

Parasitological Investigation of Helminth Infections in Indigenous Ornamental Fishes

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Abstract

Indigenous freshwater fishes represent an important component of regional aquatic biodiversity and have increasing potential in the ornamental fish sector. However, helminth infections can adversely affect fish health, physiological condition, survival and commercial value, particularly under captive and semi-captive conditions. The present study investigated the occurrence, prevalence, intensity and diversity of helminth parasites associated with five indigenous ornamental fish taxa, namely *Etroplus suratensis*, *Aplocheilichthys panchax*, *Puntius* spp., *Devario* spp. and *Channa* spp., collected from aquarium outlets, fish culture units and freshwater sources in and around Pune, Maharashtra, India, during 2024. A total of 215 fish specimens were examined. Of these, 104 individuals were infected, resulting in an overall prevalence of 48.37%. A total of 342 individual helminth parasites were recovered, representing four major groups: Monogenea (*Dactylogyrus* spp.; n = 135), Digenea (*Allocreadium* spp.; n = 76), Cestoda (*Lytocestus* spp.; n = 58) and Nematoda (*Camallanus* spp.; n = 73). *Channa* spp. exhibited the highest host-specific prevalence (62.07%), whereas *Puntius* spp. supported the highest total parasite burden (112 parasites). The gastrointestinal tract was the most frequently affected anatomical site, with a prevalence of 27.44%, while the gills represented the principal ectoparasitic site, with a prevalence of 22.33%. Parasite distribution among anatomical sites differed significantly ($\chi^2 = 46.18$, $p < 0.001$). The findings demonstrate considerable helminth diversity and infection among indigenous ornamental fishes and highlight the importance of routine parasitological screening, quarantine, appropriate stocking density, water-quality management and improved fish-health practices in ornamental fish culture and trade.

Keywords: Indigenous ornamental fishes; Helminth parasites; Monogenea; Digenea; Cestoda; Nematoda; *Dactylogyrus*; *Camallanus*; Prevalence; Fish health; Pune; Maharashtra.

1. Introduction

The freshwater ornamental fish sector in India has expanded considerably in recent years and represents an important component of aquaculture, biodiversity utilization and livelihood generation. Although exotic species have traditionally dominated ornamental fish markets, indigenous freshwater fishes are increasingly receiving attention because of their attractive coloration, distinctive morphology, behavioural characteristics and adaptability to captive conditions. Species such as the orange chromide (*Etroplus suratensis*), blue panchax (*Aplocheilichthys panchax*), cyprinid barbs (*Puntius* spp.), danios (*Devario* spp.) and snakeheads (*Channa* spp.) possess considerable ornamental potential.

Despite their potential value, ornamental fishes are exposed to several stressors during collection, transportation, stocking and maintenance. High stocking density, handling stress, inadequate nutrition, poor water quality and absence of appropriate quarantine procedures can increase host susceptibility to infectious diseases. Among the major biological constraints affecting freshwater fishes, helminth parasites are particularly important because they may cause tissue damage, nutrient depletion, mechanical obstruction, impaired respiration and increased susceptibility to secondary infections.

Monogeneans predominantly occur as ectoparasites on the skin and gills. Their attachment and feeding activities can result in epithelial damage, tissue erosion, hyperplasia and excessive mucus secretion. In contrast, digeneans, cestodes and nematodes generally occupy internal organs, particularly the gastrointestinal tract, liver and body cavity. Heavy endoparasitic infections may interfere with nutrient absorption and normal physiological functions and may ultimately reduce growth, reproductive performance and survival.

The epidemiology of fish parasites is strongly influenced by host ecology and environmental conditions. Wild fish may harbour relatively low parasite burdens without obvious clinical signs; however, captive environments can facilitate parasite transmission because of increased host density and repeated contact among individuals. Fish movement between natural water bodies, culture facilities and aquarium outlets may further contribute to the dissemination of parasites.

