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Taxonomic status of *Puntius* species found in India: A historical review

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Abstract
The taxonomic identification is a regular process to resolve ambiguities based on morphological features. The first worker on Indian fishes was Bloch whose splendid work on "Auslandische Fische" published in 1785. However, fish studies with a more scientific, more accurate and fulfilling the needs of modern taxonomy on the Indian freshwater fish fauna started only from 19th century. Beginning with Hamilton-Buchanan's (1822) account of the fishes of the Ganges, followed by Bennett (1830), J. McClelland (1839), Col. W. Sykes (1839), Cantor (1839), McClelland (1839), Wyllie (1840), Cuvier and Valenciennes (1849), Pieter Bleeker (1853), Blyth (1858),T. C. Jerdon (1849), the vast array of fish found in this area came to light. All these pioneer researchers laid a solid foundation for Indian systematic Ichthyology. Many new species has been discovered by many research scholar like Vishwanath and Laisram (2004), Jameela Beevi and Ramchandran (2005), Mercy and Jacob (2007), Devi *et al*. (2010), Krishna Kumar *et al*. (2011),Knight *et al*. (2012) and Plamoottil, M. (2015) from various parts of India. Plamoottil and Johnson (2020) described 8 new species in taxonomic notes on *Puntius* species of South India. In India, more than 60 species of genus *Puntius* has been identified and described by various workers. New fish species are being identified on the basis of morphometric and meristic characters especially in North-East and South India. This historic review summarised the entire work on taxonomic status of *Puntius* species found in India.

Keywords: *Puntius*, taxonomic status, identification, morphometric, species

Introduction
India is rich in fish genetic resources with occurrence of approximately 2400 fin fishes. The fish species diversity has been decresing very fast due to various human acivities such as water pollution, toxicity, habitat loss, overexploitation, droughts etc. So it is necessary to take extensive research study to protect the fish diversity.
Cypriniformes is known as the most diverse group of freshwater fishes with estimates of diversity reaching close to 3,500 species (Nelson, 2006) [1] contained in 280 genera and five families. These fishes are found in a vast array of environments, from subterranean aquifers to streams in Himalayas; from brackish estuaries to inland lakes; and from icy mountains to thermal springs. This broad range of environments is mirrored by the extensive morphological diversity. Many of these fishes have economic, ecological and scientific importance. This group is large, widespread and external morphology is deceptive, causing difficulties with identification and classification (www.fishbase.org). Species of this order (particularly belonging to family Cyprinidae) are usually perceived as having very similar morphologies (Howes, 1991) [2], an attribute that has likely contributed to the paucity of researchers investigating their phylogenetic relationships because of suspected conserved or constrained evolution limiting the number of phylogenetically useful morphological characters. These fishes also include many commercially important species (e.g., aquarium trade, fisheries), and as model organisms in many areas of research ranging from community ecology to developmental biology (Mayden *et al*., 2008) [3].
The history of taxonomic status of *Puntius* Species is very significant due to prevalent of ambiguities in their proper taxonomic identification. This paper summarise the historic taxonomic review for better understandings.

Historical Review
Species is a biological concept which is still remains as the corner stone of scientific research to carry out species specific research/study. Morphometric and meristic study is necessary to identify the specimen correctly so as to carry out any further studies.
Morphometric measurement is helpful in easy & correct identification of fish species in laboratory as well as at natural places. In any research work or fishery operation whether it is capture or culture, depends much upon the exact identity of the fish and this reveals the importance of taxonomy (Jayaram, 2002) [4].
The first worker on Indian fishes was Bloch whose splendid work on "Auslandische Fische" published in 1785. However, fish studies with a more scientific, more accurate and fulfilling the needs of modern taxonomy on the Indian freshwater fish fauna started only from 19th century. Beginning with Hamilton-Buchanan's (1822) account of the fishes of the Ganges, followed by Bennett (1830), J. McClelland (1839), Col. W. Sykes (1839), Cantor (1839), McClelland (1839), Wyllie (1840), Cuvier and Valenciennes (1849), Pieter Bleeker (1853), Blyth (1858),T. C. Jerdon (1849), the vast array of fish found in this area came to light. All these pioneer researchers laid a solid foundation for Indian systematic Ichthyology (Jayaram, 1999).
Francis Day, though an assistant surgeon in the services of the East India Company, brought out for the first time, the monumental treatise "Fishes of India" (1875-1878) embodying his own extensive observations and the results of the earlier workers. Day included in his work (including the supplement), 1418 species found within the boundaries of the present day India, Pakistan (including Afghanistan), Bangladesh, Myanmar and Sri Lanka. Though Day's work

had its own limitations, his monograph is irreplaceable even today considering the wide coverage and compactness. It will remain an important reference manual for the ichthyology of this region and will continue to remain so far many more years to come. Albert Gunther's (1857-70) catalogue of the fishes in the British Museum includes a number of taxa of the region but without many illustrations or analysis as Day has done (Jayaram, 1999).

