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Research Paper

Seasonal Incidence of Ecto-Parasites in Catfishes of District Indore Madhya Pradesh, India

Baba Tabasum*[1] and Rajesh Dixit[2]

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A B S T R A C T

The aim of the present study was to investigate the prevalence of monogenean helminth ecto-parasitic infections on catfishes (*C. batrachus* and *C. gariepinus*) in Indore, Madhya Pradesh. A total number of 453 fish samples of *Clarias batrachus* and *Clarias gariepinus* were collected consisting of 236 *Clarias batrachus* (143 males and 93 females) and 217 *Clarias gariepinus* (117 males and 100 females) a total of 217 specimens were examined for the period of two years. Results indicated presence of three species of parasites, *Gyrodactylus* sp., *Dactylogyrus* sp. and *Lernea*. Overall prevalence of 47.88% and Mean Intensity of 1.65% was recorded. In *Clarias gariepinus*, overall prevalence of 41.93% and Mean Intensity of 1.26% was recorded while in *Clarias gariepinus* overall prevalence of 41.93% and Mean Intensity of 1.26% was recorded. Females were found more infested than males. However, in *Clarias batrachus*, the prevalence was found higher than *Clarias gariepinus.* The results indicated that fishes are suffering ecto-parasitic infections on account of high pollution levels in the water bodies. Thus, need of hour is to reduce aquatic pollution to reduce parasitic infestations.

***Key words*:** Ecto-parasites, Infestations, Incidence, Catfishes, Seasons

Parasitic diseases are the common infectious diseases attacking wide range of fishes. Fish usually carries pathogens and parasites, usually at some cost to the fish. If this cost is sufficiently high, then disease is said to have been occurred. Diseases in fish are not completely understood till this date but are known to cause huge mortalities, especially in the younger ones. They have the ability to limit the impacts of pathogens and parasites with behavioral or biochemical means, and such fish have reproductive advantages. Interacting factors especially deteriorated environmental conditions result in low grade infection to get transformed in fatal diseases. In particular, conditions causing stress, such as natural droughts or pollution or predators, can accelerate disease outbreak. Disease infestations also occur in aquatic systems when pathogens and parasites carried by introduced species affect native species [1].

Parasitic diseases are one of the most serious problems in fishes causing serious disease outbreaks among farmed fish. Parasitic diseases are not of much concern among the wild fish stock because in most such instances, no significant harm appears to be caused by them. Assessment of the effects of parasitic infection in natural fish populations is usually very difficult because of the presence of predators or scavengers which rapidly remove moribund or dead fish, except in case of mass mortalities were the impact is very clear. Majority of the fish parasites belong to three major groups; protozoan, helminths and arthropods being dominated by crustaceans. Parasites act as a major concern to freshwater and marine fishes all over the world, and of particularly those in the tropics [2]. Parasitic infestations in fish causes nutrient devaluation [3]; alters its normal biology and behaviour [4]; decreases its immune capability, induces blindness, decreases morbidity, mortality, growth and fecundity [5]; and results in mechanical injuries depending on the parasite species and load [6]. Parasites degrade fish health by causing mechanical, physical and reproductive damages. These damages can result in reduced growth, low fecundity and low survival rate, change in behaviour and sexual characteristics, besides causing few other mal-adaptive alterations in the infected host. These changes have significant consequences not only at the individual level, but also at population, community and ecosystem levels [7]. Parasitic fauna associated with fish helps in demonstrating among fish populations inhabiting sites of different environmental quality [8]. Parasites besides this act as indicators of pollution and of other stress factors [9].

Helminth parasites are undoubtedly a well-known group among vertebrate parasites. Fishes are host to many adult helminth parasites and to their larval forms, the adult of which happens in amphibians, reptiles, birds and mammals as well as in predatory fish. Firm dependence of the parasite on its host and the exploitation of the host by the parasite provide a useful research model in the field of ecology and evolutionary biology. The diversity of helminths that infect wild fishes is higher when compared to farmed fishes [10] due to frequent chances of contact between host and parasites in wild conditions, however, the infection levels in farmed fishes is higher, usually attributed to higher fishes densities in farms [11].

