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## RESEARCH ARTICLE

# VARIABILITY IN ICHTHYOFAUNAL DIVERSITY INDICES AND SPECIES DISTRIBUTION WITHIN THE DIFFERENT STRETCHES OF DOYANG RESERVOIR, NAGALAND, INDIA

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**ABSTRACT**

The scientific assessment is included with freshwater ichthyofaunal diversity, distribution and evaluation of diversity indices analysis which are found in Doyang reservoir's different distinct stretches, Nagaland in between the year 2015 to 2018. Total 64 numbers of freshwater fishes in which 6 order and 16 families were found where most dominated order is Cypriniformes and family is Cyprinidae. Depending on fish distribution in distinct three stretches of the reservoir diversity indices like Shannon diversity index (H), Margalef's richness index, Simpson's Diversity Index (1-D), Chao-1, Dominance Indices, Species evenness has been analyzed which shows a significant result regarding that facts. These works also found out that due to the introduction and culture practices of IMC and other introduced carp species, the main reservoir fish diversity has been reduced. Introduced fish species are destroying endemic fish species habitat. Due to the less stress towards the upper stretch of reservoir (towards the Doyang River) endemic species are much more available rather than other stretches of the reservoir. The specified fishes need immediate proper scientific management and conservation strategies for future availability of these freshwater fish species.

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## INTRODUCTION

The biodiversity of aquatic water bodies has changed and is depleting very rapidly due to the anthropogenic activity, pollution, habitat loss, introduction of exotic species and other biological and non-biological factors (Moyle and Moyle 1995). Fishes are the key species in an ecosystem which determine the abundance and distribution of other aquatic organisms in the food web. It is also helpful to verify the ecosystem health and water quality (Moyle and Leidy 1992). In India, the freshwater resources are ponds, freshwater lakes, reservoirs, rivers, tanks, etc. The data discovered that about 19,370 numbers of reservoirs (with surface area of 3.15 million ha) are available across the India (Ayyappan, Jena *et al*. 2006). Besides, reservoirs play the crucial role in inland fish production, providing as vital sources of nutrients and also an important field for employment generation and livelihood formation (Bhattacharya, Chini *et al*. 2018).

In north-east region, Nagaland is one of the most well known states which have wide variety of topographical conditions, comprising of huge numbers of perennial and seasonal rivers, diverse weather conditions and inland water bodies which leads to considerable variety of native fresh water fish diversity (Ao, Dey *et al*. 2008, Odyuo and Nagesh 2012). In north-east region of India, the Doyang Reservoir (Latitude 26°13'10" N and Longitude 94°17'90" E) is one of the largest freshwater reservoir which is situated in Wokha District, Nagaland. The catchment area of reservoir is 2,258 ha which is enriched with Chumeya, Chubi, Djupvu, Tzuza and Doyang rivers. Due to the water resources, vast area and its small extensions, the ichthyofaunal diversity of this reservoir has become massive (Haldar, Vass *et al*. 2006). The main focus in this work was to find out the variability of ichthyofaunal diversity, their distribution, diversity indices analysis in three distinct stretches of Doyang reservoir.

