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Status of Distribution Pattern of *Barilius* Fish Species in Aquatic Ecosystems of India: A Review

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Abstract: The genus *Barilius* (Family: Cyprinidae) comprises small to medium-sized freshwater fish widely distributed across India's riverine ecosystems. This study examines the distribution pattern and endemism of *Barilius* species across different biogeographic regions of India. India, a megadiverse country, hosts 27 *Barilius* species across 22 states, predominantly within the Northeastern region, the Western Ghats, Eastern India, Northern India, and Central India. The Northeastern region, encompassing two biodiversity hotspots, harbours the highest *Barilius* diversity, with Assam and Tripura recording 12 species each. The Western Ghats, a UNESCO World Heritage site, also support significant *Barilius* diversity, with Karnataka exhibiting the highest species richness (7 species). Notably, 13 *Barilius* species are endemic to specific geographical regions, including *B. lairokensis*, *B. kamjongensis*, *B. ngawa*, *B. arunachalensis*, *B. chatricensis*, *B. barnoides*, and *B. profundus* in the Northeast; *B. malabaricus*, *B. ardens*, *B. canarensis*, and *B. cyanochlorus* in the Western Ghats; *B. torsai* in West Bengal; and *B. pectoralis* in Uttarakhand. Additionally, several species exhibit interregional distribution, reflecting their adaptability to diverse ecological conditions. The increasing anthropogenic pressures, including habitat degradation, climate change, and overexploitation, pose significant threats to the *Barilius* population. Conservation efforts should prioritise habitat protection, sustainable fisheries management, and region-specific strategies to mitigate biodiversity loss. This study underscores the distribution pattern of the *Barilius* species within the Indian region and highlights the need for targeted research and policy interventions to ensure the long-term sustainability of *Barilius* species in India's aquatic ecosystems.

Keywords: *Barilius*, Distribution pattern, Aquatic ecosystems, Conservation, Freshwater fish

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Introduction

India harbours approximately 3523 fish species belonging to 1097 genera and 272 families of 55

orders (Kosygin *et al.*, 2024). Among the diverse ichthyofauna of India, the genus *Barilius* (family:

Cyprinidae), commonly referred to as hill trout, represents a vital group of fast-flowing riverine fish known for their ecological, economic, and conservation significance, particularly in the ornamental fish trade. The genus *Barilius* is widespread, with its distribution encompassing various geographical regions that offer insight into the ecological niches and conservation challenges these species face (Jayaram, 2010).

The genus *Barilius* is primarily distributed across the Oriental region (Talwar and Jhingran, 1991; Jayaram, 1981; Srivastava, 1992). Various researchers have provided insights into the origin and distribution of the *Barilius* species. Based on osteological and anatomical features, Howes (1980) conducted a detailed study of the systematics of the genus. According to Srivastava (1992), *Barilius bendelisis* is found across Assam and the Himalayan region, extending through India to the Western Ghats. However, it is notably absent in regions such as Malabar, Canara, and Sindh. Jayaram (1981) suggests their occurrence in Egypt, West Africa, and the Zambezi River basin. Additionally, Mani (1974) further reports that species of this genus are also present in Africa, Iran, and northwestern India. *Barilius* species have demonstrated resilience, thriving in densely populated stream ecosystems despite being heavily exploited for recreational and subsistence fishing. However, their coexistence with other sympatric species, such as *B. bendelisis*, may lead to competition and potential population declines. Furthermore, severe environmental changes and anthropogenic disturbances could increase the risk of certain species becoming rare, endangered, or even extinct (Negi and Nautiyal, 2004). Their distribution is strongly influenced by regional hydrological and topographical factors, which create distinct ecological niches supporting high species diversity and endemism.

The extensive distribution, endemism, and ecological significance of *Barilius* species underscore the urgent need for conservation measures to address the growing threats posed by habitat fragmentation, climate change, and

overexploitation. Understanding the distribution patterns and ecological requirements of *Barilius* species is crucial for formulating effective conservation strategies. As freshwater ecosystems continue to face mounting pressures, targeted conservation interventions, habitat restoration, and policy-driven management approaches will be essential to ensuring the long-term sustainability of *Barilius* species and their habitats in Indian waters.