***Baba Tabasum**
drtabasum550@gmail.com

[1-2]Department of Zoology, P. M. B. Gujarati Science College, Devi Ahilya Vishwavidyalaya, Indore - 452 017, Madhya Pradesh

"Helminth" is a generic term that is used to refer to worms belonging to the phyla Platyhelminthes, Nematoda and Acanthocephala. These worms cause infections both in vertebrates as well as in invertebrates and the majority of these parasites have co-evolved with their hosts [12]. The three classes: Trematoda, Cestoda and Monogenea of the phylum Platyhelminthes [13] all are parasites, and are responsible for causing several diseases in several economically important fish species [14]. However, both parasitic and free-living species can be found in the phyla Nematoda and Acanthocephala.

Monogeneans are mostly the ectoparasitic forms, mainly found in the gills, nostrils, eyes and body surface of fishes. Helminths such as trematodes, cestodes, acanthocephalans and nematodes are endoparasites that may infect the eyes, muscles and gastrointestinal tract [15]. Helminths have evolved using strategies of evading the immune system of fish e.g.; they are able to mask their antigens by bonding to the host's molecules, incorporate these molecules in their surface layer and explore the host's immune response itself in order to enhance their adhesion to the infection area [16]. On the other hand, fish immune system responds with the aim of eliminating parasites or co-existing with them when attempts to eliminate them fail.

Fishes fall prey to a large number of parasites, both endoparasites as well as ectoparasites. A variety of endoparasites including nematodes, trematodes, microsporids, copepods, monogeneans are reported from fishes. Endoparasites result in the destruction of host tissues, caused either due to migration of parasites inside the host (mechanical action) or due to the attachment organs of parasites (hooks, suckers) into host tissues as anchors. Ectoparasites are the organisms that inhabit the skin or outgrowths of skin of the host. Some ectoparasites are host specific (e.g., lice), while few can parasitize a wider range of hosts. These usually induce anemia, hypersensitivity immune reactions, irritability, necrosis, secondary infections, focal haemorrhages, dermatitis. Flukes, leeches, crustaceans, insects are the common fish ectoparasites. Among ectoparasites, monogeneans of the genera Dactylogyrus and Gyrodactylus commonly infest freshwater fishes. Gyrodactylus is commonly found on the fish skin, whereas Dactylogyrus predominantly affects the gills. *Lernea*, commonly known as anchor worm, are crustacean, copepod parasites that infects the fish commonly found in stagnant or slow-moving water bodies. Infestations are more pronounced during summer months.

Several investigations have studied helminth parasites of freshwater fishes in Madhya Pradesh. Through the work of these investigations is mostly concerned on its survey, population dynamics, host specificity, organ specificity, yet the study needs to be carried out more extensively on the various aspects of parasitology. For example, the seasonal distribution, infection rate and effects on fish growth due to pesticide infestation need to be elaborately worked upon. Hence keeping in view of the importance of the work into consideration, the present work was carried out to study the incidence of ecto-parasites in *Clarias batrachus* and *Clarias gariepinus* fishes of Indore M.P.

MATERIALS AND METHODS

Study area and sampling of fish specimens

The present study was conducted in P.M.B. Gujarati Science College, Department of Zoology, Faculty of Life Sciences, Devi Ahilya Vishwavidyalaya Indore, Madhya Pradesh. The experiment was carried out on *Clarias batrachus* and *Clarias gariepinus* fishes and subjected to the parasitological examination. The study was carried out for a period of two years (four seasons per year) from December 2017 to November 2019. Collection of experimental fishes was carried out on seasonally basis and during each sampling live specimens of *C. batrachus* and *C. gariepinus* were collected and transported to the laboratory in plastic bags. Before carrying out parasitological examination, morphometric measurements of the fishes were also carried out. A total number of 453 fish samples of *Clarias batrachus* and *Clarias gariepinus* were collected from the river Narmada falling in the vicinity of Indore city to investigate the pathological changes induced by ectoparisitic forms of helminth parasites. Among *Clarias batrachus*, 236 specimens consisting of 143 males and 93 females were collected for the entire period of two years. In case of *Clarias gariepinus*, a total of 217 specimens were examined for the period of two years among which 117 were males and 100 were females. All the collected fish specimens were subjected for the examination of the presence of ectoparasites.

