iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

THE SHIVNATH RIVER: A CRITICAL ANALYSIS OF ENVIRONMENTAL STRESSORS AND CONSERVATION NEEDS

Gagan Singh Guru[1*], Chiranjeev Pandey[1], Gurprit Singh Bhatia[1]
Department of Zoology[1],
Government Digvijay Autonomous Postgraduate
College, Rajnandgaon, Chhattisgarh (India), 491441
gaganguru89660@gmail.com
ORCID- 0009-0008-5667-6268

ABSTRACT
The Shivnath River, flowing through the Rajnandgaon district in Central India, is a vital watercourse that sustains a diverse range of aquatic life and supports local communities dependent on its resources. The river's Icthyological health essentially the study of its fish species and their ecosystems is crucial for maintaining the ecological balance and biodiversity of the region. However, the Shivnath River is currently facing several pressing challenges that threaten its aquatic life and the overall riverine environment. Industrialization, urbanization, and agricultural activities have intensified in the region, leading to various forms of environmental stress. Pollution from industrial effluents and agricultural runoff has compromised water quality, while habitat degradation due to deforestation and infrastructure development has disrupted natural fish habitats. Additionally, overfishing practices, the introduction of invasive species, and the impacts of climate change further exacerbate the pressures on the river's ichthyofauna. Despite its ecological significance, the Shivnath River has been subject to limited scientific research, leaving critical gaps in our understanding of its fish populations and their needs. The lack of comprehensive baseline data and effective monitoring systems hampers conservation efforts and the development of sustainable management strategies.

Keywords
Conservation, Degradation, Environmental, Icthyological, Pollution, Shivnath River, Industrialization, Stressors.

INTRODUCTION
The Shivnath River, a significant tributary of the Mahanadi River, traverses the Rajnandgaon district in Central India. This river is a crucial component of the regional hydrological system, supporting a rich tapestry of aquatic and terrestrial ecosystems (**Aksu, I. and Bektaş, Y.,** ***2019***) [1]. Its waters sustain not only a diverse array of fish species but also provide vital resources for the local human population. Historically, the Shivnath River has been central to the livelihoods of communities through fishing, agriculture, and as a source of freshwater. Ichthyology, the branch of zoology concerned with the study of fish, plays a pivotal role in understanding aquatic ecosystems and managing freshwater resources (**Bănărescu, P. and Nalbant, T.T.,** ***1973***) [2]. In the context of the Shivnath River, ichthyology encompasses the study of native fish species, their ecological roles, breeding patterns, and interactions with their environment (**Bănărescu, P.M., Šorić, V.M., and Economidis, P.S.,** ***1999***) [3]. Fish populations are often indicators of overall river health, reflecting changes in water quality, habitat conditions, and ecological balance (**Bekkozhaeva, D.K. and Mamilov, N.Sh.,** ***2015***) [4]. The river's health is increasingly compromised by a range of anthropogenic pressures that threaten its biodiversity, these pressures include pollution, habitat destruction, overfishing, invasive species, and the impacts of climate change (**Berg, L.S.,** ***1949***) [5]. Understanding these problems requires a comprehensive analysis of their causes, effects, and interactions, pollution is one of the most significant threats to riverine ecosystems (**Bogdanov, B.E. and Petukhov, S.Yu.,** ***2017***) [6]. In the Shivnath River, industrial discharges, agricultural runoff, and domestic waste contribute to deteriorating water quality. Industrial activities have led to the introduction of heavy metals, chemicals, and other pollutants into the river (**Bogutskaya, N.G. and Naseka, A.M.,** ***2004***) [7]. Agricultural practices contribute excess nutrients and pesticides, leading to eutrophication and algal blooms that deplete oxygen levels and disrupt aquatic life (**Bogutskaya, N.G., Naseka, A.M., Shedko, S.V., et al.,** ***2008***) [8]. Domestic waste introduces pathogens and organic matter, further degrading water quality, the degradation of natural habitats along the riverbanks and within the riverbed significantly impacts fish populations (**Chibilev,**

