

# MONOGENEA ON EXOTIC INDIAN FRESHWATER FISH. 6. CO-INTRODUCTION OF *CICHLIDOGYRUS SCLEROSUS* (PLATYHELMINTHES: MONOGENEA) WITH AN INVASIVE NILE TILAPIA *OREOCHROMIS NILOTICUS* (TELEOSTEI: CICHLIDAE)

Matey C., Singh S., Prakash S., Tripathi A.\*

Department of Zoology, University of Lucknow, Lucknow-226007, India  
e-mail: \*tripathi\_amit@lkouniv.ac.in (<https://orcid.org/0000-0002-2751-4437>)

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Nile tilapia *Oreochromis niloticus* (Cichliformes: Cichlidae) is one of the most widespread invasive fish species and is host to a plethora of pathogens and parasites. However, no information is available about the health status or infectious diseases of either cultured or wild *O. niloticus* in India. This article provides the first report of *Ciclidogyrus sclerosus*, an exotic monogenean (platyhelminth) parasite, from wild *O. niloticus* in north India. Partial sequence data from the 28S rRNA gene fragments and the 18S-ITS1 region corroborated the initial determination based on morphological characteristics. The potential impact of parasite assemblage of invasive *O. niloticus*, including *C. sclerosus*, are discussed.

**Keywords:** fish parasite, BLAST, phylogenetic analysis, invasive species

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## REFERENCES

- Akoll P., Konecny R., Mwanj W. and Schiemer F. Risk assessment of parasitic helminths on cultured Nile tilapia (*Oreochromis niloticus*, L.), *Aquac.*, 2012, vol. 356, pp. 123–127. <https://doi.org/10.1016/j.aquaculture.2012.05.027>
- Arthur R.I., Lorenzen K., Homekingeo P., Sidavong K., Sanvilaikham B. and Garaway C.J. Assessing impacts of introduced aquaculture species on native fish communities: Nile tilapia and major carps in SE Asian freshwaters, *Aquac.*, 2009, vol. 299, pp. 81e88. <https://doi:10.1016/j.aquaculture.2009.11.022>
- Attayde J.L., Brasil J. and Menescal R.A. Impacts of introducing Nile tilapia on the fisheries of a tropical reservoir in North-eastern Brazil, *Fish Manag Ecol.*, 2011, vol. 18, pp. 437e443. <https://doi.org/10.1111/j.1365-2400.2011.00796.x>
- Bakke T.A., Harris P.D., Hansen H., Cable J. and Hansen L.P. Susceptibility of Baltic and East Atlantic salmon *Salmo salar* stocks to *Gyrodactylus salaris* (Monogenea), *Dis Aquat Org.*, 2004, vol. 58, pp. 171–7. <https://doi.org/10.3354/dao058171>
- Behera B.K., Pradhan P.K., Swaminathan T.R., Sood N., Paria P., Das A., Verma D.K., Rajkumar, Yadav M.K., Dev A.K., Parida P.K., Das B.K., Lal K.K. and Jena J.K. Emergence of tilapia lake virus associated with mortalities of farmed Nile tilapia *Oreochromis niloticus* (Linnaeus 1758) in India, *Aquac.*, 2018, vol. 484, pp. 168–174. [doi.org/10.1016/j.aquaculture.2017.11.025](https://doi.org/10.1016/j.aquaculture.2017.11.025)
- Britton J.R., Pegg J. and Williams C.F. Pathological and ecological host consequences of infection by an introduced fish parasite, *PLoS ONE.*, 2011, vol. 6, pp. e26365. <https://doi.org/10.1371/journal.pone.0026365>
- Bush A.O., Lafferty K.D., Lotz J.M. and Shostak A.W. Parasitology meets ecology on its own terms: Margolis et al. revised, *J Parasitol.*, 1997, vol. 83, pp. 575–583. <https://doi.org/10.2307/3284227>
- Christison K. (2002) Branchial monogenean parasites (Monogenea: Dactylogyridae) of fishes from the Okavango River and Delta, Botswana. PhD Thesis, University of the Free State, South Africa, pp 155.
- De Silva S.S., Subasinghe R.P., Bartley D.M. and Lowther A. Tilapias as Alien Aquatics in Asia and the Pacific: A Review, FAO Fisheries Technical Paper. No. 453, 2004, pp. 65.
- Douëllou L. Monogeneans of the genus *Ciclidogyrus* Paperna, 1960 (Dactylogyridae: Ancyrocephalinae) from cichlid fishes of Lake Kariba (Zimbabwe) with descriptions of five new species, *Syst. Parasitol.*, 1993, vol. 25, pp. 159–186.
- El-Sayed A.F.M. and Fitzsimmons K. From Africa to the world-The journey of Nile tilapia, *Rev. Aquac.*, 2023, vol. 15, pp. 6–21. <https://doi.org/10.1111/raq.12738>
- Froese R. and Pauly D. (Eds.) FishBase. World Wide Web electronic publication. Available at [www.fishbase.org](http://www.fishbase.org). Accessed November 2, 2023.
- Genovesi P. and Carnevali, L. Invasive alien species on European islands: eradications and priorities for future work. In: Veitch D. and Clout M (ed) Island Invasives: Eradication and Management IUCN, Gland, Switzerland, 2011, pp 56–62.