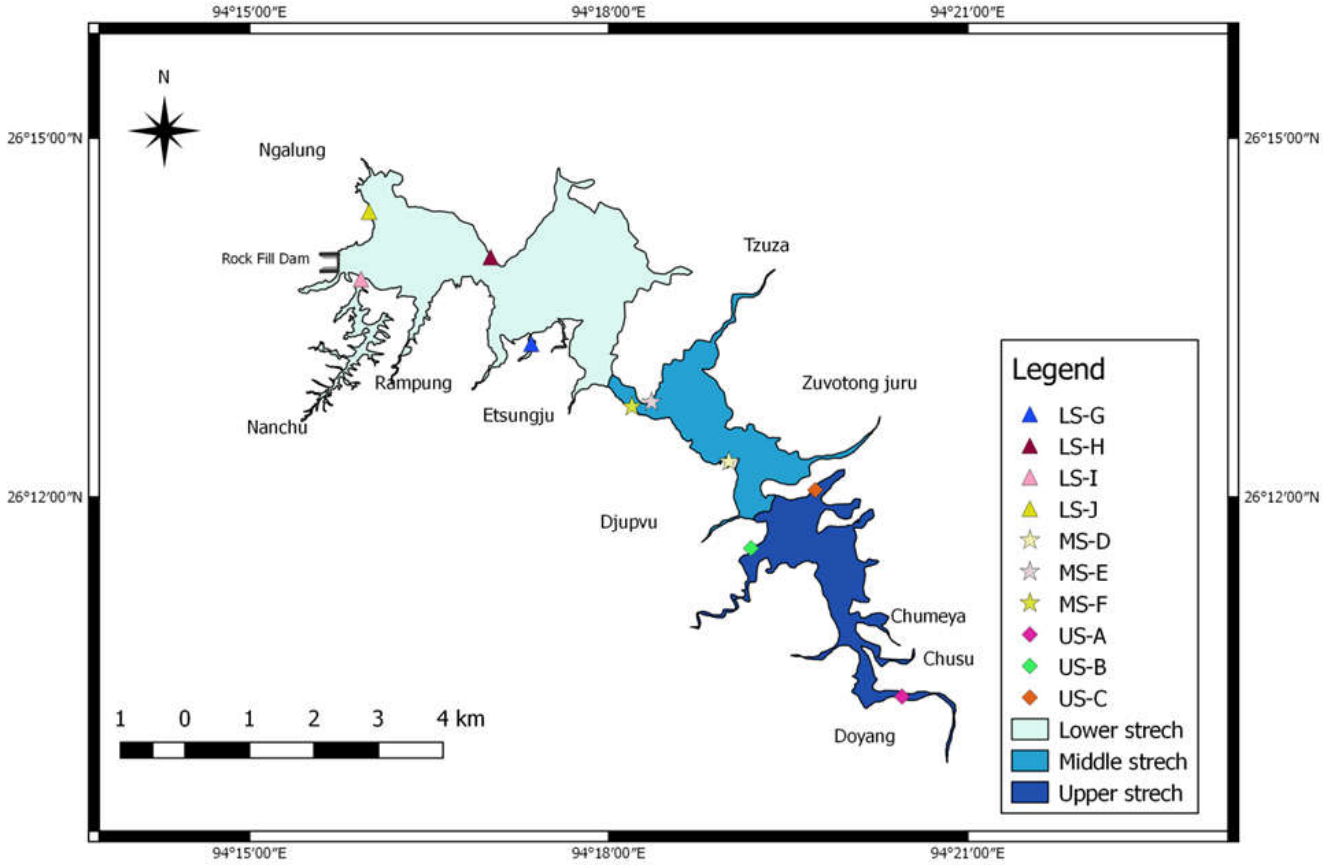


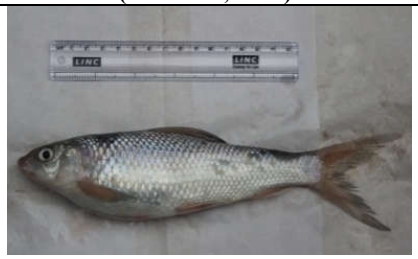

**Fig. 1. Map showing different sampling sites and three stretches at Doyang Reservoir, Nagaland, India**

***1. Anguilla bengalensis*** **(Gray, 1831)**

**2.** ***Xenentodon cancila*** **(Hamilton, 1822)**

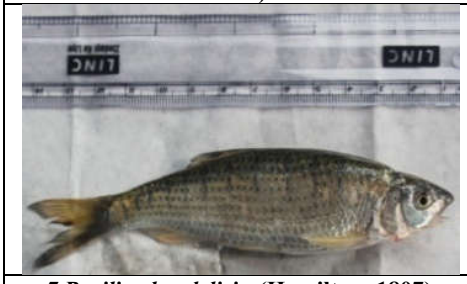
**3.** ***Botia dario*** **(Hamilton, 1822)**

