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Research Article

Seasonal epidemiology of *Clinostomum shindei* leafworm infection in freshwater fish *channa punctatus* from Dharashiv district (MS) India

Jaywant S Dhole[1], Jaykumar N Shamraj[2] and Krushna R. Nagare[3]

[1]Shikshan Maharshi Dnyandeo Mohekar Mahavidyalaya Kallam Dharashiv (M.S.) India
[2]Venkatesh Mahajan Senior College Dharashiv (M.S.) India
[3] Indraraj Arts,Commerce and Science College Sillod, Ch. Sambhajinagar (M.S.) India
Email: jaywantdhole@gmail.com

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Abstract

The present investigation focuses on the seasonal epidemiology of *Clinostomum shindei* (Jaywant Dhole et al., 2024) leafworm infection in the freshwater fish *Channa punctatus* from Dharashiv District, Maharashtra, India. The analysis revealed significant seasonal fluctuations in infection prevalence, with peak prevalence observed during summer, moderate levels in winter, and minimal prevalence during the monsoon season. These seasonal patterns suggest that the variation in parasitic infection is modulated by environmental factors and host-associated parameters, particularly feeding behavior, which may directly or indirectly influence transmission dynamics.

INTRODUCTION:

Freshwater fishes constitute a vital component of human nutrition and serve as a significant source of livelihood for substantial human populations across the Indian subcontinent. These economically important teleosts are susceptible to a diverse array of parasitic infections, particularly helminth infestations, which adversely affect host health, condition, and consequently diminish their commercial and nutritive value. Among such parasitic infections, those caused by digenetic trematodes of the genus Clinostomum Leidy, 1856 are of considerable ichthyoparasitological significance, as their metacercarial stages encyst in various tissues, leading to reduced host fitness and aesthetic deterioration of fish flesh Parasitism fundamentally represents an ecological interrelationship between distinct populations, wherein two dissimilar organisms establish an obligatory association. As defined by Noble and Noble (1976), parasitism constitutes an intimate association between two heterospecific organisms, characterized by metabolic dependence wherein the parasite derives benefit at the expense of the host organism. This ecological interaction operates within complex environmental matrices, where physicochemical parameters and biotic factors collectively modulate host-parasite dynamics. The structural attributes of Dharashiv District, situated in the southern Marathwada region of Maharashtra State on the Deccan Plateau at approximately 600 meters above mean sea level, provide an instructive ecological context for parasitological investigations. The district, intersected by the Sina, Manjira, and Terna river systems, experiences distinct seasonal periodicity: monsoon (mid-June through September), post-monsoon humid conditions (October-November), cool dry winter (mid-November through January), and progressively hot dry summer (February through June). The region receives mean annual precipitation of 722 mm, with temperature regimes ranging from minimum 12°C to maximum 46.1°C, exhibiting moderation during summer months compared to adjacent districts of Marathwada region. These pronounced seasonal variations in environmental parameters provide an

appropriate framework for examining temporal patterns in parasitic infections. Fish parasite populations exhibit considerable spatiotemporal heterogeneity attributable to environmental variability and host population characteristics (Dogiel, 1961; Wisniewski, 1958; Kennedy, 1975). The determination of whether observed differences in prevalence, intensity, density, and infection indices arise from environmental factors versus variations in host species composition and population density presents persistent methodological challenges in parasitological research (Koskivaara et al., 1991). The functional significance of parasites in regulating host population dynamics has constituted a central inquiry in wildlife disease ecology (Kennedy, 1975). Historically, ecologists and wildlife managers frequently assumed parasites to be relatively benign, specialized predators maintaining delicate equilibrium with their hosts (Lack, 1954); contemporary perspectives recognize the complex regulatory potential of parasitic infections.