Examination, isolation, identification and classification of ectoparasites

The external surface of the fishes like fins, gills and skin was examined for external parasites [17]. Skin and fins were brushed and examined through a simple magnifying glass for the presence of ectoparasites. Fish gills were dissected out and each gill filament and arch was examined with a hand lens for the presence of parasites. Skin scrapings were taken and examined separately where ever necessary. Recovered parasites were mounted on slides and viewed using compound microscope under high power magnification (×40) and identified to species level using appropriate keys [18]. All parasites recovered were recorded and parasitic indices like prevalence (Pr.%) and Mean Intensity (M.I.%) were calculated using the formulae of [19]. The formulae usedare as:

$$\text{(i) Prevalence (\%)} = \frac{\text{Total No. of hosts infected}}{\text{Total No. of hosts examined}} \times 100$$

$$\text{(ii) Mean Intensity} = \frac{\text{Total No. of parasites}}{\text{Total No. of Infected Hosts}}$$

RESULTS AND DISCUSSION

Overall prevalence of ecto-parasites

In the present study, three species of parasites were found which included *Gyrodactylus* sp., *Dactylogyrus* sp. and *Lernea*. Among 236 fishes of *Clarias batrachus*, 113 specimens were found infected with ecto-parasites with the overall percentage prevalence of 47.88% and Mean Intensity of 1.65%. In *Clarias gariepinus*, a total number of 91 fishes were found infested with parasites out of 217 collected fishes with the overall percentage prevalence of 41.93% and Mean Intensity of 1.26% (Table 1, Fig 1).

Table 1 Overall percentage of prevalence and mean intensity of *C. batrachus and C. gariepinus*

Fish	Total prevalence (%)	Total mean intensity (%)
Clarias batrachus	47.88	1.65
Clarias gariepinus	41.93	1.26

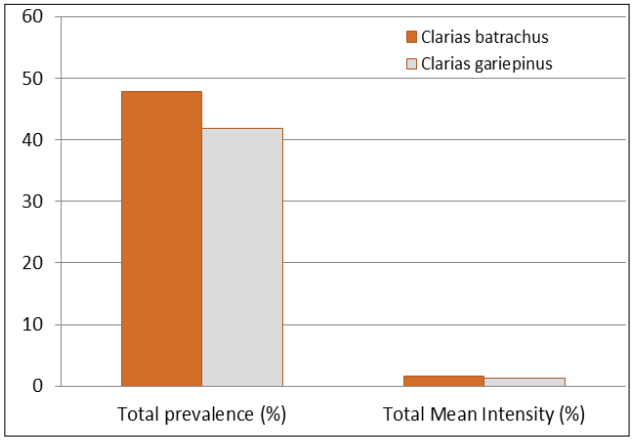


Fig 1 Overall percentage of prevalence and mean intensity of *C. batrachus and C. gariepinus*

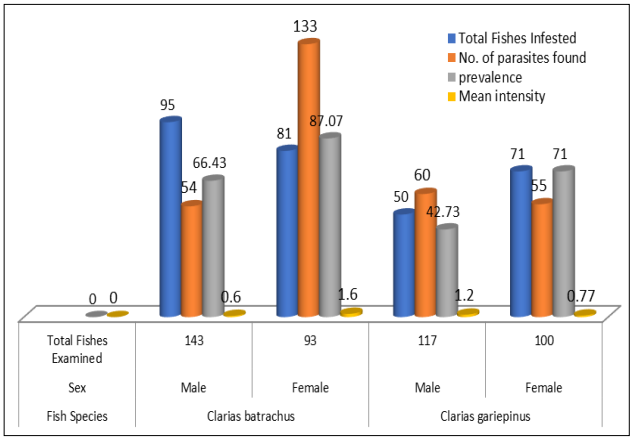


Fig 2 Gender-wise prevalence and M.I. of *Clarias batrachus* and *Clarias gariepinus*

Gender wise prevalence of parasites

On comparing the prevalence of parasites among males and females of both the fishes, it was found that females were more infested with parasites as compared to males. However, in *Clarias batrachus*, the prevalence was found higher than in *Clarias gariepinus.* The prevalence in males of *Clarias batrachus* and *Clarias gariepinus* calculated was 66.43% and 42.73% respectively with the mean intensity of 0.6 and 1.2 respectively. In females, the parasitic prevalence was found 87.07% and 0.77% in *Clarias batrachus* and *Clarias gariepinus* respectively with the mean intensities of 1.6 and 0.77 respectively (Table 2, Fig 2).