**4.** ***Lepidocephalichthys berdmorei*** **(Blyth, 1860)**



***5. Bangana dero*** **(Hamilton, 1822)**

**6.** ***Barilius barila*** **(Hamilton, 1822)**



***7.Barilius bendelisis*** **(Hamilton, 1807)**

**8.** ***Barilius vagra*** **(Hamilton, 1822)**

***9. Chagunius chagunio*** **(Hamilton, 1822)**

Continue ……

*10. Chagunius nicholsi* **(Myers, 1924)**

*11.Cirrhinus mrigala* **(Hamilton, 1822)**

*12.Crossocheilus burmanicus* **(Hora, 1936)**

*13.Crossocheilus latius* **(Hamilton, 1822)**

**14.** *Ctenopharyngodon idella* **(Valenciennes, 1844)**

**15.** *Cyprinion semiplotum* **(McClelland, 1839)**

**16.** *Cyprinus carpio* **(Linnaeus, 1758) ver.** *communis*

**17.** *Danio dangila* **(Hamilton, 1822)**

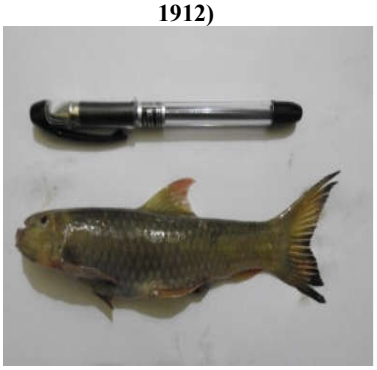
**18.** *Devario aequipinnatus* **(McClelland, 1839)**

**19.** *Devario devario* **(Hamilton, 1822)**

**20.** *Devario naganensis* **(Chaudhuri, 1912)**

**21.** *Esomus danrica* **(Hamilton, 1822)**

**22.***Garra annandalei* **(Hora, 1921)**



**23.** *Garra gotyla* **(Gray, 1830)**

**24.***Garra lissorhynchus* **(McClelland, 1842)**

Continue….

25. *Garra mcclellandi* (Jerdon, 1849)

26. *Garra naganensis* (Hora, 1921)

27.*Gibelion catla* (Hamilton, 1822)

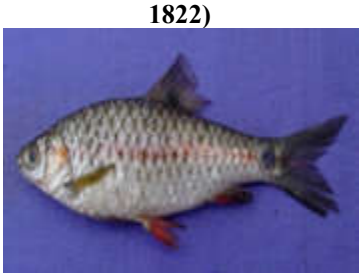
28. *Hypophthalmichthys molitrix* (Valenciennes, 1844)

29. *Labeo bata* (Hamilton, 1822)

30. *Opsarius barna* (Hamilton, 1822)

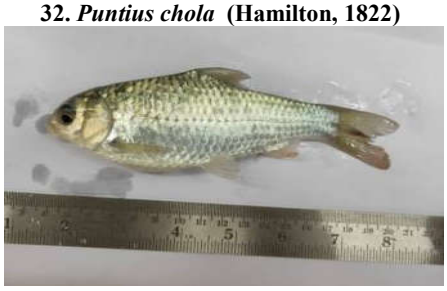
31. *Pethia ticto* (Hamilton, 1822)

32. *Puntius chola* (Hamilton, 1822)



33.*Puntius sophore* (Hamilton, 1822)

34. *Schizothorax richardsonii* (Gray, 1832)

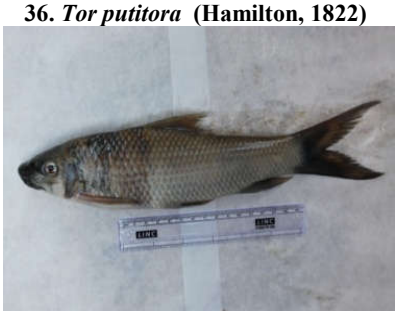


35. *Systomus sarana* (Hamilton, 1822)

36. *Tor putitora* (Hamilton, 1822)

37. *Tor tor* (Hamilton, 1822)

38.*Labeo calbasu* (Hamilton, 1822)



39. *Labeo dyocheilus* (McClelland, 1839)

40. *Labeo gonius* (Hamilton, 1822)

41. *Labeo pangusia* (Hamilton, 1822)

42. *Labeo rohita* (Hamilton, 1822)

