

## Monogenean Infestations Among Freshwater Ornamental Fishes: An Overview

Rehana Abidi\*, Gazala Eram Khan and U. K. Chauhan<sup>1</sup>

Fish Health Management Division, National Bureau of Fish Genetic Resources, Canal Ring  
Road, P.O.- Dilkusha, Lucknow-226002, Uttar Pradesh, India

<sup>1</sup>Department of Environmental sciences A.P.S University Rewa, M.P., India

**Abstract:** Diseases outbreaks are being increasingly recognized as a significant constraint to aquaculture and ornamental fish trade and affecting economic development of the fishery sector. Monogeneans (flukes), a group of fatal metazoan parasites are recognized as a major menace to ornamental fish culture and commonly found on the gills and skin of fishes. A few may invade the internal organs like rectal cavity, ureter, body cavity or the blood vascular system. Monogenean infestation causes heavy mortality of fish population because gills are directly involved in gas transfer ion exchange and maintenance of acid base balance in the body. They also break the site of attachment and cause localized hemorrhages. At the same time, they feed upon the cells of ruptured tissue and blood. There are more than 100 families of monogeneans found in freshwater, brackish water and marine fishes of the world in various temperatures. Among these two families Gyrodactylidae and Dactylogyridae are very important as they mostly infest cyprinid fishes which have high economic value. Several workers have emphasized the significance of highly pathogenic species of these two families Gyrodactylidae and Dactylogyridae causing morbidity and mortality in ornamental fish. A detailed account of the research done on the two families Gyrodactylidae and Dactylogyridae of class Monogenea is described in this review.

**Key Words:** Monogenea, Ornamental, Fish, *Gyrodactylus*, *Dactylogyrus*

### Introduction

Ornamental fish keeping is one of the most popular hobbies in the world today. The growing interest in aquarium fishes has resulted in steady increase in aquarium fish trade globally. The trade with a turnover of US \$ 5 Billion and an annual growth rate of 8 percent offers a lot of scope for development. Estimates place the value of the marine ornamental trade at US\$ 200-330 million per year. India's share in ornamental fish trade is less than 0.01% of the global trade. It is widely recognized that ornamental fishes have caused the spread of pathogens and diseases such as fish lice, anchor worms, *Ichthyophthirius multifiliis*, *Cryptobia*, etc. (Thilakarathne *et al.*, 2003). It is

evident that ornamental fishes and the water used to transport them, can act as vector for viruses and other pathogens of national and international significance. Monogeneans are recognized as a major hazard to fish culture associated with inadequate sanitation, crowding and deterioration of water quality. They pose serious threat to fish farming. They inflict injuries and deteriorate the fish health by clinging to the skin, gills, gill chamber, nasal organ, buccal cavity and fins of fishes. Monogenean infestation causes heavy mortality of fish population because gills are directly involved in gas transfer ion exchange and maintenance of acid base balance in the body. They also break the site of attachment and cause localized hemorrhages. At the same time, they feed upon

---

\*Email: eram.gazala@rediffmail.com

the cells of ruptured tissue and blood. Monogenean may be mechanical vector for viral and bacterial pathogens of fish (Grimes *et al.*, 1985).

Among trematodes Whittington and Cribbs (1998) suggested more than 25000 species of monogenean parasites and more than 95% of them have been reported from fishes. They are present in all inland waters and seas and demonstrate a high degree of host specificity and follow their respective specific fish hosts throughout their distribution range. The first record of monogenea was found in 1906. Among monogeneans, two families Gyrodactylidae and Dactylogyridae are very important as they mostly infest cyprinid fishes which are used as food and cultured largely in the whole world (Gibson *et al.*, 1996). Among these genus *Dactylogyrus* and *Gyrodactylus* are more dangerous and cause extensive damage resulting into significant mortality of fries and fingerlings of carps.

### **Gyrodactylus outbreaks and diseases**

*Gyrodactylus*, is a wide spread monogenetic genus, infecting skin, fins and gills of fry and fingerlings of carps, salmon, trouts and some other economically important freshwater fishes of India. In Canada and Norway, *Gyrodactylus* has wiped away the whole salmon fishery. Thilakarathne *et al.*, 2003 reported *Gyrodactylus* infestation in the *Cyprinus carpio* with prevalence of 75%.