For safeguarding the habitat and conserving the species, their distribution pattern is firstly targeted. The present status on the distribution pattern of the *Barilius* species is scattered and not updated in scientific reports. So, the present study offers a comprehensive review of the published works on the distribution pattern of *Barilius* species within the all-aquatic ecosystem of the Indian region.

Materials and Methods

The present review was based on collecting scattered data on the distribution patterns of *Barilius* species in Indian aquatic ecosystems. A systematic literature review was performed using Google Scholar, Web of Science, Scopus, and other academic databases to collect relevant research articles, reports and checklists related to the *Barilius* species. The present data was classified along with a stepwise scientific approach to present the distribution pattern of *Barilius* species in different states of India (Fig. 1).

The compiled data were analysed to assess the distributional trends of *Barilius* species across various freshwater ecosystems in India, identify well-documented regions, and highlight areas requiring further research efforts. The study follows a review-based approach and does not involve direct experimental or field-based investigations.

Results and Discussion

The present status of the distribution pattern and occurrence of *Barilius* species in different aquatic ecosystems of India is presented in Table 1 and

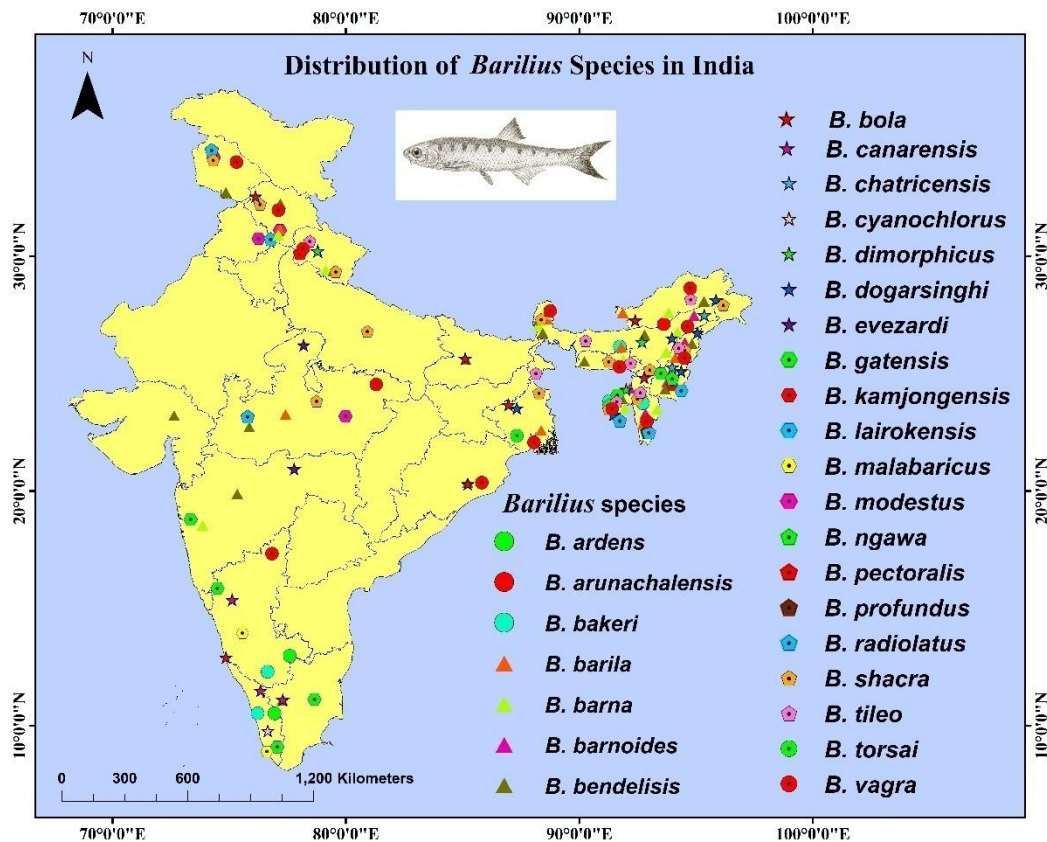


Fig. 1: Distribution of *Barilius* species in the Indian region.