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

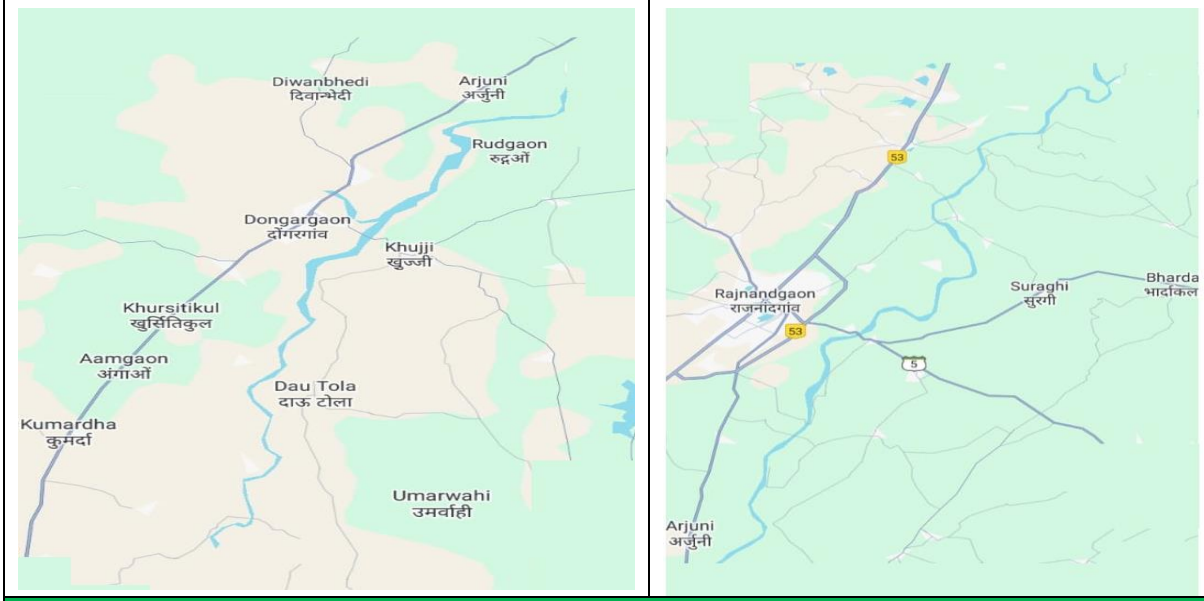
A.A., Reka Ural. ***1987)*** [9]. Deforestation and land conversion for agricultural and industrial purposes have led to increased sedimentation and erosion, construction projects such as dams and weirs alter natural flow regimes, disrupt sediment transport, and obstruct fish migration routes (**Doadrio, I. and Madeira, M.J.,** ***2004***) [10]. These changes compromise the availability and quality of critical habitats such as spawning grounds and feeding areas, overfishing poses a severe threat to the sustainability of fish populations in the Shivnath River (**Dyldin, Yu.V., Hanel, L., Fricke, R., et al.,** ***2020***) [11]. Unsustainable fishing practices, including the use of non-selective gear and illegal fishing methods, lead to the depletion of fish stocks and the disruption of ecological balance (**Fricke, R., Eschmeyer, W.N., van der Laan, R., Eds.,** ***2020***) [12]. Bycatch, or the capture of non-target species, further exacerbates the problem, impacting the overall biodiversity of the river, the introduction and spread of invasive species present a growing concern for the Shivnath River's aquatic ecosystems (**Fish Base*2019*,**) [13]. Non-native fish species, either introduced intentionally or accidentally, can outcompete native species for resources, alter habitat structures, and introduce new diseases. Invasive aquatic plants can also disrupt the river's ecological balance by altering nutrient cycles and habitat conditions (**Kabacoff, R.I.,** ***2015***) [14]. Climate change is having a profound impact on river ecosystems globally, and the Shivnath River is no exception (**Kalashnikov, Yu.E.,** ***1978***) [15]. Altered precipitation patterns, increased temperatures, and changing seasonal flows affect the river's hydrology and water quality, these changes influence fish physiology, breeding cycles, and distribution patterns (**Karasev, G.L.,** ***1987***) [16]. The increased frequency of extreme weather events can also exacerbate other stressors on the river, despite the importance of ichthyology in managing river ecosystems, there is a notable lack of comprehensive research and data for the Shivnath River (**Kostarev, G.F.,** ***1973***) [17]. Baseline studies on fish diversity, population dynamics, and habitat requirements are limited. This scarcity of information hampers effective management and conservation efforts. Monitoring systems are often inadequate to address emerging issues and respond to changes in fish populations and river conditions (**Kostarev, G.F.,*2003***) [18]. The challenges faced by the Shivnath River have significant socio-economic implications for local communities, fishing is a major livelihood for many residents, and the decline in fish populations can directly impact their income and food security (**Kottelat, M.,** ***1997***) [19]. Additionally, the degradation of water quality and river habitats affects agricultural productivity and overall quality of life (**Kottelat, M.,** ***2006***) [20]. There is a need for sustainable management practices that balance ecological health with socio-economic needs, addressing the problems of river ichthyology in the Shivnath River requires an integrated approach that encompasses scientific research, community involvement, and policy development (**Kottelat, M. and Freyhof, J.,** ***2007***) [21]. Collaborative efforts between researchers, local communities, and policymakers are essential to develop and implement effective conservation strategies. Education and awareness programs can also play a crucial role in fostering a culture of environmental stewardship and sustainable resource use (**Kottelat, M. and Persat, H.,** ***2005***) [22].