In August 1949, Tripathi purchased healthy carp fry (1.5 - 2.5 cms long) of *Labeo rohita* (rohu), *Cirrhinus mrigala* (mrigal), *C. reba*, *Labeo bata* (bata) and *Catla catla* from a local market at Barrackpore. 5 specimens of fry of each species were examined for ectoparasitic infection. Among them one fry of rohu (1.8 cms) had three specimen of a species of *Gyrodactylus* on its fins. The rest of fry of rohu, mrigal and bata started dying. On the eighth day about ten dead fry were found to be heavily

infected with *Gyrodactylus* species. The fry of *Catla catla* were free from the infection and there was no mortality amongst them. The maximum number of *Gyrodactylus* present on different species of fish was as follows: rohu – 75, mrigal – 68 and bata – 48, showed that rohu carried the maximum parasite load. The characteristics features of this species were, testis Post – ovarian, testis and ovary both spherical. Ootype anterior to ovary; uterus big, oval having one embryo which may further have a daughter ‘grand daughter’ embryos in it. Cirrus spherical and lateral near the intestinal bifurcation with one big and 4–5 small cuticular hooks. This parasite had been placed in the species “*elegans*” based on the characters of its anchor and anchor roots. It differs from all the other sub-species of this species in the size of its anchors, pharynx and marginal hooklets. The Indian form overlaps both of them in various body measurement and they may all be ultimately one. The marginal hook lets of *G.e. Sinicus* were smallest of these three sub-species, the Indian form of *Gyrodactylus elegans* is found on totally different hosts from those Chinese and Japanese forms. Among various species of *Gyrodactylus*, *G. salaris* Malmberg (1970) is a fatal and virulent pathogen of significant economic and ecological importance. Endemicity of *G. salaris* is also present; Bakke *et al.* (1990) strongly supported the hypothesis that *G. salaris* is endemic to Norway. Gyrodactylosis caused by *G. salaris* became a noticeable disease under the provision of the Diseases of Fish Act 1937 since 1991 in the UK. The Ministry of Agriculture, Fisheries and Food (MAFF) under the auspices of EC Directive 91/67EEC, has undertaken a monitoring programme of both farmed and wild fish stocks in England and Wales.

Molecular phylogeny of 11 *Gyrodactylus* species was based on a short 278 bp internal transcribed spacer-1 (ITS-1) fragment and a combination of the 5.8S gene and ITS2. The species were *G. kobayashii*, *G. gurleyi*, *G.*

*pungitii*, *G. rogatensis*, *G. gasterostei*, *G. derjavini*, *G. salaris*, *G. rarus*, *G. tumbulli*, *G. bullatarudis* and *G. arcuatus*, divided into 2 groups having either a short or long ITS-1 sequence, which matched with the subgenera *Mesonephrotus*, *Metanephrotus* and *Limnonephrotus*. Zietara and Lumme (2002) compared Malmberg (1970) division of the genus with the molecular phylogeny constructed with the internal transcribed spacers (ITS) sequences of 4 different subgenera namely *Mesonephrotus*, *Metanephrotus*, *Paranephrotus*, and *Limnonephrotus*.

Thirty one Gyrodactylid species were examined from five families of freshwater fish and worked upon the utility of variable region V4 and internal transcribed spacer (ITS) region as molecular markers for *Gyrodactylus* species. The variable region V4 of the 18S small subunit ribosomal RNA gene and ribosomal RNA internal transcribed spacers ITS1 and ITS2 were sequenced. Both the V4 region and spacers ITS1 and ITS2 proved useful for Gyrodactylid diagnosis. Sequences of these fragments exhibited interspecific variations and allowed clear determination at the species level. Minor differences in the sequences between Western and Eastern European populations were detected for *Gyrodactylus salaris*/*Gyrodactylus thymalli*, *Gyrodactylus teuchis* and *Gyrodactylus truttae*, but these do not affect species diagnosis based on ribosomal DNA sequence. These results confirm the utility of both variable region V4 and the ITS as molecular markers for *Gyrodactylus* species. The first DNA analysis of *Gyrodactylus salaris* was performed by Cunningham and his coworkers (Cunningham *et al.*, 1995; Cunningham, 1997) who developed method for DNA sequence analysis of Gyrodactylid which although employed primarily for the diagnosis of pathogen *Gyrodactylus salaris*, provided an opportunity for molecular analysis completing the existing morphological taxonomy. High species was also