Table 2 Gender-wise prevalence and M.I. of *Clarias batrachus* and *Clarias gariepinus*

Fish Species	Sex	Total fishes examined	Total fishes infested	No. of parasites found	Prevalence (%)	Mean Intensity (%)
Clarias batrachus	Male	143	95	54	66.43	0.6
	Female	93	81	133	87.07	1.6
Clarias gariepinus	Male	117	50	60	42.73	1.2
	Female	100	71	55	71.0	0.77

Year-wise prevalence of parasites

Present study was carried out for the period of two years which was bifurcated into four seasons per year. The start of the season in the 1st year was from winter 2017 to autumn 2018. The study of second year started from winter 2018 upto autumn 2019. In 1st year, in case of *Clarias batrachus*, prevalence of ecto-parasites was found highest in females, 79.59% while as in males, the prevalence recorded was 54.43% with the mean intensities of 1.46 and 2.05 respectively in females and males. In the second year of study from 2018-19, again the prevalence in females was recorded high, i.e., 95.46% than the males which was recorded 81.25% with the mean intensities of 1.81 & 1.90 respectively (Table 3).

In case of *Clarias gariepinus* also, the highest prevalence was recorded in females than males. In first year, the prevalence in females recorded was 71.19% with the mean intensity of 0.71, while as in males, the prevalence in the first year, i.e., 2017-18 was recorded 44.44% with the mean intensity of 1.03. In the second year of study, i.e., 2018-19, the prevalence in females was recorded high, 65.85% and mean intensity 0.93 while as in males, the prevalence was 40.0% and mean intensity 1.61 (Table 4).

Table 3 Yearly prevalence and intensity of ecto-parasites in *Clarias batrachus*

Year	Gender	No. of fishes examined	No. of hosts infected	No. of Parasites found	Prevalence (%)	Mean intensity (%)
From Winter 2017-	Males	79	43	88	54.43	2.05
18 to Autumn 2018	Females	49	39	57	79.59	1.46
From Winter 2018-	Males	64	52	99	81.25	1.90
19 to Autumn 2019	Females	44	42	76	95.46	1.81

Table 4 Yearly prevalence and intensity of ecto-parasites in *Clarias gariepinus*

Year	Gender	No. of fishes examined	No. of hosts infected	No. of Parasites found	Prevalence (%)	Mean intensity (%)
From Winter 2017-	Males	72	32	33	44.44	1.03
18 to Autumn 2018	Females	59	42	30	71.19	0.71
From Winter 2018-	Males	45	18	29	40.0	1.61
19 to Autumn 2019	Females	41	27	25	65.85	0.93

Season-wise prevalence of parasites

The prevalence of parasites was determined in different seasons as well. The seasons were divided into summer, monsoon, post monsoon and winter. During first year from autumn 2017- autumn 2018, the overall prevalence of ecto-parasites (*Gyrodactylus* sp., *Dactylogyrus* sp. and *Lernea*) in females were found maximum during monsoon and post-monsoon months with the values of 90.91%, followed by

winter, 77.78% and summer (55.56%). The mean intensities in the females were found 2.0, highest in winter and 1.6 in summer season. In males of *Clarias batrachus*, the highest prevalence in the first year of study was recorded in winters, i.e., 68.18% followed by post-monsoon, 65.0%. The mean intensities were recorded highest in monsoon, 3.0 followed by summer season of the value of 2.17 (Table 5). During second year of study from autumn 2018-autumn 2019, the highest prevalence in the females of *Clarias gariepinus* was recorded in post-monsoon followed by winter and was of the values 84.62% and 83.33% respectively with highest mean intensities of 3.0 and 2.4 in summer and winter respectively. The males were found to have highest prevalence in 85.71% in monsoon followed by 83.33% in summers during second year. The highest mean intensity in males was recorded in winter, 2.13 followed by post-monsoon, 1.86 (Table 6).