Study Area

The Shivnath River, a significant tributary of the Mahanadi River, flows through the Rajnandgaon district located in Central India's Chhattisgarh state. Originating from the south eastern slopes of the Maikal Range, the Shivnath River meanders through a diverse landscape before joining the Mahanadi River [From, Table 01]. The river's basin encompasses approximately 7,500 square kilometres, with its journey characterized by varying topography, including hilly terrains, plains, and fertile river valleys (**Mayr, E., Linsley, E.G., and Usinger, R.L., 1953**) [23]. We select the studies are Rajnandgaon to Chaowki, which is 63.4 Km. The Shivnath River's flow regime is influenced by the seasonal monsoon, which brings heavy rains from June to September (**Mastitskii, S.E. and Shitikov, V.K.,** ***2015***) [24]. This seasonal variability affects the river's discharge, sediment load, and water quality. The river's hydrology is marked by significant fluctuations in flow levels, which play a critical role in shaping the river's ecosystems and influencing fish populations (**Mendel, J., Lusk, S., Vasil'eva, E.D., et al.,** ***2008***) [25].

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

***Table* 01: Study Area.**



In both maps blue line show study area, which is Shivnath River.

MATERIALS AND METHOD

Water Quality and Pollution

Observations from various sampling points along the Shivnath River indicate significant water quality issues. Elevated levels of pollutants, including heavy metals (e.g., mercury and lead) and nutrients (e.g., nitrates and phosphates), were detected. Industrial effluents and agricultural runoff are primary sources of these pollutants. The high concentration of organic matter from domestic waste has led to increased bacterial contamination. These conditions have been linked to poor fish health, including abnormalities and high mortality rates among sensitive species.

Habitat Degradation

Habitat degradation is evident along the river, particularly in riparian and floodplain areas. Deforestation and land conversion have led to increased sedimentation, resulting in silted riverbeds and loss of critical spawning and nursery habitats. Construction of dams and weirs has disrupted natural flow patterns, further exacerbating habitat loss. The degradation of riparian vegetation has reduced natural bank stabilization, contributing to erosion and impacting fish habitats.

Overfishing

Overfishing has been observed as a significant issue, particularly in areas close to populated regions and markets. Non-selective fishing practices, such as the use of gill nets and seine nets, have resulted in the capture of juvenile and non-target species, leading to reduced fish populations. The decline in key species, such as major carps, is evident from lower catch rates reported by local fishermen. Overfishing has disrupted the aquatic ecosystem balance, affecting the entire food web.

Invasive Species

The presence of invasive species has been increasingly noted, with non-native fish like Nile tilapia and aquatic plants such as water hyacinth becoming prominent. These invasive are outcompeting native species for resources and altering habitat conditions. Water hyacinth, in particular, forms dense mats that reduce oxygen levels and light penetration, negatively impacting native fish and other aquatic organisms.

Climate Change Effects

Climate change has introduced alterations in flow regimes and water temperatures. Erratic seasonal flows and increased water temperatures have affected fish distribution and reproductive patterns.

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

Table 02: Fishes Present in Study Area.