Despite the increasing interest in indigenous ornamental fishes, information regarding their helminth infection dynamics in the Marathwada region of Maharashtra remains limited. Therefore, the present study was undertaken to investigate the prevalence, mean intensity, mean abundance, taxonomic diversity and anatomical distribution of helminth parasites in selected indigenous ornamental fishes from Latur district, Maharashtra.

2. Materials and Methods

2.1 Sampling Area

Fish specimens were collected from selected aquarium outlets, ornamental fish culture units, and freshwater sources in and around Pune, Maharashtra, India. The collected indigenous ornamental fish specimens were transported to the Department of Zoology, Sir Parashurambhau College, Pune, Maharashtra, India, for parasitological examination.

The study focused on the detection, isolation, and preliminary identification of helminth parasites associated with indigenous ornamental freshwater fishes. All specimens were examined using standard parasitological techniques under laboratory conditions.

2.2 Selection of Host Species

Five indigenous fish taxa with ornamental potential were selected on the basis of their local availability.

Table 1. Indigenous ornamental fish species examined during the study

Sr. No.	Fish species	Common name	Family	No. examined
1	<i>Etroplus suratensis</i> (Bloch, 1790)	Orange chromide	Cichlidae	42
2	<i>Aplocheilichthys panchax</i> (Hamilton, 1822)	Blue panchax	Aplocheilichthidae	36
3	<i>Puntius</i> spp.	Barb	Cyprinidae	60
4	<i>Devario</i> spp.	Danio	Danionidae	48
5	<i>Channa</i> spp.	Snakehead	Channidae	29
Total 215				

2.3 Fish Collection and Laboratory Examination

Live specimens were transported to the Parasitology Research Laboratory, Department of Zoology/Fishery Science, Rajarshi Shahu Mahavidyalaya, Latur, in clean and well-aerated containers containing water from the respective collection sites. Fish were maintained temporarily in holding tanks and examined within 12–24 h of arrival. Fish were euthanized humanely according to applicable institutional guidelines. Standard

morphometric parameters, including total length (cm) and wet body weight (g), were recorded before parasitological examination.

2.4 Ectoparasitic Examination

The external surface, fins, operculum and gill filaments of each fish were carefully examined under a stereomicroscope.

Mucus scrapings from the skin and excised gill arches were mounted in 0.9% physiological saline and examined microscopically for the presence of ectoparasitic helminths.

2.5 Endoparasitic Examination

A ventral longitudinal incision was made to expose the coelomic cavity. The gastrointestinal tract, liver, gall bladder, kidneys, swim bladder and body cavity were removed separately and placed in Petri dishes containing physiological saline. The digestive tract was opened longitudinally and carefully examined under a stereomicroscope for lumen-dwelling helminths. Other visceral organs were examined for attached, embedded or encysted parasites.

2.6 Fixation, Staining and Preservation

Monogeneans and digeneans were fixed in Alcohol-Formalin-Acetic Acid (AFA) under light coverslip pressure. The specimens were stained with acetocarmine, dehydrated through a graded ethanol series (30–100%), cleared in xylene and mounted in DPX.

Cestodes were fixed in hot 4% formalin, stained with aceto-alum carmine, cleared and permanently mounted.

Nematodes were fixed in warm 70% ethanol containing 5% glycerine, cleared in pure glycerine for temporary examination and subsequently preserved in 70% ethanol.

2.7 Taxonomic Identification

Recovered helminths were identified to the generic level using morphological characteristics and standard taxonomic keys and reference literature, including Bychowsky (1961), Yamaguti (1958, 1961) and Gibson et al. (2002). Important diagnostic characters examined included body shape and size, attachment structures, anchors, hooks, suckers, scolex morphology, reproductive structures, digestive structures and other taxonomically relevant features.

2.8 Epidemiological Parameters

The epidemiological parameters were calculated according to the standardized definitions of Margolis et al. (1982) and Bush et al. (1997).

Prevalence

Prevalence (%) = (Number of infected fish / Total number of fish examined) × 100

Mean Intensity

Mean Intensity = Total number of parasites recovered / Number of infected fish

Mean Abundance

Mean Abundance = Total number of parasites recovered / Total number of fish examined

Where, the number of infected fish represents hosts harbouring at least one parasite, while the total parasite count represents the total number of individual helminths recovered from all examined fish.