- Gu D.E., Ma G.M., Zhu Y.J., Xu M., Luo D., Li Y.Y., Wei H., Mu X.D., Luo J.R. and Hu Y.C. The impacts of invasive Nile tilapia (*Oreochromis niloticus*) on the fisheries in the main rivers of Guangdong Province, China, *Biochem Syst and Ecol.*, 2015, vol. 59, pp. 1–7. <https://doi.org/10.1016/j.bse.2015.01.004>.
- Hall T. BioEdit: A user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT, *Nucleic Acids Symp Ser.*, 1999, vol. 41, pp. 95–98.
- Hassouna N., Michot B. and Bachellerie J.P. The complete nucleotide sequence of mouse 28S rRNA gene. Implications for the process of size increase of the large subunit rRNA in higher eukaryotes, *Nucleic Acid Res.*, 1984, vol. 12, pp. 3563–3583. <https://doi.org/10.1093/nar/12.8.3563>
- Jiménez-García M.I., Vidal-Martinez V.M. and Lopez-Jimenez S. Monogeneans in Introduced and Native Cichlids in Mexico: Evidence for Transfer, *J Parasitol.*, 2001, vol. 87, pp. 907–909. [https://doi.org/10.1645/0022-3395\(2001\)087\[0907:MIIANC\]2.0.CO;2](https://doi.org/10.1645/0022-3395(2001)087[0907:MIIANC]2.0.CO;2)
- Jones S.R. The occurrence and mechanisms of innate immunity against parasites in fish, *Dev Comp Immunol.*, 2001, vol. 25, pp. 841–852. [https://doi.org/10.1016/S0145305X\(01\)00039-8](https://doi.org/10.1016/S0145305X(01)00039-8)
- Joshi K.D., Basheer V.S., Kumar A., Srivastava S.M., Sahu V. and Lal K.K. Alien fish species in open waters of India: Appearance, establishment and impacts, *The Indian J Anim Sci.*, 2021, vol. 91, pp. 167–173.
- Kabata Z. Parasites and Diseases of Fish Cultured in the Tropics. Taylor & Francis, London-Philadelphia, 1985.
- Lerssuttichawal T., Maneepitaksanti W. and Purivirojkul W. Gill Monogeneans of Potentially Cultured Tilapias and First Record of *Cichlidogyrus mbirizei* Buring et al., 2012, in Thailand, *Walailak. J. Sci. & Tech.*, 2015, vol. 13, no. 7, pp. 543–553.
- Lockwood J.L., Hoopes M.F. and Marchetti M.P. Invasion ecology. Blackwell, Oxford., 2007.
- Maneepitaksanti W. and Nagasawa K. Monogeneans of *Cichlidogyrus* Paperna, 1960 (Dactylogyridae), gill parasites of tilapias, from Okinawa Prefecture, Japan, *Biogeography*, 2012, vol. 14, pp. 111–119.
- Mendlová M., Desdevives Y., Civáňová K., Pariselle A. and Šimková A. Monogeneans of West African Cichlid Fish: Evolution and Cophylogenetic Interactions, *PLoS ONE.*, 2012, vol. 7, pp. e37268. <https://doi.org/10.1371/journal.pone.0037268>
- NFDB Guidelines for responsible farming of tilapia in India, 2015 <https://nfdb.gov.in/welcome/guidelines>, Accessed December 18, 2023.
- Paperna I. and Thurston J.P. Monogenetic trematodes collected from cichlid fish in Uganda; including the description of five new species of *Cichlidogyrus*, *Rev Zool Bot Afr.*, 1969, vol. 79, pp. 15–33.
- Peeler E.J., Oidtmann B.C., Midtlyng P.J., Miossec L. and Gozlan R.E. Non-native aquatic animals introductions have driven disease emergence in Europe, *Biol Invasions.*, 2011, vol. 13, pp. 1291–1303.