SN	Order	Family	Scientific Name	Local Name	Fin Formula	IUCN
1	Cypriniformes	Cyprinide	*Labeo rohita (F. Hamilton, 1822)*	Rohu	D. 16 (3/13); P. 17; V.9; A. 7; (2/5); C. 19; L. 1. 40- -41 ; L.tr. 6½ □ 7½ /9; Barbels 1 pair.	LC
2	Cypriniformes	Cyprinide	*Carla catla (F. Hamilton, 1822)*	Catla	D.18-19 (3/15-16); P. 19; V.9; A. 8(3/5); C. 19; L.1. 43; L.tr. 7(1/2) - 6(1/2).	LC
3	Cypriniformes	Cyprinide	*Cirihinus mrigala (F. Hamilton, 1822)*	Mrigal	D. 16(3/13); P. 18; V. 9; A.8(2/6); C. 15; L. 1. 42-44; L.tr. 6(1/2). Barbels 1paire	LC
4	Cypriniformes	Cyprinide	*Wallago attu (F. Hamilton, 1822)*	Padhina	D. 5; P.1/14; V. 10; A.86 (4/82); C.17; Barbels 2 pairs	LC
5	Symbranchifroms	Symbrachidae	*Amphipnous cuhia (F. Hamilton, 1822)*	Bam	D. very reudimentry, just fold of skin, P., V. , A. , and C. absent	LC
6	Clupeiforms	Clipeoidei	*Ilisha motius ((F. Hamilton, 1822)*	Sarangi	D.15-17 (3/12-14); P.14-16; V.6-7;A. 40-41; (2/38-39); C.17; Lr. 44 -45; L.tr. 12-13	LC
7	Perciforms	Cichlidae	*Oreochromis mosambica (A. Smith, 1840)*	Tilapia	D. 11 (3/8); P.13 □ 15; V.9; A.8 (3/5); C. 19; L.1. 26 □ 27; L.tr. 5½ - 6/6½	LC

RESULT AND DISCUSSION

Recent studies have shown a marked decline in fish health and diversity in the Shivnath River, correlated with increasing levels of pollution. Water samples collected from various points along the river revealed elevated concentrations of heavy metals such as mercury and lead, as well as high levels of nitrates and phosphates from agricultural runoff (**Mitrofanov, V.P., *1988***) [26]. Fish populations showed signs of stress, including abnormal growths, reduced reproductive success, and increased mortality rates. Species such as the Indian major carps and smaller indigenous fish have been particularly affected (**Naseka, A.M., *1998***) [27]. Pollution is a critical factor impacting the ichthyofauna of the Shivnath River. Heavy metals can accumulate in fish tissues, leading to toxic effects and potential health risks for consumers. Nutrient overload from agricultural runoff results in eutrophication, which depletes oxygen levels and creates hypoxic conditions detrimental to fish survival [*Labeo rohita (F. Hamilton, 1822)*] [From, Table 02]. The reduction in water quality disrupts the aquatic food web, affects fish breeding and growth, and decreases overall biodiversity. Effective pollution management strategies, including stricter regulations on industrial discharges and improved agricultural practices, are essential to mitigate these impacts. Habitat assessments indicate significant degradation of riparian and floodplain areas along the Shivnath River. Deforestation and land conversion have led to increased sedimentation and erosion, which negatively affect aquatic habitats [*Carla catla (F. Hamilton, 1822)*] [From, Table 02]. Field surveys found that many critical spawning and nursery areas for fish species are now silted and less accessible. The construction of dams and weirs has altered natural flow patterns, further impacting fish migration and habitat