2.9 Statistical Analysis

The data were summarized using descriptive statistics. The chi-square (χ^2) test was used to evaluate differences in prevalence among host species and anatomical sites. Statistical significance was considered at $p < 0.05$.

3. Results

3.1 Overall Prevalence and Parasite Burden

A total of 215 fish specimens representing five indigenous ornamental fish taxa were examined. Of these, 104 fish were infected with at least one helminth parasite, resulting in an overall prevalence of 48.37%.

A total of 342 individual helminth parasites were recovered. The overall mean intensity was 3.29 parasites per infected fish, while the overall mean abundance was 1.59 parasites per examined fish. Among the examined hosts, *Channa* spp. showed the highest prevalence (62.07%), followed by *Puntius* spp. (51.67%), *Etrophus suratensis* (50.00%), *Devario* spp. (43.75%) and *Aplocheilichthys panchax* (36.11%).

Table 2. Epidemiological indices of helminth infection among examined fish species

Host species	No. examined	No. infected	Prevalence (%)	Total parasites	Mean intensity	Mean abundance
<i>Etrophus suratensis</i>	42	21	50.00	76	3.62	1.81
<i>Aplocheilichthys panchax</i>	36	13	36.11	34	2.62	0.94
<i>Puntius</i> spp.	60	31	51.67	112	3.61	1.87
<i>Devario</i> spp.	48	21	43.75	58	2.76	1.21
<i>Channa</i> spp.	29	18	62.07	62	3.44	2.14
Overall	215	104	48.37	342	3.29	1.59

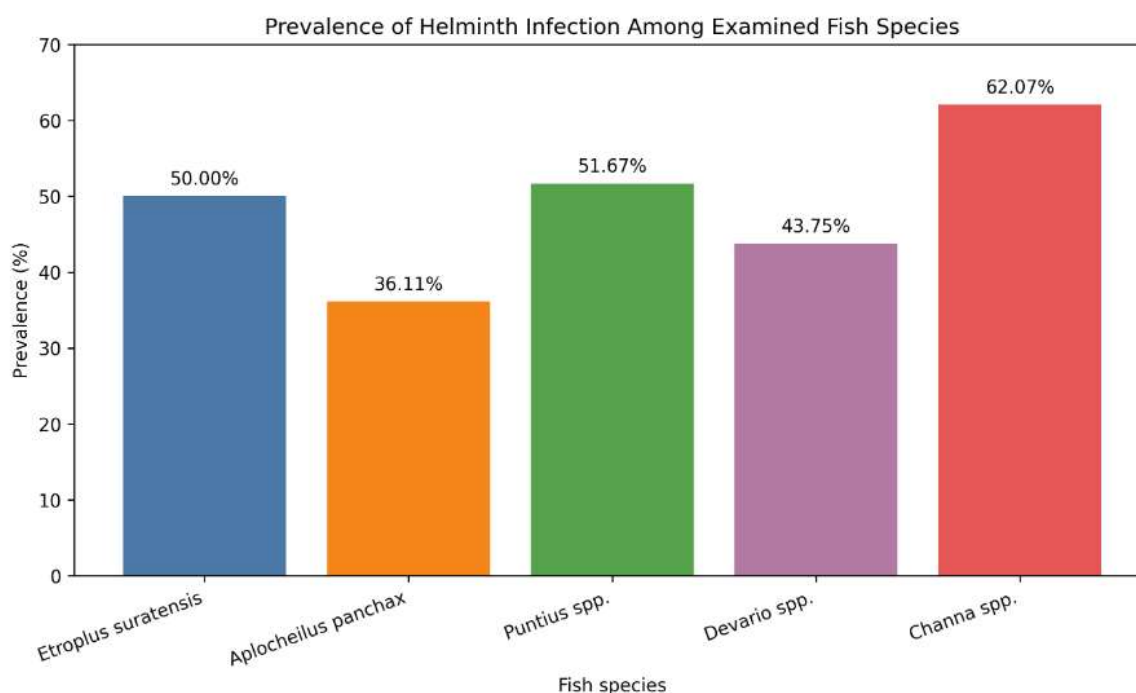


Figure 1. Prevalence of helminth infection among examined indigenous ornamental fish species.