Figure 2. Biodiversity hotspots are regions with exceptionally high species diversity and endemism that have experienced significant anthropogenic pressures, leading to the exploitation and depletion of native species. To qualify as a biodiversity hotspot, a region must contain at least 60% of the world's biodiversity (Myers *et al.*, 2000). India encompasses four major biodiversity hotspots: the Himalayas, Indo-Burma, Sundaland, and the Western Ghats (Meena, 2020). A total of 27 species of *Barilius* fish are distributed across 22 states in India, encompassing the Northeastern region, the Western Ghats, Eastern states, Northern states, and Central India (Table 1, Fig. 1).

The Northeastern region of India encompasses two of the world's thirty-four recognised biodiversity hotspots, characterised by unique topographical and hydrological features that support a rich diversity of aquatic flora and fauna. The intricate drainage systems of this region,

particularly in Assam (the Brahmaputra and Barak Drainage System), create a mosaic of floodplain rivers and wetlands that serve as critical habitats for freshwater fish. This region is a significant hotspot for ichthyofaunal diversity, harbouring approximately 500 freshwater fish species, with Assam alone accounting for around 180 recorded fish species, including several that are globally threatened (Vishwanath, 2021). Many of these fish species hold substantial economic importance, particularly in the ornamental fish trade. Among them, the genus *Barilius* exhibits high species richness and commercial value, particularly in the ornamental fish trade. Assam and Tripura together host the highest diversity of *Barilius* species in India, with 12 species recorded, followed by Manipur and Mizoram (10 species), Arunachal Pradesh (9 species), Nagaland (8 species), Meghalaya (6 species), and Sikkim (6 species). The presence of such high endemism and species richness in this region underscores the

Table 1: Distribution of *Barilius* fish species in different River systems of Indian States

S. No.	State	Location(s)	River(s)	<i>Barilius</i> spp.	Reference(s)
1.	Assam			<i>B. bakeri</i>	Goswami <i>et al</i> (2012)
			Manas River	<i>B. barila</i>	Jabeen and Barbhuiya (2018)
		Dhubri, Kokrajhar, Assam	Manas River, Hel River, Beki River, Brahmaputra River	<i>B. barna</i>	Jabeen <i>et al</i> (2017)
				<i>B. barnoides</i>	Goswami <i>et al</i> (2012)
			Subansiri River drainage, Beki River, Manas River, Hel River	<i>B. bendelisis</i>	Bakalial <i>et al</i> (2014)
			Manas River, Hel River	<i>B. bola</i>	Barman <i>et al</i> (2024)
				<i>B. chatricensis</i>	Goswami <i>et al</i> (2012)
				<i>B. dimorphicus</i>	Goswami <i>et al</i> (2012)
			Barak River	<i>B. dogarsinghi</i>	Kar (2003)
		Chirang District	Brahmaputra and Barak drainage system	<i>B. shacra</i>	Kumari <i>et al</i> (2003)
				<i>B. tileo</i>	Sukham <i>et al</i> (2014)
2.	Tripura			<i>B. bakeri</i>	Goswami <i>et al</i> (2012)
			Manu River	<i>B. barna</i>	Panda and Datta (2017)
				<i>B. barnoides</i>	Goswami <i>et al</i> (2012)
				<i>B. bendelisis</i>	Goswami <i>et al</i> (2012)
			Gomti River	<i>B. dimorphicus</i>	Kar (2003)
				<i>B. dogarsinghi</i>	Goswami <i>et al</i> (2012)
				<i>B. gatensis</i>	Goswami <i>et al</i> (2012)
				<i>B. ngawa</i>	Goswami <i>et al</i> (2012)
				<i>B. radiolatus</i>	Goswami <i>et al</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al</i> (2012)
				<i>B. tileo</i>	Goswami <i>et al</i> (2012)
3.	Manipur			<i>B. vagra</i>	Goswami <i>et al</i> (2012)
				<i>B. barila</i>	Goswami <i>et al</i> (2012)
				<i>B. barna</i>	Goswami <i>et al</i> (2012)
		Ukhrul District	Chatrikong and Challou Rivers	<i>B. barnoides</i>	Vishwanath (2021)
		Likhailok	Barak Drainage	<i>B. bendelisis</i>	
		Ukhrul District	Chatrickong River	<i>B. chatricensis</i>	Selim and Vishwanath, (2002)
			Chindwin River drainage, Khuga River	<i>B. dogarsinghi</i>	Vishwanath (2021)
				<i>B. gatensis</i>	Goswami <i>et al</i> (2012)
		Lunbung, Kamjong District	Taret-lok river	<i>B. kamjongensis</i>	Arunkumar <i>et al</i> (2022)
			Chindwin drainage, Maklang River	<i>B. kirokensis</i>	Arunkumar and Singh (2000)
			Sherou river, Lokchao River of Chindwin Drainage, Thoubal River	<i>B. ngawa</i>	Sukham <i>et al</i> (2014); Singh <i>et al</i> (2016)
4.	Mizoram			<i>B. bakeri</i>	Goswami <i>et al</i> (2012)
				<i>B. barila</i>	Goswami <i>et al</i> (2012)
				<i>B. barna</i>	Goswami <i>et al</i> (2012)
				<i>B. barnoides</i>	Goswami <i>et al</i> (2012)
				<i>B. bendelisis</i>	Goswami <i>et al</i> (2012)
		Kolchaw, Lawntai district	Koladyne river	<i>B. profundus</i>	Dishma and Vishwanath (2012)
				<i>B. radiolatus</i>	Goswami <i>et al</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al</i> (2012)
				<i>B. tileo</i>	Goswami <i>et al</i> (2012)
5.	Arunachal Pradesh			<i>B. vagra</i>	Goswami <i>et al</i> (2012)
			Siang River basin	<i>B. arunachalensis</i>	Nath <i>et al</i> (2010)
			Dikrong River	<i>B. barila</i>	Vishwanath (2021)