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

availability. Habitat degradation severely impacts the ecological balance of the river. The loss of riparian vegetation reduces natural bank stabilization, leading to increased sedimentation that can smother spawning sites and disrupt fish habitats. Altered flow regimes due to infrastructure development hinder fish migration, crucial for spawning and seasonal movements. Restoration efforts, such as reforestation of riverbanks and the implementation of fish passages in dams, are necessary to rehabilitate affected habitats and support the recovery of fish populations [*Cirihinus mrigala (F. Hamilton, 1822)* and *Ilisha motius ((F. Hamilton, 1822)*] [From, Table 02]. Overfishing disrupts the ecological balance of the river by depleting fish stocks faster than they can replenish. The use of non-selective fishing methods contributes to the decline of both target and non-target species, affecting the entire aquatic ecosystem. Implementing sustainable fishing practices, such as the use of selective gear and the establishment of fishing regulations and quotas, can help manage fish populations and ensure their long-term viability. Community-based management strategies can also promote local stewardship and compliance with conservation measures. Invasive species can have profound effects on native ecosystems by outcompeting native species, altering habitat conditions, and introducing new diseases. The presence of non-native fish can lead to declines in native fish populations and disrupt ecological interactions. Invasive aquatic plants can clog waterways, reduce light penetration, and disrupt nutrient dynamics, further affecting fish and other aquatic life. Effective management of invasive species requires monitoring and early detection programs, as well as strategies for controlling or eradicating invasive populations [*Wallago attu (F. Hamilton, 1822)* and *Amphipnous cuhia (F. Hamilton, 1822)* and *Oreochromis mosambica (A. Smith, 1840)*] [From, Table 02]. Climate change can exacerbate existing environmental issues by altering water temperatures, flow regimes, and seasonal patterns. These changes impact fish physiology, reproductive cycles, and habitat suitability (**Naseka, A.M., Erk'akan, F., and Küçük, F., *2006***) [28]. Warmer water temperatures can stress fish species adapted to cooler conditions, while altered flow regimes can disrupt spawning migrations and habitat availability. Adaptive management strategies, including monitoring climate impacts and developing resilience measures for aquatic ecosystems, are essential to address these challenges (**Turan, D., Kaya, C., Bayçelebi, E., et al., *2017*)** [42]. Addressing research and data gaps is crucial for effective management and conservation of the Shivnath River's Icthyological resources. Comprehensive baseline studies and long-term monitoring programs are needed to track changes in fish populations, water quality, and habitat conditions. Enhanced research efforts can provide valuable insights into the impacts of various stressors and inform evidence-based management practices (**Turan, D., Japoshvili, B., Aksu, İ., and Bektaş, Y., *2016***) [41]. Declines in fish stocks affect livelihoods dependent on fishing, and reduced water quality impacts agricultural productivity (**Nikolsky, G.V., *1936***) [29]. The socio-economic impact of environmental issues on the Shivnath River highlights the interconnectedness of ecological health and human well-being. The decline in fish populations can lead to economic hardship for communities reliant on fishing, while water quality issues can affect agricultural yields and overall quality of life. Integrating socio-economic considerations into conservation and management strategies is essential for achieving sustainable outcomes and supporting community resilience (**Nikolsky, G.V., *1956***) [30].

OBSERVATION

Observations from various sampling points along the Shivnath River indicate significant water quality issues. Elevated levels of pollutants, including heavy metals (e.g., mercury and lead) and nutrients (e.g., nitrates and phosphates), were detected (**Parin, N.V., Evseenko, S.A., and Vasil'eva, E.D., *2014***) [31]. Industrial effluents and agricultural runoff are primary sources of these pollutants. The high concentration of organic matter from domestic waste has led to increased bacterial contamination, these conditions have been linked to poor fish health, including abnormalities and high mortality rates among sensitive species (**Petrova, A.V., *2013***) [32]. Habitat degradation is evident along the river, particularly in riparian and floodplain areas (**Turan, D., Ekmekçi, F.G., Luskova, V., and Mendel, J., *2012***) [40]. Deforestation and land conversion have led to increased sedimentation, resulting in silted riverbeds and loss of critical spawning and nursery habitats (**Petrova, A.V., *2013***) [33]. The degradation of riparian vegetation has reduced natural bank stabilization, contributing to erosion and impacting fish habitats (**Ruchin, A.B. and Naseka, A.M., *2003***) [34]. Non-selective fishing practices, such as the use of gill nets and seine nets, have resulted in the capture of juvenile and non-target species, leading to reduced fish populations (**Tang, K.L., Agnew, M.K., Chen, W.-J., et al., *2011***) [39]. The decline in key species, such as major carps, is evident from lower catch rates reported by local fishermen (Sheraliev, B., Allayarov, S., and Peng, Z., (2020) [35]. Overfishing has disrupted the aquatic ecosystem balance, affecting the entire food web. The presence of invasive species has been increasingly noted, with non-

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

native fish like Nile tilapia and aquatic plants such as water hyacinth becoming prominent (**Tagaev, D.A. and Zhaparova, A.T., *2018***) [36]. Water hyacinth, in particular, forms dense mats that reduce oxygen levels and light penetration, negatively impacting native fish and other aquatic organisms (**Tagaev, D.A. and Zhaparova, A.T., *2019***) [37]. Climate change has introduced alterations in flow regimes and water temperatures, erratic seasonal flows and increased water temperatures have affected fish distribution and reproductive patterns [insert species]. Species adapted to stable and cooler conditions are showing signs of stress, such as altered breeding cycles and reduced populations (**Takàcs, P., Bihari, P., Eròs, T., et al., *2014***) [38].