3.2 Helminth Taxonomic Diversity

Four major helminth groups were recovered: Monogenea, Digenea, Cestoda and Nematoda.

Monogeneans represented the largest proportion of the recovered parasite community, accounting for 135 of the 342 parasites (39.47%). Digeneans represented 22.22% (76/342), nematodes 21.35% (73/342), and cestodes 16.96% (58/342).

Table 3. Taxonomic composition and distribution of recovered helminths

Sr. No.	Parasite taxon	Group	Infection site	Primary host species	No. recovered
1	<i>Dactylogyrus</i> spp.	Monogenea	Gills, skin	<i>Puntius</i> spp., <i>Devario</i> spp.	135
2	<i>Allocreadium</i> spp.	Digenea	Intestine	<i>Etroplus suratensis</i>	76
3	<i>Lytocestus</i> spp.	Cestoda	Intestine	<i>Channa</i> spp.	58
4	<i>Camallanus</i> spp.	Nematoda	Intestine, body cavity	<i>Aplocheilus panchax</i> , <i>Channa</i> spp.	73

3.3 Organ-Specific Distribution

The distribution of helminth infections differed significantly among anatomical sites ($\chi^2 = 46.18$, $p < 0.001$). The gastrointestinal tract represented the principal site of endoparasitic infection, whereas the gills were the major site of ectoparasitic infection.

The intestine showed the highest prevalence (27.44%), followed by the gills (22.33%), skin/fins (8.84%), body cavity (5.12%) and liver (3.26%).

Table 4. Anatomical distribution of helminth parasites

Organ/site	No. examined	No. infected	Prevalence (%)	Dominant helminth group	Pathological features observed
Gills	215	48	22.33	Monogenea (<i>Dactylogyrus</i>)	Epithelial hyperplasia, excess mucus
Skin/Fins	215	19	8.84	Monogenea	Surface erosion, mild irritation
Intestine	215	59	27.44	Cestoda, Digenea, Nematoda	Mucosal hypertrophy, luminal congestion
Liver	215	7	3.26	Digenea	Localized tissue compression
Body cavity	215	11	5.12	Nematoda (<i>Camallanus</i>)	Coelomic irritation, mild swelling

Discussion

The present investigation revealed a considerable occurrence and diversity of helminth parasites among indigenous ornamental fishes examined in Pune, Maharashtra, India. An overall prevalence of 48.37% was recorded, with 342 individual parasites recovered from 215 examined fish. The occurrence of infection indicates substantial exposure of ornamental fishes to helminth parasites under aquarium-associated, culture and freshwater environmental conditions. Prevalence, mean intensity and mean abundance are widely accepted epidemiological parameters for describing parasite occurrence and infection burden in host populations (Margolis et al., 1982; Bush et al., 1997).

The prevalence varied considerably among host species, with *Channa* spp. showing the highest infection rate (62.07%). This relatively high prevalence may be associated with the carnivorous feeding behaviour and ecological habits of *Channa* spp. Predatory fishes may acquire helminth infections through ingestion of infected prey or intermediate hosts, particularly in aquatic food webs where parasites utilize multiple hosts during their life cycles (Kabata, 1985; Poulin, 2004). Differences in feeding behaviour, habitat preference, host susceptibility and exposure to infective stages may therefore contribute to the observed variation in infection among fish species.

The prevalence recorded in the present study (48.37%) is comparable to the 51.16% prevalence reported by Pathan et al. (2025) in freshwater and ornamental fishes investigated in Latur, Maharashtra. Their study examined 43 fish specimens and reported helminth infections in 22 individuals, with *Carassius auratus* and *Poecilia sphenops* showing relatively high infection rates. The authors identified *Dactylogyrus*, *Gyrodactylus*, *Anisakis*, *Parasundon* and *Rondonia* among the recovered helminths. The similarity in overall prevalence between the two studies suggests that helminth infection may be relatively common among ornamental and freshwater fishes maintained or traded under regional conditions in Maharashtra (Pathan et al., 2025).