**43. *Neolissochilus hexagonolepis* (McClelland, 1839)**

**44.*Schistura manipurensis* (Chaudhuri, 1912)**

**45. *Schistura multifasciata* (Day, 1878)**

**46.*Schistura reticulofasciata* (Singh & Banarescu, 1982)**

**47. *Psilorhynchus homaloptera* (Hora & Mukerji, 1935)**

**48. *Anabas testudineus* (Bloch, 1792)**

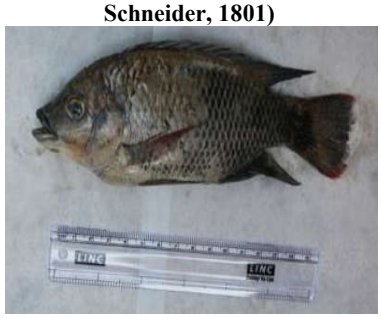
**49. *Badis badis* (Hamilton, 1822)**

**50. *Channa punctata* (Bloch, 1793)**

**51. *Channa orientalis* (Bloch & Schneider, 1801)**

**52. *Channa stewartii* (Playfair, 1867)**

**53. *Channa striata* (Bloch, 1793)**



**54. *Oreochromis mossambicus* (Peters, 1852)**

55. *Clarias batrachus* (Linnaeus, 1758)

56. *Heteropneustes fossilis* (Bloch, 1794)

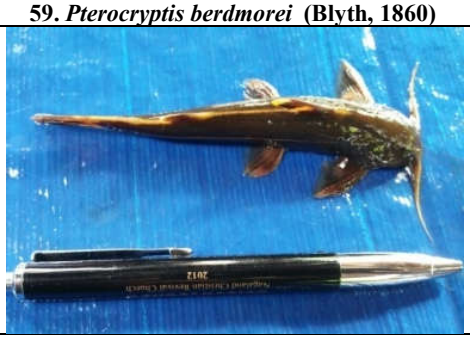
57. *Ompok bimaculatus* (Bloch, 1794)

58. *Ompok pabo* (Hamilton, 1822)

59. *Pterocryptis berdmorei* (Blyth, 1860)

60. *Pterocryptis gangelica* (Peters, 1861)

61. *Glyptothorax telchitta* (Hamilton, 1822)



62. *Glyptothorax trilineatus* (Blyth, 1860)

63. *Macrognathus pancalus* (Hamilton, 1822)

64. *Mastacembelus armatus* (Lacepède, 1800)

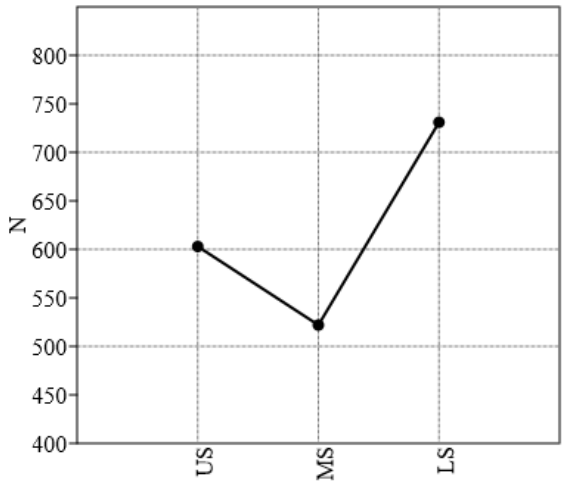



Fig. 2. a

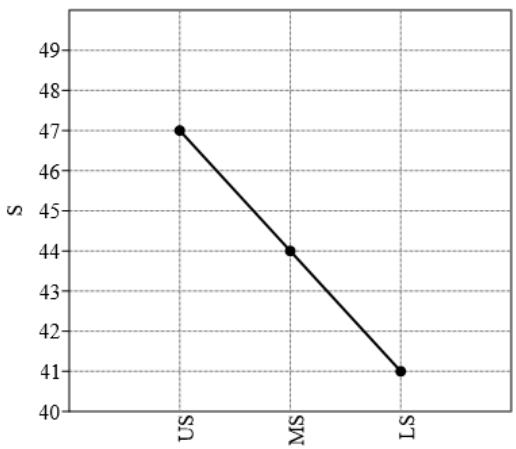



Fig. 2.b

**Fig. 2. a. Number of fish species (N) sampling in different sites of Doyang reservoir. (b.) Diversity indices of fish species availability in different study sites of the Doyang reservoir. (US-Upper Stretch, MS- Middle Stretch, LS- Lower Stretch)**

## MATERIALS AND METHODS

The Doyang reservoir (Fig. 1) was principally focused to find out the freshwater fish diversity and distribution in different random sampling sites from 2015 to 2018 (about 3 years of study). The fish samples were collected by gillnets, cast nets and also from the local fish market and local fishermen with the help of mechanized and non-mechanized boat. After the collection of fish sample, fishes were identified up to species level with the help of standard protocol and online servers (Talwar 1991, Jayaram 1999, Froese and Pauly 2000, Nelson, Grande *et al*. 2016). Depending on fish distribution in distinct three stretches of the reservoir, diversity indices like Shannon diversity index (H), Margalef's richness index, Simpson's Diversity Index (1-D), Chao-1, Dominance Indices, Species evenness has been analyzed.