ACKNOWLEDGEMENT

The author personally greets Dr. Sanjay Thiskey and Dr. Majid Ali, who helped us in review of article and also expresses his heartfelt gratitude to Chiranjeev Pandey, through whom he provided us with sufficient data, knowledge and basic understanding on bio fertilizers, which made our article work to easy.

CONCLUSION

The Shivnath River is facing a complex array of challenges that threaten its Icthyological health and overall ecological integrity. By understanding and addressing these problems through a multidisciplinary approach, we can work towards ensuring the sustainability of the river's fish populations and the broader aquatic ecosystem. Continued research, effective management, and community engagement are vital to protecting this invaluable natural resource for future generations. A range of complex challenges affecting its Icthyological health, including pollution, habitat degradation, overfishing, invasive species, and climate change. Addressing these issues requires a multifaceted approach that includes pollution control, habitat restoration, sustainable fishing practices, invasive species management, and climate adaptation strategies. By addressing these challenges through scientific research, effective management, and community engagement, we can work towards ensuring the sustainability and resilience of the Shivnath River's aquatic ecosystems.

REFERENCES

1. Aksu, I. and Bektaş, Y., (2019).Mitochondrial phylogeny and biogeography of the genus *Gobio* (Teleostei: Cyprinidae) in Turkey, *Zool. Middle East*, 2019, vol. 65, no. 2, pp. 128–141. https://doi.org/10.1080/09397140.2019.1586126
2. Bănărescu, P. and Nalbant, T.T., (1973) Pisces, Teleostei. Cyprinidae (Gobioninae), *Das Tierreich. Lief*, 1973, vol. 93, pp. 1–304.
3. Bănărescu, P.M., Šorić, V.M., and Economidis, P.S., (1999)*Gobio gobio* (Linnaeus, 1758), in *The Freshwater Fishes of Europe*, Vol. 5: *Cyprinidae*, Bănărescu, P.M., Ed., Wiebelsheim: Aula-Verlag, 1999, pp. 81–134.
4. Bekkozhaeva, D.K. and Mamilov, N.Sh.,(2015) Morphobiological characteristic and current state of Siberian gudgeon *Gobio cynocephalus* Dybowski, 1869 from the Sherubai-Nura River, *Vestn. Kazakh. Nats. Univ., Ser. Ekol*., 2015, no. 2-2 (44), pp. 494–498.
5. Berg, L.S., (1949). *Ryby presnykh vod SSSR i sopredel'nykh stran* (Freshwater Fishes of Soviet Union and Adjacent Countries), Moscow: Akad. Nauk SSSR, 1949a, part 2, pp. 469–926.
6. Bogdanov, B.E. and Petukhov, S.Yu., (2017). Morphobiological characteristic of the Siberian gudgeon *Gobio cynocephalus* from the upper section of the Lena River, *Hydrobiol. J.*, 2017, vol. 53, no. 4, pp. 54–61.
7. Bogutskaya, N.G. and Naseka, A.M., (2004). *Katalog beschelyustnykh i ryb presnykh i solonovatykh vod Rossii s nomenklaturnymi i taksonomicheskimi kommentariyami* (Catalog of Agnatha and Fishes of Fresh and Brackish Waters of Russia with Nomenclature and Taxonomic Comments), Moscow: KMK, 2004.
8. Bogutskaya, N.G., Naseka, A.M., Shedko, S.V., et al., (2008) The fishes of the Amur River: updated check-list and zoogeography, *Ichthyol. Explor. Freshwater*, 2008, vol. 19, no. 4, pp. 301–366.
9. Chibilev, A.A., *Reka Ural.(1987). Istoriko-geograficheskie i ekologicheskie ocherki o basseine reki Urala* (The Ural River: Historical-Geographic and Ecological Essays about the Ural River Basin), Leningrad: Gidrometeoizdat, 1987.