noticed; Boeger *et al.* (2003) assigned high species richness to Gyrodactylidae (16 genera, 446 species names). Boeger *et al.* (2003) included rDNA ITS2 sequences of genera *Gyrodactylus*, *Acanthophthalmus*, *Fundulotrema* and *Gyrodactyloides* into a phylogenetic reconstruction of the family.

### **Dactylogyrus outbreaks and diseases**

The most pathogenic species of family Dactylogyridae includes members of the genus *Dactylogyrus* Diesing, Yamaguti (1985) first listed about 111 species of this genus. These are gill parasites of cyprinid fishes worldwide. The systematics of this genus has become unmanageable due to introduction of a large number of species and subspecies. It is highly diversified group within the monogenea (Gussev, 1985). In this genus a number of congeneric species coexisting on the same host species has been reported and several studies have been conducted on host specificity.

At least 7 species are known from carp (*Cyprinus carpio*), Gussev (1985) listed eight species of *Dactylogyrus* from *Cyprinus carpio*. These are *D. achmerowi*, *D. anchoratus*, *D. crassus*, *D. extensus*, *D. minutus*, *D. mrazaki*, *D. vastator*, *D. yinwenyingae*. Several workers have reported *Dactylogyrus extensus* and *Gyrodactylus e. medius* from *Carassius auratus* and *Cyprinus carpio* (Thilakarathne *et al.*, 2003). Jain (1957) added three more species viz., *D. cotius* on *Osteobrama cotio*, *D. multispiralis* on *Silonia silondia* & *D. batae* on *Labeo bata* from Lucknow. Three new species of the Dactylogyridae were described from aquarium fishes in India and two new genera were proposed: *Heterotylus heterotylus* n.g., n.sp. from *Hypostomus* sp. (Loricariidae), *Diaphorocleidus armillatus* n. g., n. sp. from *Gymnocorymbus ternetzi* (Characidae) and *Urocleidoides vaginoclastrum* n. sp. from *Xiphophorus helleri* (Poeciliidae) (Jogunoori *et al.*, 2004).

## Discussion

There are many important issues and doubts related to the taxonomy and systematics of these highly diverse and voluminous genera of families Gyrodactylidae and Dactylogyridae (Bakke *et al.* 2002). Genera *Dactylogyrus* and *Gyrodactylus* are highly diversified group and have more than 900 and 400 species and subspecies respectively. This crisis about taxonomic identification, misleading identification and wrong phylogeny can be solved with the modern biotechnological tools. A number of congeneric species are coexisting on the same host species. Few studies have been conducted on host specificity but no concrete answer is in picture likewise (Cunnigham, 1997). As the methods used for parasite's identification are based on morphometry /morphology it is difficult to distinguish between closely related species and erroneous results can be there. Some of these species are very important from fisheries point of view and need immediate attention. Hence it is essential to develop accurate and reliable molecular techniques to solve these ambiguities. Fortunately, now we have more advance molecular techniques and tools to solve the mysteries of evolution, taxonomy and systematics which will proves to be very significant in identification, comparison and to establish phylogenetic relationships in various Monogenean species however partial/full DNA sequences was not obtained (Cunnigham, 1997, Cunnigham *et al.*, 1995). Sequencing of parasite's DNA is essentially required to get the primers for PCR and for that authentic identification of parasite is a must. Screening and construction of cDNA library for monogeneans is also important. Once the DNA sequences of parasites are available, it will be very easy to do further biological studies and solve the mysteries of past. Further, for any molecular work parasites are continuously required in amplification. Hence work on the

culture of parasites should also be taken up. Rapid detection of parasites in the early phase of disease outbreaks, can control the spread of disease to the newer areas. Rapid detection is crucial for taking up import decisions and to diagnose and identify exotic fatal OIE listed parasite *Gyrodactylus salaris* which in turn will help in safe import of live ornamental or food fishes.