## RESULTS AND DISCUSSION

The reservoir was categorized into three distinct areas for the proper assessment.

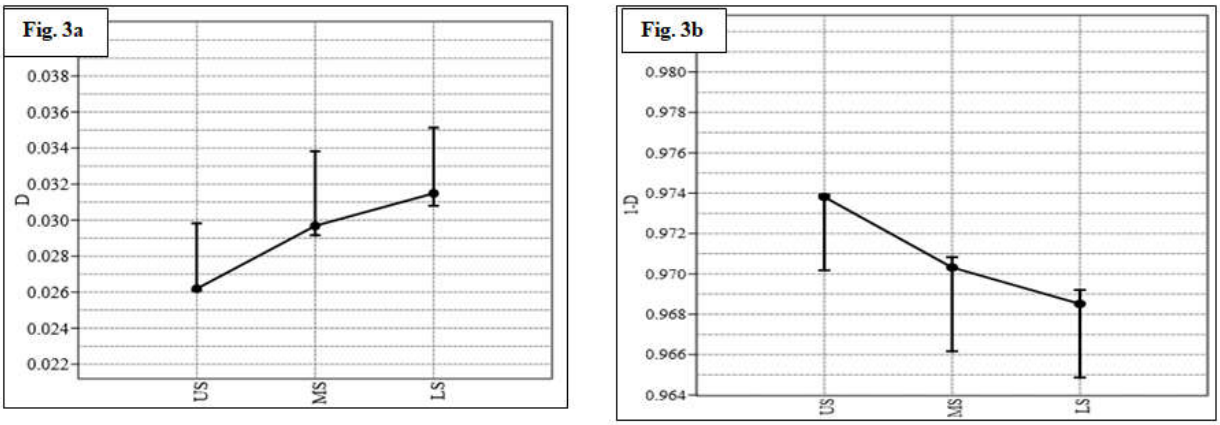



**Fig. 3. (a.) Species dominance index (D) of fish species at three different study sites at Doyang reservoir. (b.) Simpson Dominance index (1-D) of fish species at different sites of Doyang reservoir**

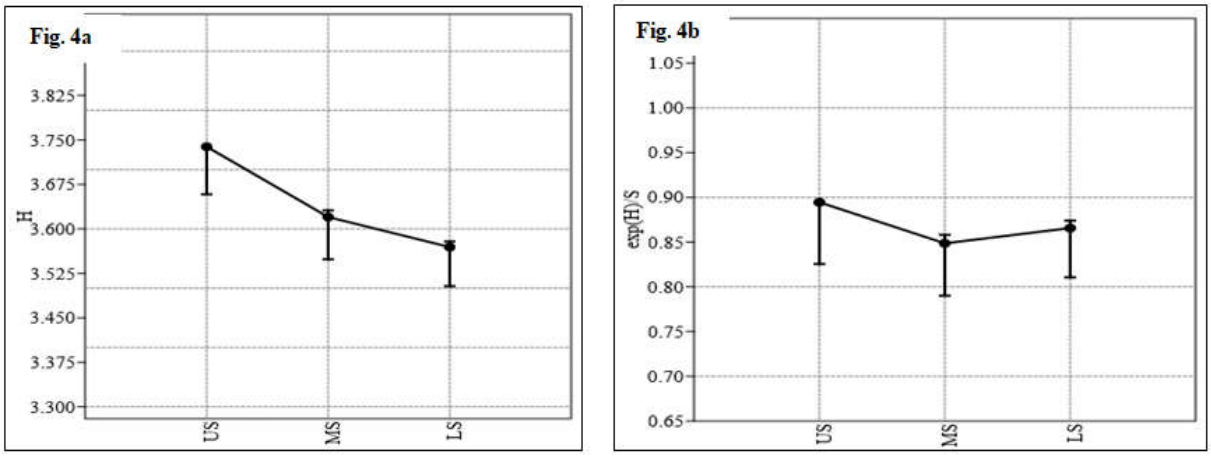



**Fig. 4. (a.) Shannon Diversity indices (H) of fish fishes in respective study sites at Doyang reservoir. (b.) Evenness index (expH/s) of fish species at three different study sites at Doyang reservoir**