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

10. Doadrio, I. and Madeira, M.J., (2004). A new species of the genus *Gobio* Cuvier, 1816 (Actynopterigii, Cyprinidae) from the Iberian Peninsula and southwestern France, *Graellsia*, 2004, vol. 60, no. 1, pp. 107–116. https://doi.org/10.3989/graellsia.2004.v60.i1.197
11. Dyldin, Yu.V., Hanel, L., Fricke, R., et al., (2020). Fish diversity in freshwater and brackish water ecosystems of Russia and adjacent waters, *Publ. Seto Mar. Biol. Lab*., 2020, vol. 45, pp. 47–116.
12. Fricke, R., Eschmeyer, W.N., van der Laan, R., Eds., (2020). *Eschmeyer's Catalog of Fishes: Genera, Species, References, Version 08/2020*, http://researcharchive.calacademy.org/research/ichthyology/catalog/ fishcatmain.asp.
13. *FishBase,(2019).Version 12/2019*, Froese, R. and Pauly, D., Eds., 2019. http://www.fishbase.org.
14. Kabacoff, R.I., (2015). *R in Action: Data Analysis and Graphics with R*, New York: Manning, 2015, 2nd ed.
15. Kalashnikov, Yu.E., (1978). *Ryby basseina reki Vitim* (Fishes of the Vitim River Basin), Novosibirsk: Nauka, 1978.
16. Karasev, G.L., (1987). *Ryby Zabaikal'ya* (Fishes of Transbaikalia), Novosibirsk: Nauka, 1987.
17. Kostarev, G.F., (1973). Genesis of ichthyofauna of the Chusovaya River, *Vopr. Ikhtiol*., 1973, vol. 13, no. 4, pp. 611–617.
18. Kostarev, G.F.,(2003). The presence of Siberian forms of fishes in the Chusovaya River, *Biol. Ekol. Ryb Prikam'ya*, 2003, no. 1, pp. 77–85.
19. Kottelat, M., (1997). European freshwater fishes. An heuristic checklist of the freshwater fishes of Europe (exclusive of former USSR), with an introduction for non-systematics and comments on nomenclature and conservation, *Biologia* (Bratislava), 1997, vol. 52, suppl. 5, pp. 1–271.
20. Kottelat, M., (2006). *Fishes of Mongolia. A Check-List of the Fishes Known to Occur in Mongolia with Comments on Systematics and Nomenclature*, Washington: The World Bank, 2006.
21. Kottelat, M. and Freyhof, J., (2007). *Handbook of European Freshwater Fishes*, Cornol: Kottelat, and Freyhof, 2007.
22. Kottelat, M. and Persat, H.,(2005). The genus *Gobio* in France, with redescription of *G. gobio* and description of two new species (Teleostei: Cyprinidae), *Cybium*, 2005, vol. 29, no. 3, pp. 211–234.
23. Mayr, E., Linsley, E.G., and Usinger, R.L., (1953). *Methods and Principles of Systematic Zoology*, New York: McGraw-Hill, 1953.
24. Mastitskii, S.E. and Shitikov, V.K., (2015). *Statisticheskii analiz i vizualizatsiya dannykh s pomoshch'yu R* (Statistical Data Analysis and Visualization in R), Moscow: DMK Press, 2015.
25. Mendel, J., Lusk, S., Vasil'eva, E.D., et al.,(2008). Molecular phylogeny of the genus *Gobio* Cuvier, 1816 (Cyprinidae, Pisces) and its contribution to taxonomy, *Mol. Phylogenet. Evol*., 2008, vol. 47, no. 3, pp. 1061–1075. https://doi.org/10.1016/j.ympev.2008.03.005
26. Mitrofanov, V.P., (1988).Genus *Gobio* Cuvier, 1817—gudgeon, in *Ryby Kazakhstana* (Fishes of Kazakhstan), Alma-Ata: Nauka, 1988, vol. 3, pp. 5–23.
27. Naseka, A.M., (1998). Subfamily Gobioninae, in *Annotirovannyi catalog kruglorotykh i ryb kontinental'nykh vod Rossii* (Annotated Catalogue of Cyclostomata and Fishes of Russian Continental Waters), Moscow: Nauka, 1998, pp. 81–87.
28. Naseka, A.M., Erk'akan, F., and Küçük, F., (206). A description of two new species of the genus *Gobio* from Central Anatolia (Turkey) (Teleostei: Cyprinidae), *Zoosyst. Ross*., 2006, vol. 15, no. 1, pp. 185–194.
29. Nikolsky, G.V., (1936). The materials on geographical variability of the gudgeons *Gobio gobio* (L.) in Northeastern Kazakhstan and Western Siberia, *Tr. Zool. Inst., Akad. Nauk SSSR*, 1936, vol. 3, pp. 457–473.
30. Nikolsky, G.V., (1956). *Ryby basseina Amura. Itogi Amurskoi ikhtiologicheskoi ekpeditsii 1945−1949 gg*. (Fishes of the Amur River Basin: the Results of Amur Ichthyological Expedition 1945−1949), Moscow: Akad. Nauk SSSR, 1956.
31. Parin, N.V., Evseenko, S.A., and Vasil'eva, E.D., (2014) *Ryby morei Rossii: annotirovannyi katalog* (Fishes of Russian Seas: Annotated Catalogue), Moscow: KMK, 2014.
32. Petrova, A.V., (2013). Morphological characteristic of the gudgeons from the Shush' River (the Yenisei River basin), *Materialy IX Vserossiiskoi nauchno-tekhnicheskoi konferentsii studentov, aspirantov i molodykh uchenykh "Molodezh' i nauka"* (Proc. IX All-Russ. Sci.-Tech. Conf. of

