia*, and *Opisthorchis* is higher during the months of July, August and September throughout the year in both the sexes. In female hosts, it is higher through out the year excepts few month. It is also higher in camparison to others earlier described parasites and get more of less the similar pattern to that of intensity.

**The higher density** is confined to ponds, Tal, and thus the host fishes were prone to repeated digenetic trematode parasites. On the other hand, the fishes collected from the Gomti and other rivers at Jaunpur, do not show such repeated infection (*Agarwal et.al., 1986*). The cause of low density might be due to the flow of
water, availability of intermediate host in the river and the physiological condition of host fishes.

The percent dominance of all the earlier described parasites show similar result to that of density. It increases in progressive manners from the months of February or March upto a maximum in the month of July or August and then sharply decreases during winter months. It also acquires more or less the similar pattern to that of intensity and incidence of infection like density.

Among all the earlier described parasites, the higher percent dominance was observed in case of *Opisthorchis* in the month of August in the female of *Notopterus notopterus*. Except *Opisthorchis* dominance was also higher in *Channa* species, *Rita rita*, *Mystus tengara*, *Bagarius bagarius* and *Mystus cavasius*.

Further the female fishes of all described parasitic hosts except *Heteropneustes fossilis* were found heavily infected in comparison to the male fishes with their respective trematodes. The reasons for this may be correlated with the status of gonadal growth and maturation period of the host. Some what similar correlation has been reported in case of *Discocotyle sagittata*, *Phyllodistomum simili*, and *Crepidostomum* spp. by Thomas (1964b). He has also pointed
out that the difference in the incidence and intensity may be due to physiological resistance between the male and female fishes and not due to the ecological and behavioural resistance of the sexes. Evans (1977b) specially noted that the sex of fishes had no relation to the occurrence to *Asymphylodora kubanicum* in *Rutilus rutilus*.

**Rampus (1975)** also reported a higher level of infection by *Nicola gallica* in maturing and gravid females of *Cottus gobio*. The effect of an over all physiological condition of the host is responsible for the relation of parasite rather than a direct hormonal response. However, **Szidat (1956, 1958)** has considered that the hormonal effect of the host influences the development of the trematode *Genarchella* and is further supported by **Bauer (1959a)**.

According to **Thomas (1964b)** and **Pennuyuick (1971c)** probably various hormones, specially estrogen present during the gonadal recrudences makes the female fishes less resistant, and thus provides a favourable environment to the parasite. According to **Gupta, et.al. (1984)** and **Agarwal (1986)**, the female fishes (*Channa punctatus*) are more susceptible to endohelminth infection during maturation and spawing times. It is further evidenced by fact that a
higher incidence of infection during breeding season occurs because the fishes usually move to shallow water for breeding and spawing and thus the changes of encountering of infective larval trematodes get enhanced.

**High incidence of infection of** *Neopodocotyle* **in male of** *Heteropnuestes fossilis*, through in significant have been observed during most of the months of the year. *Thomas (1964b)* has also noticed higher infection by helminth in male fishes. This was also evidenced in male Stickle back as compared to female ones, parasitized by *Diplostomum* spp. suggesting that estrogen is responsible for higher resistance in female than the males, *(Pennuyick, 1971a,b)*.