Puntius spp. showed the highest absolute parasite burden, with 112 parasites recovered from 31 infected fish. The mean intensity was 3.61 parasites per infected fish, indicating a relatively high parasite burden in this host. This observation may be associated with repeated exposure to directly transmitted monogeneans and favourable opportunities for parasite transmission under conditions of close host contact. Monogeneans possess relatively simple life cycles and can rapidly increase in abundance when susceptible hosts occur at high densities, making them particularly important parasites in confined or intensively managed fish populations (Thoney & Hargis, 1991).

Monogeneans constituted the dominant parasite group in the present investigation, accounting for 39.47% of the total parasites recovered. *Dactylogyrus* spp. were primarily associated with the gills and skin of *Puntius* and *Devario*. The predominance of monogeneans is consistent with previous investigations of ornamental fishes in India, where considerable diversity of monogenean parasites has been reported, including *Dactylogyrus* and *Gyrodactylus* spp. (Tripathi et al., 2025). Similarly, Pathan et al. (2025) reported *Dactylogyrus* and *Gyrodactylus* among the helminths recovered from freshwater and ornamental fishes in Maharashtra. These observations emphasize the importance of monogenean surveillance in ornamental fish health management (Pathan et al., 2025; Tripathi et al., 2025).

Gill-associated helminths are particularly important because parasite attachment and feeding can damage the respiratory epithelium and induce excessive mucus production, epithelial hyperplasia and structural alterations of the gill lamellae. Such pathological changes may reduce respiratory efficiency and compromise fish health, particularly when infections are heavy or combined with environmental stressors (Sudaryatma & Eriawati, 2018). Therefore, the relatively frequent occurrence of gill-associated monogeneans in the present study has potential implications for the health and survival of ornamental fishes.

The gastrointestinal tract was the most frequently affected anatomical site, with 59 infected fish and a prevalence of 27.44%. Digeneans, cestodes and nematodes were associated with this site. The gastrointestinal tract provides favourable nutritional and attachment conditions for many endoparasitic helminths. The occurrence of several taxonomically different helminth groups within the digestive tract also suggests that differences in feeding behaviour and exposure to infected prey or intermediate hosts may contribute to parasite acquisition (Kabata, 1985; Scholz, 1999).

Allocreadium spp. were recorded from *Etroplus suratensis*. Digenean parasites commonly involve intermediate hosts in their life cycles, and their presence in fish may therefore reflect interactions between fish hosts and aquatic invertebrate communities. The occurrence of digeneans may consequently provide indirect evidence of exposure to infected intermediate hosts within the surrounding aquatic environment. Host diet, habitat use and feeding strategy are important factors influencing the probability of acquiring such parasites (Poulin, 2004).

The recovery of *Lytocestus* spp. from *Channa* spp. and *Camallanus* spp. from *Aplocheilichthys panchax* and *Channa* spp. further demonstrates the taxonomic diversity of endoparasitic helminths present in the examined fish community. However, because parasite identification in the present investigation was primarily based on morphological characteristics and several taxa were reported only to the generic level, conclusions concerning species-specific host specificity should be interpreted cautiously. Molecular characterization using suitable genetic markers would improve taxonomic resolution and help confirm the identity of morphologically similar helminth taxa.

From a fish-health perspective, the importance of helminth infection extends beyond prevalence alone. Gill parasites may interfere with respiratory function, whereas gastrointestinal helminths may adversely affect nutrient absorption, digestion and general physiological condition. Heavy parasitic infections may also contribute to reduced growth, poor body condition and increased susceptibility to secondary infections (Scholz, 1999; Noga, 2010).