iJETRM
International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

Students, Post-Graduate Students, and Young Scientists “Youth and Science”), Krasnoyarsk: Sib. Fed. Univ., 2013a. http://conf.sfu-kras.ru/sites/mn2013/section093.html.

33. Petrova, A.V., (2013) Morphological characteristic of the Siberian gudgeon *Gobio cynocephalus* Dybowski, 1869 (Cyprinidae:Gobioninae) from the Zeya River basin, *Amur. Zool. Zh*., 2013b, vol. 4, pp. 460–463.
34. Ruchin, A.B. and Naseka, A.M., (2003). Morphological characteristics of two sympatric gudgeons from the Sura River (Mordovia), *J. Ichthyol*., 2003, vol. 43, no. 4, pp. 279–282.
35. Sheraliev, B., Allayarov, S., and Peng, Z., (2020). First records of *Gobio nigrescens* and *Gobio sibiricus* (Cypriniformes: Gobionidae) from the Amu Darya River basin, Uzbekistan, *J. Appl. Ichthyol*., 2020, vol. 36, no. 2, pp. 235–239. https://doi.org/10.1111/jai.14019
36. Tagaev, D.A. and Zhaparova, A.T., (2018) The gudgeons of genus *Gobio* (Pisces: Cyprinidae) from Central and Eastern Kazakhstan: historical description, systematics, and studies, *Vestn. Evraziiskogo Nats. Univ. im. L.N. Gumileva, Ser. Biol. Nauki*, 2018, no. 3 (124), pp. 90–96. https://doi.org/10.32523/2616-7034-2018-124-3-90-96
37. Tagaev, D.A. and Zhaparova, A.T., (2019). Variability of plastic features of Siberian gudgeon (*Gobio sibiricus* Nikolskii, 1936) from the Karkaraly River (Central Kazakhstan), *Vestn. Karagandinsk. Univ., Ser. Biol., Med., Geogr*., 2019, no. 2 (94), pp. 86–92.
38. Takács, P., Bihari, P., Eröss, T., et al., (2014) Genetic heterogeneity reveals on-going speciation and cryptic taxonomic diversity of stream-dwelling gudgeons (Teleostei, Cyprinidae) in the Middle Danubian hydrosystem (Hungary), *PLoS One*, 2014, vol. 9, no. 5, p. e97278. https://doi.org/10.1371/journal.pone.0097278
39. Tang, K.L., Agnew, M.K., Chen, W.-J., et al., (2011) Phylogeny of the gudgeons (Teleostei: Cyprinidae: Gobioninae), *Mol. Phylogenet. Evol*., 2011, vol. 61, pp. 103–124. https://doi.org/10.1016/j.ympev.2011.05.022
40. Turan, D., Ekmekçi, F.G., Luskova, V., and Mendel, J., (2012). Description of a new species of genus *Gobio* from Turkey (Teleostei: Cyprinidae), *Zootaxa*, 2012, vol. 3257, no. 1, pp. 56–65. https://doi.org/10.11646/zootaxa.3257.1.4
41. Turan, D., Japoshvili, B., Aksu, İ., and Bektaş, Y., (2016) Description of two new species of the genus *Gobio* (Teleostei: Cyprinidae) from the Black Sea coast of Turkey, *Zool. Middle East*., 2016, vol. 62, no. 2, pp. 112–124. https://doi.org/10.1080/09397140.2016.1182779
42. Turan, D., Kaya, C., Bayçelebi, E., et al., (2017). *Gobio baliki*, a new gudgeon from Turkey (Teleostei: Cyprinidae), *Zootaxa*, 2017, vol. 4350, no. 2, pp. 284–290. https://doi.org/10.11646/zootaxa.4350.2.4