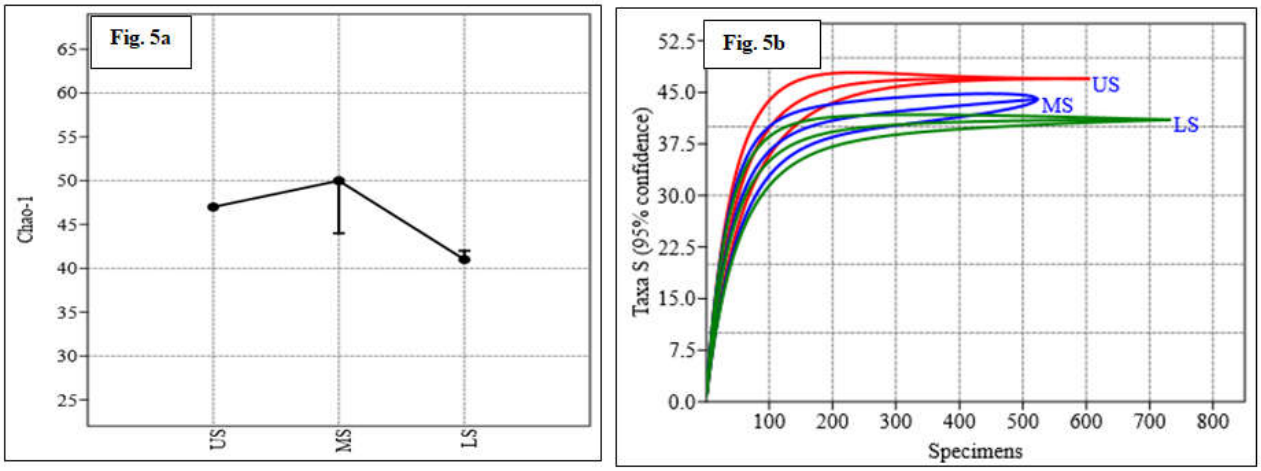



**Fig. 5. (a.) Chao-1 diversity indexing depending on three study areas of Doyang reservoir (b.) Individual rarefaction index between total numbers of individual (total specimen) with available fish species (Taxa.) in different study sites**

Towards the Doyang river site denoted as 'upper stretch', the main Doyang reservoir denoted as 'lower stretch' and the rest of the middle part of the reservoir mentioned as 'middle stretch'. This work points out that a total 64 numbers of freshwater fish species are found in this reservoir and its extensions where the most distinct fish order is Cypriniformes and fish family is Cyprinidae.

Depending on availability of the freshwater species in three different stretches, the species diversity indices has been calculated. About 1900 number of fish sample has been assessed from the distinct areas stretch (Fig. 2a). The result shows that the total number of species is higher in upper stretch and lower in lower stretch due to presence of wild/endemic species towards the Doyang River and higher

abundance of Cypriniformes in main reservoir is due to the introduction of exotic carp species (Fig. 2b). The species dominance index ranges from 0.026 to 0.035 (higher value in LS and lower value in US) where as the Simpson dominance index (1-D) of fish species shows the range from 0.965 to 0.974 (higher value in US and lower value in LS) with significant impact (Fig. 3a and 3b). The Shannon diversity index (H) value is measured between 3.75 to 3.525 whereas, evenness index confirmed the range from 0.90 to 0.79 (Fig. 4a and 4b). The chao-1 and individual rarefaction index of available fish taxa has been also assessed (Fig. 5a and 5b).

**Conclusion**

The Doyang Reservoir comprises of huge variety of endemic species diversity of freshwater icthyo-fauna and is not only helpful for fish production but also important for diverse aquatic organism to stabilize the local reservoir ecosystem. These works also found out that due to the introduction and culture practices of IMC and other introduced carp species, the main reservoir fish diversity has been reduced. Introduced exotic fish species are gradually destroying endemic fish species habitat. Due to the less stress towards the upper stretch of reservoir (towards the Doyang River), endemic species are much more available rather than other stretches of the reservoir. So, there is an urgent need of proper scientific management plans for future availability of endemic fish population.

**Acknowledgement**

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