The host species selected for investigation, *Channa punctatus* (Bloch, 1793), commonly designated the spotted snakehead, represents an economically valuable air-breathing freshwater teleost widely distributed across Indian inland water bodies. This species exhibits pronounced seasonal reproductive cyclicity modulated by environmental variables, with rainfall patterns exerting predominant influence on gonadal maturation and spawning periodicity, followed by water temperature regimes (Sarkar etal., 2018). Such environmentally-cued physiological periodicity potentially influences host susceptibility and parasite transmission dynamics, establishing a rationale for seasonal epidemiological investigations. Research by Sarkar and colleagues (2018) demonstrated that seasonal variation in rainfall profoundly affects reproductive physiology in C. punctatus, with favorable precipitation ranging between 800-1400 mm corresponding to water temperatures of 29-31°C during spawning periods. These environmentally-mediated physiological fluctuations may indirectly modulate host-parasite interactions through alterations in feeding behavior, metabolic investment, and immunocompetence across seasons. The present investigation was undertaken to elucidate the seasonal epidemiology of *Clinostomum shindei* Jaywant Dhole et al. (2024) infection in *Channa punctatus* from freshwater bodies of Dharashiv District, Maharashtra, examining temporal variations in infection parameters in relation to environmental periodicity and host-associated factors.

MATERIALS AND METHODS:

The freshwater fishes were collected from different area of Dharashiv District during the period from Oct. 2023 to Sept 2025. Fishes were opened up dorso ventrally and the internal organs examined. The entire digestive system was removed and placed in a Petri dish with physiological saline. Infection of each group of parasites was treated as follows: collected tapeworm were first relaxed and then fixed in hot 4%formalin and stained using Harris haematoxyline. Stained parasites were washed in distilled water, dehydrated in ascending grades of alcohol, cleared in xylene, mounted in D.P.X. Drawings were made using a camera lucida. (Francis Weesner 1964). The identification is made with the help of "Systema Helminthum" by Yamaguti (1961). The data related to percentage of infection, intensity and abundance were determined standard formulae of Hoffmann (1999).

RESULTS AND DISCUSSION:

A total of 237 specimens of *Channa punctatus* (Bloch, 1793) were examined for helminthic infection from various freshwater bodies in Dharashiv District, Maharashtra, during the study period from October 2023 to September 2025. The investigation revealed that 97 individuals (40.93%) were infected with *Clinostomum shindei* (Jaywant Dhole et al., 2024), yielding a total of 111 parasite specimens recovered from infected hosts. The anatomical distribution of parasites demonstrated predominant localization within the intestinal lumen, with ancillary recoveries from mesenteric tissues and coelomic cavity. This predilection for intestinal habitat corresponds with observations by Islam et al. (2022) who reported *Clinostomum* adherent to adipose tissue and visceral organ membranes in *Trichopodus pectoralis*. The analysis of seasonal infection patterns revealed pronounced temporal heterogeneity in prevalence rates. Maximum prevalence (peak values) was documented during the summer months (February-June), with moderate infection levels recorded throughout the winter season (November-January), and minimal prevalence observed during the monsoon period (July-September). This seasonal gradient in infection prevalence demonstrates statistical significance and aligns with the fundamental principle articulated by Dogiel (1961) that fish parasite populations exhibit considerable spatiotemporal heterogeneity attributable to environmental variability and host population characteristics.

The observed seasonal pattern corroborates the findings of Shah et al. (2013), who demonstrated that prevalence, mean abundance, and mean intensity of *Clinostomum schizothoraxi* infection in Carassius carassius varied significantly along seasonal gradients of water temperature in Kashmir Himalayan lakes. These investigators established that temperature-mediated fluctuations in molluscan intermediate host populations directly influenced infection status in fish populations, with peak transmission occurring during periods of optimal thermal conditions. Examination of age-dependent infection patterns revealed that parasite prevalence and intensity exhibited positive correlation with host age and size classes. Juvenile specimens demonstrated minimal infection levels, while adult and larger size classes exhibited markedly elevated parasite burdens. This ontogenetic pattern in infection susceptibility corresponds with the findings of Sk Injamamul Islam (2022), who reported differential infection intensities between age cohorts in cultured Trichopodus pectoralis from central Thailand.