There is sea change in approaches to fish taxonomy from the time of Francis Day. There is also an urgency of exploring and documenting thoroughly our ichthyofauna as many water bodies still remain unexplored and are under severe threat from anthropogenic activities (Jayaram, 2002) [4]. In the 20th century, the publications of late S. L. Hora's (1920-1955) research work was indispensable. Hora in his life time published over 440 papers and established three families, 28 genera (including subgenera) and 139 species, many of which are still valid. Dev Dev Mukerji also made several noteworthy contributions to the Indian fish fauna. In a similar manner the late K. S. Mishra (1947, 1952, 1953) published a series of checklists and aids for the identification of the common commercial fishes of India and Pakistan dealing with 402 marine, brackish and freshwater fish species belonging to 205 genera under 100 selected families. A revision of the fishes of the genus *Puntius* was published by Jayaram (1991c). Talwar & Jhingran (1991) [6] published in two volumes an account of the Inland fishes of India and adjacent countries. The taxonomic and morphological study of various species of fish including genus *Puntius* occurring in the water bodies of U.P. and Bihar state were carried out by Srivastava (1968, 1980) [7].

Cyprinidae is a large family of freshwater fishes that comprise the carps, the true minnows, and their relatives (for example, the barbs and barbels). *Puntius* is a genus of ray-finned fishes in the family Cyprinidae of the order Cypriniformes. Fishes of this genus are known as the spotted barbs for the predominant pattern, though many have vertical black bands instead. The name *Puntius* comes from *pungti*, a Bengali term for small cyprinids. The type species is the Pool Barb (*Puntius sophore*), first described as *Cyprinus sophore* by Hamilton in 1822.

Fishes of the genus *Puntius* are found in Southeast Asia and India, including Sri Lanka. The maximum size for an adult of this genus is less than 25 cm (10 inches), typically 15 cm (6 in), and many species only achieve around 5 cm (2 in) adult length. They appear similar to miniature carp and are brightly coloured or patterned. Being omnivorous, their diet depends on small invertebrates and plant matter. Their breeding takes place by egg scattering and close to the bottom and within areas of dense plant growth.

In India, more than 60 species of genus *Puntius* has been identified and described by various workers. New fish species are being identified on the basis of morphometric and meristic characters especially in North-East and South India.

Vishwanath and Laisram (2004) [9] described the diagnostic characters of ten species and detailed description of two new species of the genus *Puntius* from Manipur and recorded *P. javanicus* and *P. stoliczkanus* for the first time from the state. Kullander and Fang (2005) [10] described two new species *viz*., *Puntius didi* and *P. tiantian* from Putao in northernmost Myanmar. Jameela Beevi and Ramchandran (2005) discovered a new *Puntius* Species Puntius muvattupuzhaensis is described from the River Muvattupuzha, Ernakulam district, Kerala, southern India. Linthoingambi and Vishwanath (2007) [12] described *Puntius ater* and *P. khugae*, two new species of fishes, each having a black longitudinal stripe on the side, from the Chindwin basin in Manipur, India. Kullander (2008) again characterised five new small species of *Puntius*: *Puntius erythromycter*, *P. nankyweensis*, *P. thelys*, *P. macrogramma*, and *P. pugio* on the basis of morphometric and meristic characters from northern Myanmar.

Mercy and Jacob (2007) found and described a new species *Puntius pookodensis* from Wayanad, Kerala, India and Devi *et al*. (2010) described *Puntius rohani*, a new species of barb in the *Puntius filamentosus* group from the southern Western Ghats of India. On the basis of morphometric and meristic characters a new species of barb *Puntius madhusoodani* described by Krishna Kumar *et al*. (2011) [16] from Manimala River, Kerala, South India and *Puntius nigripinnis* described by Knight *et al*. (2012) [17] from southern Western Ghats, India.

Plamoottil, M. (2015) [18] described *Puntius dolichopterus*, a new fish species (cypriniformes: cyprinidae), from Kerala, India. Plamoottil, M. and Johnson, R. (2020) [19] described 8 new species in taxonomic notes on *Puntius* species of South India which included *Puntius viridis* (2013), *Puntius nelsoni* (2014), *Puntius nigronotus* (2014), *Puntius dolichopterus* (2015), *Puntius euspilurus* (2016), *Puntius stigma* (2018), *Puntius kyphus* (2019) and *Puntius sanctus* (2020).

The above review of literature indicated that the study of morphometric and meristic character is very useful to remove any ambiguity and identification of the new species. Proper identification is also necessary for further cytogenetic and molecular studies.

Conclusion

There are many unexplored water bodies and aqua habitats which may harbour species of fishes yet to be discovered and documented; many insufficiently known species to be collected and redescribed, decisions to be taken on protection of habitats based on fish genetic resources which need conservation, all to be done before unmindful destruction of ecosystem (Jayaram, 2002) [4]. The taxonomic status of certain fishes still needs clarity. This is ongoing process which needs more research and proper identification with inclusion of cytogenetic and molecular data. The history of taxonomic identification shows regular research should be carried out on these fishes to be characterised on morphometric and meristic features in more water bodies. So that taxonomic ambiguities must be resolved with proper findings.

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