Table 5 Season-wise prevalence of ecto-parasites in *Clarias batrachus* from 2017 - 2018

Season	Gender	Total no. of hosts examined	Hosts found infected	Total No. of parasites found	Prevalence (%)	Mean intensity (%)
Summer	M	18	6	13	33.33	2.17
	F	9	5	8	55.56	1.6
Monsoon	M	19	9	27	47.37	3.0
	F	11	10	11	90.91	1.1
Post-monsoon	M	20	13	27	65.0	2.08
	F	11	10	10	90.91	1.0
Winter	M	22	15	21	68.18	1.4
	F	18	14	28	77.78	2.0

Table 6 Season-wise prevalence of ecto-parasites in *Clarias batrachus* from 2018-2019

Season	Gender	Total no. of hosts examined	Hosts found infected	Total No. of parasites found	Prevalence (%)	Mean intensity (%)
Summer	M	12	10	18	83.33	1.8
	F	7	3	9	42.86	3.0
Monsoon	M	14	12	21	85.71	1.75
	F	16	13	16	81.25	1.23
Post-monsoon	M	18	14	26	77.78	1.86
	F	13	11	15	84.62	1.36
Winter	M	20	16	34	80.0	2.13
	F	18	15	36	83.33	2.4

Table 7 Season-wise prevalence of ecto-parasites in *Clarias gariepinus* from 2017-2018

Season	Gender	Total no. of hosts examined	Hosts found infected	Total No. of parasites found	Prevalence (%)	Mean intensity (%)
Summer	M	13	4	4	30.77	1.0
	F	9	7	7	77.78	1.0
Monsoon	M	17	6	6	35.29	1.0
	F	14	10	10	71.43	1.0
Post-monsoon	M	19	9	9	47.37	1.0
	F	17	11	6	64.71	0.55
Winter	M	23	13	13	56.52	1.0
	F	19	14	7	73.68	2.0

Table 8 Season-wise prevalence of ecto-parasites in *Clarias gariepinus* from 2018-2019

Season	Gender	Total no. of hosts examined	Hosts found infected	Total No. of parasites found	Prevalence (%)	Mean intensity (%)
Summer	M	8	4	4	50.0	1.0
	F	6	2	2	33.33	1.0
Monsoon	M	13	4	4	30.77	1.0
	F	9	4	4	44.44	1.0
Post-monsoon	M	7	3	8	42.86	2.67
	F	15	14	10	93.33	0.71
Winter	M	17	7	11	41.18	1.57
	F	11	9	9	81.82	1.0

In *Clarias gariepinus*, during first year 2017-18, the highest prevalence recorded in females was during summers followed by winter and monsoon with the values of 7.78%, 73.68% and 71.43% respectively. The mean intensities in females were found highest in winter upto 2.0. In males of *Clarias gariepinus*, the highest prevalence recorded was in winter followed by post-monsoon with the values 56.52% and 47.37% respectively with the mean intensities remaining constant in all the seasons with the values of 1.0. During second year from 2018-19, females recorded highest prevalence in post-monsoon followed by winter with the values of 93.33% and 81.82% with almost same mean intensities of 1.0 in all the seasons. In males of *Clarias gariepinus*, the highest prevalence during second year of study was recorded in summer with the values of 50.0% followed by post monsoon and winter upto the values of

42.86% and 41.18% respectively. The mean intensities were highest recorded during second year was in post-monsoon with the values of 2.67 and 1.57 in winters (Table 8).

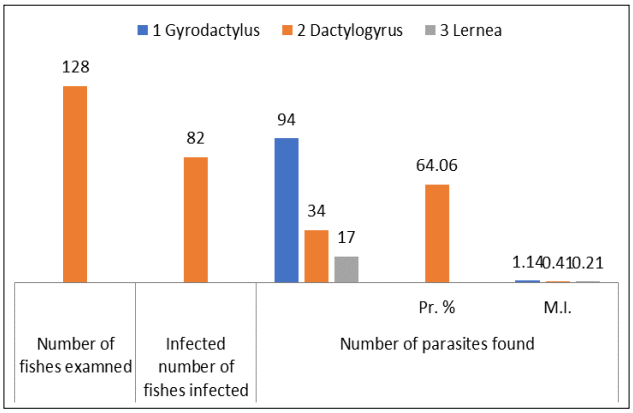
Parsite – wise prevalence of parasites

While calculating the prasite – wise prevalence in catfishes, *Gyrodactylus* sp. was found most abundant in both, *C. batrachus* and *C. gariepinus* in both years. Mean intensity with respect to the parasites followed the same pattern in the entire study with the highest abundance of *Gyrodactylus*>*Dactylogyrus*> *Lernea*. During first year of study, the mean intensities with respect to *Gyrodactylus*, *Dactylogyrus* and *Lernea* were 1.14, 0.41 and 0.21 respectively suggesting that *Gyrodactylus* was having a highest prevalence and influence on the fishes (Table 9). In second year of study, mean intensities for *Gyrodactylus*, *Dactylogyrus* and *Lernea* recorded were 1.07, 0.5 and 0.29 respectively (Table 10).