- Peterson M.S., Slack W.T. and Woodley C.M. The occurrence of non-indigenous Nile tilapia, *Oreochromis niloticus* (Linnaeus) in coastal Mississippi, USA: ties to aquaculture and thermal effluent, *Wetlands.*, 2005, vol. 25, pp. 112–121. [https://doi.org/10.1672/0277-5212\(2005\)025\[0112:TOONNT\]2.0.CO;2](https://doi.org/10.1672/0277-5212(2005)025[0112:TOONNT]2.0.CO;2)
- Prieto A., Fajer E. and Vinjoy M. *Cichlidogyrus sclerosus* (Monogenea: Ancyrocephalidae) in *Tilapia hornorum* × *Tilapia mossambica* (perca dorada) under intensive cultivation, *Rev. Salud Anim.*, 1985, vol. 7, pp. 291–295.
- Poulin R., Paterson R.A., Townsend C.R., Tompkins D.M. and Kelly W. Biological invasions and the dynamics of endemic diseases in freshwater ecosystems, *Freshwater Biol.*, 2011, vol. 56, pp. 676–688. <http://dx.doi.org/10.1111/j.1365-2427.2010.02425.x>
- Preema P.G., Dharmaratnam A. and Swaminathan T.R. Antimicrobial resistance analysis of pathogenic bacteria isolated from freshwater Nile tilapia (*Oreochromis niloticus*) cultured in Kerala, India, *Curr. Microbiol.*, 2020, vol. 77, pp. 3278–3287. <https://doi.org/10.1007/s00284-020-02158-1>
- Pugachev O.N., Gerasev P.I., Gussev A.V., Ergens R. and Khotenowsky I. Guide to Monogenoidea of freshwater fish of Palaearctic and Amur Regions. Ledizione-Ledi, Milan, 2009.
- Raj N.S., Swaminathan T.R., Dharmaratnam A., Raja S.A., Ramraj D. and Lal K.K. *Aeromonas veronii* caused bilateral exophthalmia and mass mortality in cultured Nile tilapia, *Oreochromis niloticus* (L.) in India, *Aquac.*, 2019, vol. 512, pp. 734278. <https://doi.org/10.1016/j.aquaculture.2019.734278>
- Rao M., Kumar S.H., Kumar S., Bedekar M.K., Tripathi G. and Valappil R.K. Microbiological investigation of Tilapia lake virus–associated mortalities in cage-farmed *Oreochromis niloticus* in India, *Aquac Int.*, 2021, vol. 29, pp. 511–526. <https://doi.org/10.1007/s10499-020-00635-9>
- Rio-Zaragoza O.B.D., Fajer-Avila E.J. and Almazan-Rueda P. Haematological and gill responses to an experimental infection of dactylogyrid monogeneans on the spotted rose snapper *Lutjanus guttatus* (Steindachner, 1869), *Aquac Res.*, 2010, vol. 41, pp. 1592–1601. <https://doi.org/10.1111/j.1365-2109.2009.02471.x>
- Roberts R.J. and Sommerville C. Diseases of tilapias. In: Pullin, R.S.V. & McConnell, R.H. (Eds) The biology and culture of tilapias. International Center for Living Aquatic Resources Management, Manila, Philippines: ICLARM Conference Proceedings., 1982, vol. 7, pp. 247–263.
- Schmid-Hempel P. Evolutionary parasitology: the integrated study of infections, immunology, ecology, and genetics. Oxford University Press, Oxford., 2011.
- Singh A.K. and Lakra W.S. Risk and benefit assessment of alien fish species of the aquaculture and aquarium trade into India, *Rev. Aquac.*, 2011, vol. 3, pp. 3–18. <https://doi.org/10.1111/j.1753-5131.2010.01039.x>
- Šimková A., Plaisance L., Matějusová I., Morand S. and Verneau O. Phylogenetic relationships of the Dactylogyridae Bychowsky, 1933 (Monogenea: Dactylogyridae): the need for the systematic revision of the Ancyrocephalinae Bychowsky, 1937, *Syst Parasitol.*, 2003, vol. 54, pp. 1–11. <https://doi.org/10.1023/A:1022133608662>