The findings of the present study are also relevant in light of the recent investigation by Gutte and Nalle (2026) on ornamental fishes from Latur District, Maharashtra. That study recorded an overall helminth prevalence of 62.5% and demonstrated significant differences in physiological, haematological, biochemical and immune parameters between healthy and helminth-infected fishes. Infected fishes showed reductions in several indicators of physiological and immune status, while increased leukocyte counts, serum glucose, liver enzyme activities and respiratory burst activity indicated physiological stress and altered immune responses (Gutte & Nalle, 2026). These observations support the view that helminth infections can have consequences extending beyond parasite presence and may influence the overall health status of ornamental fishes.

The difference between the 48.37% prevalence recorded in the present study and the 62.5% prevalence reported by Gutte and Nalle (2026) may be attributable to differences in fish species composition, sample size, sampling sources, environmental conditions, stocking densities, parasite communities and diagnostic procedures. Similarly, the prevalence reported by Pathan et al. (2025) was 51.16%, which is relatively close to the prevalence observed in the present investigation. Collectively, these studies indicate that helminth infections represent a recurring health concern among ornamental and freshwater fishes in Maharashtra (Pathan et al., 2025; Gutte & Nalle, 2026).

The ornamental fish trade may further contribute to parasite dissemination because fishes are routinely transferred between collection sites, breeding facilities, wholesalers, retailers and private aquaria. Movement of infected fish can introduce parasites into previously uninfected populations. Recent investigations have highlighted substantial monogenean diversity among ornamental fishes and emphasized the importance of parasite surveillance in fish populations subjected to translocation (Tripathi et al., 2025). Consequently, quarantine, routine parasitological screening and appropriate health certification should be considered important components of ornamental fish management.

Routine parasitological examination, maintenance of appropriate stocking density, regular water-quality monitoring, hygienic aquarium practices and quarantine of newly introduced fishes should form the basis of preventive parasite management. Early detection is particularly important because treatment strategies vary according to parasite group and site of infection. Appropriate parasite-control measures should therefore be selected based on accurate diagnosis and implemented under suitable fish-health or veterinary guidance (Kabata, 1985; Noga, 2010).

The significant difference observed in parasite distribution among anatomical sites ($\chi^2 = 46.18$, $p < 0.001$) indicates that the recovered helminth groups were not distributed randomly among host tissues and may exhibit distinct tissue preferences. Such distribution may be influenced by parasite attachment mechanisms, host tissue suitability, nutrient availability and parasite life-cycle characteristics. Nevertheless, the present study has certain limitations, particularly the absence of molecular confirmation and the identification of some parasites only to the generic level. Future studies incorporating larger sample sizes, seasonal sampling, histopathological assessment and molecular characterization would provide stronger evidence regarding parasite transmission, host specificity, tissue tropism and epidemiological dynamics in indigenous ornamental fishes of Maharashtra.

Overall, the present findings demonstrate that helminth infections are an important parasitological concern in indigenous ornamental fishes, with notable variation in prevalence, parasite burden and anatomical distribution among host species. The combined evidence from studies conducted in Maharashtra indicates the need for continued parasitological surveillance, improved quarantine practices and integrated fish-health management to minimize parasite transmission and maintain the health and commercial value of ornamental fishes (Pathan et al., 2025; Gutte & Nalle, 2026; Tripathi et al., 2025).

5. Conclusion

The present study provides baseline epidemiological information on helminth infections in selected indigenous ornamental fishes from Latur district, Maharashtra. An overall helminth prevalence of 48.37% was recorded among 215 examined fish, with 342 individual parasites representing four major helminth groups: Monogenea, Digenea, Cestoda and Nematoda.

Channa spp. exhibited the highest host-specific prevalence, whereas *Puntius* spp. showed the highest total parasite burden. Monogeneans represented the most abundant parasite group, while the gastrointestinal tract was the principal site of endoparasitic infection.

The findings highlight the importance of systematic parasitological surveillance in indigenous ornamental fishes. Regular screening, appropriate quarantine, good water-quality management, responsible stocking practices and hygienic handling can contribute substantially to reducing parasite transmission and improving fish health.