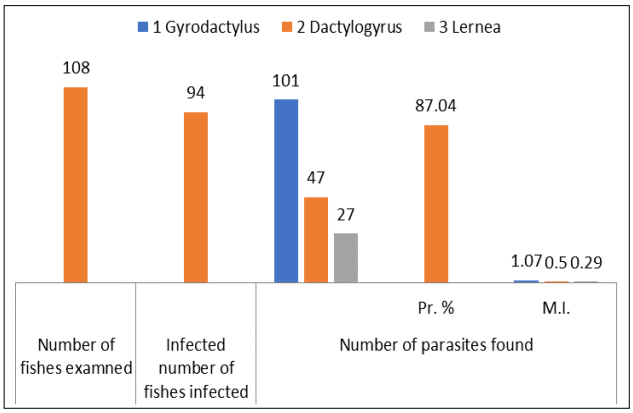
In case of *Clarias gariepinus* in first year, the *Gyrodactylus* was again found in abundance in both the years of study. During first year, the mean intensities of *Gyrodactylus*, *Dactylogyrus* and *Lernea* were 0.49, 0.36 and 0.41 respectively (Table 11) while as in the second year, i.e., in 2018-19 the mean intensities was 0.62, 0.36 and 0.13 for *Gyrodactylus*, *Dactylogyrus* and *Lernea* respectively (Table 12).

Table 9 Parasite - wise prevalence in *Clarias batrachus* from 2017-2018

Species of parasites recovered	Number of fishes examined	Infected number of fishes infected	Number of parasites found	Pr. %	M.I.
Gyrodactylus			94		1.14
Dactylogyrus	128	82	34	64.06	0.41
Lernea			17		0.21



Parasite - wise prevalence in *Clarias batrachus* from 2017-2018



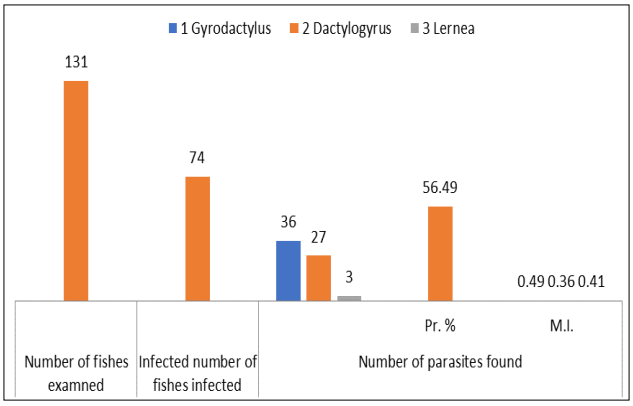
Parasite - wise prevalence in *Clarias batrachus* from 2018-2019

Table 10 Parasite - wise prevalence in *Clarias batrachus* from 2018-2019

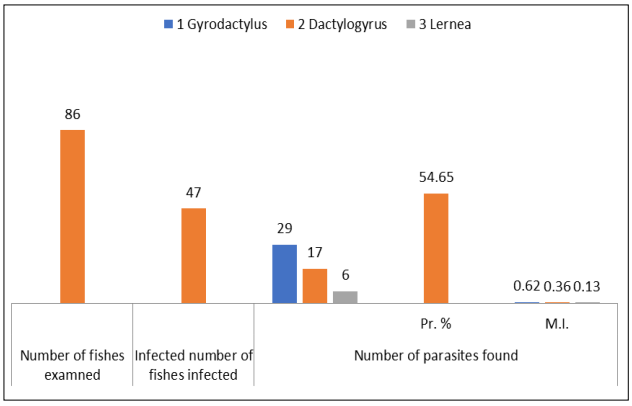
Species of parasites recovered	Number of fishes examined	Infected number of fishes infected	Number of parasites found	Pr. %	M.I.
Gyrodactylus			101		1.07
Dactylogyrus	108	94	47	87.04	0.5
Lernea			27		0.29