		Tirap District, Namsai District	Charju River, Tengapani River	<i>B. barna</i>	Tesia and Bordoloi (2012); Wangchu <i>et al</i> (2017); Loyi <i>et al</i> (2018)
			Charju River, Dikrong River, Buroi River, Tengapani River	<i>B. bendelisis</i>	Sahoo <i>et al</i> (2009); Hazarika <i>et al</i> (2011); Tesia and Bordoloi (2012); Loyi <i>et al</i> (2018)
		Tirap District, Namsai District	Namsang River, Tengapani River	<i>B. bola</i>	Dutta and Dutta (2013); Loyi <i>et al</i> (2018)
				<i>B. dogarsinghi</i>	Goswami <i>et al</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al</i> (2012)
		Papum Pare district, Tirap District	Dikrong river, Charju River, Namsang River	<i>B. tileo</i>	Tesia and Bordoloi (2012); Dutta and Dutta (2013)
			Dikrong River	<i>B. vagra</i>	Vishwanath (2021)
6.	Uttarakhand		Tons River	<i>B. barila</i>	Negi and Mamgain (2013)
		Ramnagar, Nainital Khanda, Srinagar Dehradun Bhimtal	Kosi River Alaknanda River Yamuna River, Tamsa Stream, Asan River Chanfee River, Tons River	<i>B. barna</i>	Mishra <i>et al</i> (2012); Nautiyal <i>et al</i> (2013); Bahuguna <i>et al</i> (2021)
		Ramnagar, Nainital Khanda, Srinagar Dehradun Bhimtal Pithoragarh Chaukhutiya, Almora	Kosi River Alaknanda River Yamuna River, Tamsa Stream, Asan River Chanfee River, Gaula River, Song River, Henval River, Asan River, Bhagirathi, Tons River, Saryu River, Kalsa River, Suwalekh stream, Western Ramganga River	<i>B. bendelisis</i>	Mishra <i>et al</i> (2012); Saxena <i>et al</i> (2016); Pandey and Upadhyay (2016); Bahuguna <i>et al</i> (2021); Malik <i>et al</i> (2022)
			Nayar River, Song River	<i>B. bola</i>	Malhotra (1984); Nautiyal <i>et al</i> (2019)
		Eastern Doon Valley, Haridwar, Pauri, Uttarakhand		<i>B. dimorphicus</i>	Tilak & Husain (1998)
		Dehradun	Yamuna drainage system	<i>B. pectoralis</i>	Husain (2012)
			Song River, Asan River	<i>B. shacra</i>	Uniyal and Uniyal (2021); Devi <i>et al</i> (2023)
			Song River, Asan River	<i>B. tileo</i>	Devi <i>et al</i> (2023)
		Srinagar, Uttarakhand, Chalthi area, Champawat, Chaukhutiya, Almora	Alaknanda River, Ladhiya River, Tons River, Western Ramganga River, Song River, Henval River	<i>B. vagra</i>	Singh <i>et al</i> (2016); Pandey and Upadhyay (2016)
7.	West Bengal	Chandan Chowra of Cooch Behar district	Teesta, Mahananda, Torsa River, Jaldhaka, Kaljani, Sankosh River	<i>B. barila</i>	Dey <i>et al</i> (2016); Sarkar (2021)
			Teesta River, Murti River, Torsa River, Jaldhaka, Kaljani, Sankosh River	<i>B. barna</i>	Paul <i>et al</i> (2018); Sarkar (2021)
		Darjeeling	Kangsabati Reservoir, Relli hill stream, Teesta, Torsa River, Jaldhaka, Kaljani, Sankosh River	<i>B. bendelisis</i>	Acharjee and Barat (2014); Kumar <i>et al</i> (2017); Sarkar (2021)
			Jaldakha River, Torsa River, Kaljani, Sankosh River	<i>B. bola</i>	Sarkar (2021); Roy <i>et al</i> (2024)