Further investigations incorporating seasonal sampling, histopathology, molecular identification and detailed environmental assessment are recommended to elucidate the epidemiology, host specificity and pathogenic significance of helminth infections in indigenous ornamental fishes.

Ethics Statement

All procedures involving fish capture, handling and parasitological examination were conducted in accordance with applicable institutional ethical standards for animal handling.

Conflict of Interest

The authors declare that they have no conflict of interest regarding the publication of this manuscript.

References

- **Bush, A. O., Lafferty, K. D., Lotz, J. M., & Shostak, A. W. (1997).** Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology*, 83(4), 575–583. <https://doi.org/10.2307/3284227>
- **Bychowsky, B. E. (1961).** *Monogenetic trematodes: Their systematics and phylogeny*. American Institute of Biological Sciences.
- **Gibson, D. I., Jones, A., & Bray, R. A. (Eds.). (2002).** *Keys to the Trematoda* (Vol. 1). CABI Publishing and The Natural History Museum.
- **Gutte, S. M., & Nalle, D. A. (2026).** Impact of helminth infection on physiological, hematological, biochemical, and immune parameters of ornamental fishes from Latur District, Maharashtra, India. *Asian Journal of Fisheries and Aquatic Research*, 28(8), 8–24. <https://doi.org/10.9734/ajfar/2026/v28i81120>
- **Kabata, Z. (1985).** *Parasites and diseases of fish cultured in the tropics*. Taylor & Francis.

- **Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M., & Schad, G. A. (1982).** The use of ecological terms in parasitology: Report of an ad hoc committee of the American Society of Parasitologists. *Journal of Parasitology*, 68(1), 131–133. <https://doi.org/10.2307/3281335>
- **Noga, E. J. (2010).** *Fish disease: Diagnosis and treatment* (2nd ed.). Wiley-Blackwell.
- **Pathan, A. A., Shaikh, N. Q., & Nalle, D. A. (2025).** Prevalence and identification of helminths parasites in domestic animals: A parasitological survey. *International Journal of Research and Analytical Reviews*, 12(2), 606–610. IJRAR25B2013. The published article reports a 51.16% helminth prevalence in freshwater/ornamental fishes from Latur, Maharashtra.
- **Poulin, R. (2005).** Relative infection levels and taxonomic distances among the host species used by a parasite: Insights into parasite specialization. *Parasitology*, 130(1), 109–115. <https://doi.org/10.1017/S0031182004006304>
- **Scholz, T. (1999).** Parasites in cultured and feral fish. *Veterinary Parasitology*, 84(3–4), 317–335. [https://doi.org/10.1016/S0304-4017\(99\)00039-4](https://doi.org/10.1016/S0304-4017(99)00039-4)
- **Sudaryatma, P. E., & Eriawati, N. N. (2012).** Histopathologic feature(s) of the *Dactylogyrus* sp.-infected gills in the ornamental marine fish. *Jurnal Sain Veteriner*, 30(1). <https://doi.org/10.22146/jsv.2483>
- **Thoney, D. A., & Hargis, W. J., Jr. (1991).** Monogenea (Platyhelminthes) as hazards for fish in confinement. *Annual Review of Fish Diseases*, 1, 133–153. [https://doi.org/10.1016/0959-8030\(91\)90027-H](https://doi.org/10.1016/0959-8030(91)90027-H)
- **Tripathi, A., Matey, C., Buchmann, K., & Hahn, C. (2025).** Monogeneans on exotic Indian freshwater fish. 7. Results of a national study on ornamental fishes from 2019–2022. *Parasite*, 32, Article 28. <https://doi.org/10.1051/parasite/2025021>. This study examined 619 exotic ornamental fish and identified substantial monogenean diversity, including *Dactylogyrus* and *Gyrodactylus*.
- **Yamaguti, S. (1958).** *Systema helminthum. Vol. I: The digenetic trematodes of vertebrates*. Interscience Publishers.
- **Yamaguti, S. (1961).** *Systema helminthum. Vol. III: The nematodes of vertebrates*. Interscience Publishers.