Table 11 Parasite - wise prevalence in *Clarias gariepinus* from 2017-2018

Species of parasites recovered	Number of fishes examined	Infected number of fishes infected	Number of parasites found	Pr. %	M.I.
Gyrodactylus			36		0.49
Dactylogyrus	131	74	27	56.49	0.36
Lernea			3		0.41



Parasite - wise prevalence in *Clarias gariepinus* from 2017-2018



Parasite - wise prevalence in *Clarias gariepinus* from 2018-2019

Table 12 Parasite - wise prevalence in *Clarias batrachus* from 2018-2019

Species of parasites recovered	Number of fishes examined	Infected number of fishes infected	Number of parasites found	Pr. %	M.I.
Gyrodactylus			29		0.62
Dactylogyrus	86	47	17	54.65	0.36
Lernea			6		0.13

All the parasites recovered in the present study are believed to get anchored to fishes due to several reasons. The primary reason in this regard is the environmental pollution. When water bodies get polluted, they gave way to the parasites to get attached to fish species. It is because of the reason that the fishes undergo stress due to high pollution levels which lead to a compromise in their immunity, thus allowing the worms to make easy attachment to the hosts. Parasitic infestations regarded as secondary disease occur mostly in the fishes already stressed or infected with any other pathogen. Environmentally stressed fish fall easy prey to the larval forms of parasites and larval recruitment become more intensive during these conditions. However, one obvious prediction is that pollutants may reduce the immunological capabilities of hosts, rendering them more susceptible to some parasites [20]. It is now established that eutrophication plays an important role in rise, maturation and abundance of fish parasites.Eutrophication among lakes and over time was associated with greater overall parasite species richness in *Rutillus rutillus* and *Perca fluviatillis* [21]. Fish collected from various sites of River Narmada indicated that the pollution levels are high on those sites which directly influence the parasite and fish relationships. Urbanization of the area wherein all the sewage from houses, sludge, animal droppings and human excretions directly find their way into the river. The fishermen community living along the banks of the river depict low socio-economic status, less education to maintain the cleanliness of the water body and of course no or insignificant drainage system that has led to disturbance in its water quality.

Ectoparasites can significantly affect host by impairing physiological, behavioural and morphological traits, and damaging the host integument [22]. Monogenetic trematodes represented the most prevalent among external parasites found [23]. The prevalence of ectoparasites (*Gyrodactylus* sp., *Dactylogyrus* sp. and *Lernaea*) was studied in *C. batrachus* and *Clarias gariepinus* species. This study showed that ectoparastic helminths namely *Dactylogyrus, Gyrodactylus* and *Lernaea* show different infestation rates varying according to season, host species, host size and also as per the sex of species. The parasites bring out variations in weight and head length of the infested specimens and the variations produced vary in different size groups of the fish. These parasites induce several haematological and histological alterations in the host species that alter the normal physiological functions in them. Among the *Clarias batrachus* and *Clarias gariepinus* species, the greater prevalence was found in *Clarias gariepinus.* Findings revealed that the females of both *Clarias batrachus* and *Clarias gariepinus* were less susceptible to ectoparasitic infestations as compared to their respective males. A significant difference in ecto-parasitic infections between the different sexes of *Clarias gariepinus* and highlighted that the male fish had a higher infection rate than the female [24]. The higher susceptibility of male fish towards parasite could be owing to certain ecological factors perhaps originating from feeding differences between males and females. According to them. Female fishes were generally more liable than males to infections with cestodes, nematodes and trematodes [25].

CONCLUSIONS

The overall present study concluded that ectoparasites are often seen in the Catfishes of District Indore M.P. *Clarias batrachus* has been found comparatively more infectious of ectoparasites than *Clarias gariepinus*. It was observed that the females get more infested of ectoparasites than males. The yearly prevalence in both the Catfishes revealed that females are likely to get more infested by ectoparasites than males. Seasonal prevalence revealed at the highest time of attachment of parasites with fishes is generally Monsoon and Post-monsoon in both the fishes. Parasite-wise prevalence that Gyrodactylus was highest prevalent ectoparasite in both *Clarias batrachus batrachus* and *Clarias gariepinus*. The study was found in coherence of earlier studies which revealed a positive co-relation of parasitic infestations with pollution of water bodies. This study gives an idea that pollution of water bodies must be reduced to get fish fauna rid of parasites.

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