- Šimková A., Matějusová I. and Cunningham C.O. A molecular phylogeny of the Dactylogyridae sensu Kritsky & Boeger (1989) (Monogenea) based on the D1-D3 domains of large subunit rDNA, *Parasitol.*, 2006, vol. 133, pp. 43–53. <https://doi.org/10.1017/S0031182006009942>
- Shinn A.P., Avenant-Oldewage A., Bondad-Reantaso M.G., Cruz-Laufer A.J., García-Vásquez A., Hernández-Orts J.S., Kutch R., Longshaw M., Metselaar M., Pariselle A., de Leon G.P.P., Pradhan P.K., Rubio-Godoy M., Sood N., Vanhove M.P.M. and Deveney M.R. A global review of problematic and pathogenic parasites of farmed tilapia, *Rev Aquac.*, 2023, vol. 15, pp. 92–153. <https://doi.org/10.1111/raq.12742>
- Sinnappah N.D., Lim L.H.S., Rohde K., Tinsley R., Combes C. and Verneau, O. A paedomorphic parasite associated with a neotenic amphibian host: phylogenetic evidence suggests a revised systematic position for Sphyranuridae within anuran and turtle polystomatoineans, *Mol Phylogenet Evol.*, 2001, vol. 18, pp. 189–201. <https://doi.org/10.1006/mpev.2000.0877>
- Sumithra T.G., Reshma K.J., Anusree V.N., Sayooj P., Sharma S.R.K., Suja G., Amala P.V., Joseph S. and Sanil N.K. Pathological investigations of *Vibrio vulnificus* infection in Genetically Improved Farmed Tilapia (*Oreochromis niloticus* L.) cultured at a floating cage farm of India, *Aquac.*, 2019, vol. 511, pp. 734217. <https://doi.org/10.1016/j.aquaculture.2019.734217>
- Tamura K., Stecher G. and Kumar S. MEGA 11: Molecular Evolutionary Genetics Analysis Version 11, *Mol Biol Evol.*, 2021, vol. 38, pp. 3022–3027. <https://doi.org/10.1093/molbev/msab120>
- Thompson J.D., Gibson T.J. and Higgins D.G. Multiple sequence alignment using ClustalW and ClustalX, *Curr Protoc Bioinform.*, 2003, vol. 1, pp. 2–3. <https://doi.org/10.1002/0471250953.bi0203s00>
- Thoney D.A. and Hargis Jr. W.J. Monogenea (Platyhelminthes) as hazards for fish in confinement, *Annu Rev Fish Dis.*, 1991, vol. 1, pp. 133–153. [https://doi.org/10.1016/0959-8030\(91\)90027-H](https://doi.org/10.1016/0959-8030(91)90027-H)
- Torchin M.E., Lafferty K.D., Dobson A.P., McKenzie V.J. and Kuris A.M. Introduced species and their missing parasites, *Nature.*, 2003, vol. 421, pp. 628–630. <https://doi.org/10.1038/nature01346>
- Trewavas E. Tilapiine species of the genera *Sarotherodon*, *Oreochromis* and *Danakilia*. British Museum (Natural History), London, 1983.
- Tripathi, A., Agrawal, N., and Srivastava, N., Monogenoidea on Exotic Indian Freshwater Fishes. 1. A New Geographical Record of *Sciadicleithrum iphthimum* Kritsky, Thatcher, and Boeger, 1989 (Dactylogyridae) with the first Description of its egg, *Comp. Parasitol.*, 2010, vol. 77, no. 1, pp. 83–86. <https://doi.org/10.1654/4382.1>
- Tripathi, A., Rajvanshi, S., and Agrawal, N., Monogenoidea on exotic Indian freshwater fishes. 2. Range expansion of *Thaparocleidus caecus* and *T. siamensis* (Dactylogyridae) by introduction of striped catfish *Pangasianodon hypophthalmus* (Pangasiidae), *Helminthologia.*, 2014, vol. 51, pp. 23–30. <https://doi.org/10.2478/s11687-014-0204-0>
- Tripathi, A., Monogenoidea on exotic Indian freshwater fish. 3. Are Indian guidelines for importation of exotic aquarium fish useful and can they be implemented; The case of Neotropical *Gussevia spiralicirra* Kohn and Pernera, 1964, *Curr. Sci.*, 2015, vol. 108, pp. 2101–2105. <https://www.jstor.org/stable/24905581>
- Tripathi A., Matey C. and Agarwal, N. Monogenoidea on exotic Indian freshwater fish. 4. *Dactylogyrus minutus* from Platinum Ogon, an ornamental variety of the common carp *Cyprinus carpio* (Cypriniformes, Cyprinidae), *BioInvasions Rec.*, 2022, vol. 11, pp. 510–523. <https://doi.org/10.3391/bir.2022.11.2.23>
- Tripathi A. and Matey C. Monogenea on exotic Indian freshwater fish. 5. First report of pathogenic *Gussevia asota* (Platyhelminths) from Oscar *Astronotus ocellatus* (Agassiz 1831) (Perciformes: Cichlidae), *Zootaxa.*, 2023, vol. 5231, no. 1, pp. 052–064. <https://doi.org/10.11646/zootaxa.5231.1.4>
- Wilson J.R., Saunders R.J. and Hutson K.S. Parasites of the invasive tilapia *Oreochromis mossambicus*: evidence for co-introduction, *Aquatic Invasions.*, 2019, vol. 14, no. 2, pp. 332–349. <https://doi.org/10.3391/ai.2019.14.2.11>