The pronounced seasonal variation in *Clinostomum shindei* infection prevalence observed in the present investigation necessitates examination of underlying environmental mechanisms modulating transmission dynamics. Water temperature constitutes a primary determinant of digenean trematode transmission success, influencing cercarial emergence from molluscan intermediate hosts, cercarial survival and infectivity in the external environment, and host foraging behavior and metabolic rates. Shah et al. (2013) demonstrated that seasonal temperature gradients in freshwater ecosystems directly correlated with fluctuations in *Clinostomum metacercarial* abundance, with elevated temperatures during summer months enhancing parasite transmission efficiency. Similar results also observed Jaywant Dhole et al., (2010) on helminthic observation of various freshwater fishes. The minimal infection prevalence recorded during monsoon season may be attributed to multiple interacting factors. Increased water volume and flow rates during monsoon months likely dilute cercarial concentrations in the water column, reducing encounter probabilities with susceptible fish hosts. Additionally, heightened turbidity and altered physicochemical parameters during heavy precipitation may adversely affect miracidial and cercarial survival. These observations align with the conceptual framework proposed by Chubb (1979), who documented that seasonal environmental changes fundamentally influence trematode population dynamics in freshwater fish assemblages.

The seasonal infection pattern observed in Channa punctatus may be substantially mediated by host feeding behavior and trophic ecology. Pennuyuick (1971) documented that fish acquired maximal parasite burdens during late winter through summer months, when elevated water temperatures stimulated feeding activity concomitant with peak abundance of zooplankton and benthic invertebrate communities serving as intermediate hosts. The piscivorous and carnivorous feeding habits of *C. punctatus* likely facilitate transmission of *Clinostomum metacercariae* through predation on infected forage fish or ingestion of cercariae-infected intermediate hosts. The warmer summer months in Dharashiv District, characterized by temperatures reaching 46.1°C, coincide with peak feeding activity in *C. punctatus*. Elevated metabolic demands during this period drive increased foraging intensity, consequently enhancing exposure to infective stages present in the environment. Furthermore, the accelerated developmental rates of intra molluscan stages at elevated temperatures likely synchronize cercarial emergence with periods of maximal host feeding activity, representing an adaptive strategy optimizing transmission success.

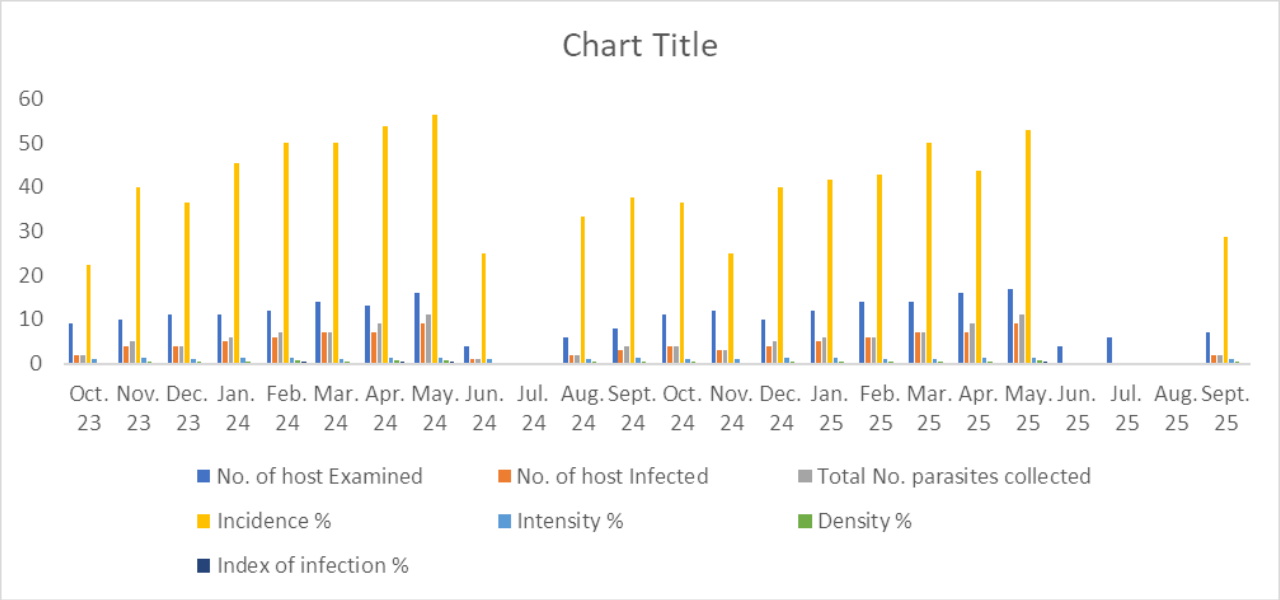
The prevalence rates observed in the present investigation (40.93%) fall within the range reported for *Clinostomum* infections in other geographical regions. Shah et al. (2013) documented lake-specific variation in *C. schizothoraxi* prevalence in Kashmir, with elevated infection levels in hypertrophic Anchar Lake compared to mesotrophic and eutrophic water bodies. The higher prevalence observed in the current study may reflect favorable environmental conditions for transmission in Dharashiv District water bodies. The seasonal pattern documented herein, characterized by peak summer prevalence and minimal monsoon infection, corresponds with classical descriptions of *Clinostomum* seasonality in freshwater ecosystems. The foundational investigations of Bykhovskaya (1929) in the Volga district of the former USSR first established the influence of annual seasons on clinostomid infection dynamics, a pattern subsequently corroborated by numerous investigators across diverse geographical regions. The consistency of this seasonal signature across taxa and localities suggests fundamental underlying mechanisms conserved in clinostomid transmission ecology.