## Acknowledgment

The authors express their sincere thanks to the Head, Fish Health Management Division; Library and Director NBFGR Lucknow for providing guidance and unconditional support.

## References

- Bakke T.A., Harris P.D. and Cable J. (2002) Host specificity dynamics: Observations on gyrodactylid monogeneans. *J. Parasitol.*, **32**, 281-308
- Bakke, T.A. Jansen, P.A. and Hansen, L.P. (1990) Differences in the host resistance of Atlantic Salmon, *Salmo Salar* L., Stocks in the Monogenean *Gyrodactylus salaris* malmberg, 1957. *J. Fish Biol.*, **37**, 577 – 587
- Boegar W.A., Kritsky D.C. and Pie M.R. (2003) Context of diversification of the viviparous Gyrodactylid (Plathelminthes, Monogenea), *Zool. scripta.*, **32**, 437-448
- Cunnigham, C.O., Macgillivray, D.M., Mackenzie K. and Melvin W.T. (1995) Discrimination identification of *Gyrodactylus* species parasitizing salmonid fish using DNA probe. *J. Fish Dis.*, **18**, 539-544
- Cunnigham, C.O. (1997) Species variation within the internal transcribed spacers genes (ITS) region of *Gyrodactylus* (Monogenea: Gyrodactylidae) ribosomal RNA genes. *J. Parasitol.*, **83**, 215-219
- Grimes, D. J., S. H. Gruber, and E. B. May (1985) Experimental infection of lemon sharks, *Negaprion brevirostris* (Poey), with *Vibrio* species. *J. Fish Dis.*, **8**, 173–180.
- Gusev A.V. (1985) Parasitic metazoan class Monogenea key to parasite of freshwater fishes of USSR Nauka, 10-353
- Gibson, D.I. ,Timofeeva, T.A., and Gerasev, P.A. (1996) New names for homonyms in the genus *Dactylogyrus Diesing*, 1850 (Monogenea, Dactylogyridae). *Sys. Parasitol.*, **35**, 1-2

- Jain S.L. (1957) Monogenea of Indian freshwater fishes V. *Dactylogyrus Multispiralis* n. sp. From the gill filaments of *Silondia silondia* (Ham.) from Lucknow, India. *Proc. Nat. Acad. Sci. Ind.*, Sec. B., **27**, 26 – 30.
- Malmberg, G. (1970) The excretory system and marginal hooks as a basis for the systematics of *Gyrodactylus* (Trematoda, Monogenea). *Ark.Zool.*, **23**, 1-235
- Thilakaratne I.D., Rajapaksha G., Hewakopara A., Rajapakse R.P. and Faizal A.C. (2003) Parasitic infections in freshwater ornamental fish in Sri Lanka. *Dis. Aquat. Org.* **54**, 157-162
- Whittington I.D. and Cribbs B.W. (1998) Glands associated with the anterior adhesive areas of Monogeneans *Entobdella* sp. and *Entobdella australis* (Capsalladea) from the skin of *himentura fai* and *Taenura lymma* Dasyatidae *Int.J.Parasitol.* **28**, 653-665
- Jogunoori W., Kritsky D.C. and J. Venkatanarasaiah Neotropical Monogenoidea (2004) Three new species from the gills of introduced aquarium fishes in India, the proposal of *Heterotylus* n. g. and *Diaphorocleidus* n. g., and the reassignment of some previously described species of *Urocleidoidea* Mizelle & Price, 1964 (Polyonchoinea: Dactylogyridae) *Sys. Parasitol.* **58**, 115–124
- Yamaguti Satya (1985) *Systema Helminthum. Monogenea and Aspidocotylea* Volume 1, International books and periodical supply services New delhi 110005
- Zietara, M.S. and Lumme, J.,(2002) Speciation by host switch and adaptive radiation in a fish parasite genus *Gyrodactylus* (Monogenea, Gyrodactylidae). *Evolution*, **56**, 2445-2458