Conclusion:

The present investigation demonstrates significant seasonal variation in Clinostomum shindei infection in Channa punctatus from Dharashiv District, with peak prevalence during summer, moderate levels in winter, and minimum during monsoon. These patterns are modulated by environmental factors, particularly water temperature, and host-associated parameters including feeding behavior and age-related susceptibility. The findings contribute to understanding the population dynamics of this economically significant parasite and provide baseline data for developing integrated control strategies.

Table : Population of Clinostomum Sp. from Channa punctatus during Oct. 2023 - Sept. 2025

Name of Month	No. of host Examined	No. of host Infected	Total No. parasites collected	Incidence %	Intensity %	Density %	Index of infection %
Oct. 23	09	02	02	22.22	1	0.22	0.04
Nov. 23	10	04	05	40	1.25	0.5	0.2
Dec. 23	11	04	04	36.36	1	0.36	0.13
Jan. 24	11	05	06	45.45	1.2	0.54	0.24
Feb. 24	12	06	07	50	1.16	0.58	0.29
Mar. 24	14	07	07	50	1	0.5	0.25
Apr. 24	13	07	09	53.84	1.28	0.69	0.42
May. 24	16	09	11	56.25	1.22	0.68	0.38
Jun. 24	04	01	01	25	1	0.25	0.06
Jul. 24	-	-	-	-	-	-	-
Aug. 24	06	02	02	33.33	1	0.33	0.11
Sept. 24	08	03	04	37.5	1.33	0.5	0.18
Oct. 24	11	04	04	36.36	1	0.36	0.13
Nov. 24	12	03	03	25	1	0.25	0.06
Dec. 24	10	04	05	40	1.25	0.5	0.2
Jan. 25	12	05	06	41.66	1.2	0.5	0.20
Feb. 25	14	06	06	42.85	1	0.42	0.18
Mar. 25	14	07	07	50	1	0.5	0.25
Apr. 25	16	07	09	43.75	1.28	0.56	0.24
May. 25	17	09	11	52.94	1.22	0.64	0.34
Jun. 25	04	00	00	00	00	00	00
Jul. 25	06	00	00	00	00	00	00
Aug. 25	-	-	-	-	-	-	-
Sept. 25	07	02	02	28.57	1	0.4683	0.28
Total	**237**	**97**	**111**	**40.92**	**1.14**	**1.14**	**0.19**



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