		Jaldapara National Park	Torsa River	<i>B. dogarsinghi</i>	Bhakta <i>et al.</i> (2023)
			Teesta, Torsa River, Jaldhaka, Kaljani, Sankosh River	<i>B. shacra</i>	Sarkar (2021)
			Teesta, Torsa River, Jaldhaka, Kaljani, Sankosh River	<i>B. tileo</i>	Sarkar (2021)
			Torsa River, Brahmaputra River System	<i>B. torsai</i>	Kumari <i>et al.</i> (2019)
		Dooars Region	Teesta, Jaldhaka, Torsa, Kaljani, Sankosh Rivers	<i>B. vagra</i>	Chanda (2017); Sarkar (2021)
8.	Nagaland			<i>B. barila</i>	Goswami <i>et al.</i> (2012)
				<i>B. barna</i>	Swain <i>et al.</i> (2008)
				<i>B. barnoides</i>	Goswami <i>et al.</i> (2012)
				<i>B. bendelisis</i>	Goswami <i>et al.</i> (2012)
				<i>B. dogarsinghi</i>	Goswami <i>et al.</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al.</i> (2012)
				<i>B. tileo</i>	Goswami <i>et al.</i> (2012)
				<i>B. vagra</i>	Goswami <i>et al.</i> (2012)
9.	Karnataka	Western Ghats of Karnataka	Sita-Swarna River System	<i>B. ardens</i>	Knight <i>et al.</i> (2015)
		Khudremukh National Park, Karnataka	Bollae Stream	<i>B. bakeri</i>	Arunachalam <i>et al.</i> (2009)
		Bidar District, Karnataka	Mullamari River, Varada River	<i>B. bola</i>	Naik <i>et al.</i> (2013)
		Southern Karnataka	Krishna and Tungabhadra River System, Harangi Reservoir	<i>B. canarensis</i>	Knight <i>et al.</i> (2015)
			Cauvery River	<i>B. gatensis</i>	Raghunathan (1989); Sivakumar <i>et al.</i> (2024)
		Sullia, Karnataka	Payaswini River	<i>B. malabaricus</i>	Prabhu <i>et al.</i> (2020)
			Cauvery River	<i>B. vagra</i>	Raghunathan (1989)
10.	Madhya Pradesh		Tapti, Betwa, Tawa	<i>B. barila</i>	Das <i>et al.</i> (2013)
			Narmada, Chambal, Son, Betwa, Tapti, Tawa, Shipra, Goi, Kanhan, Chhota Mahanadi, Kanai, Silki, Pench, Weinganga, Tamasa	<i>B. bendelisis</i>	Das <i>et al.</i> (2013)
		Rewa District	Bichiya River	<i>B. bola</i>	Singh and Patel (2013)
			Narmada River	<i>B. evezardi</i>	Pathak and Lavudya (2021)
			Weinganga River	<i>B. modestus</i>	Das <i>et al.</i> (2013)
			Narmada River	<i>B. radiolatus</i>	Pathak and Lavudya (2021)
			Son River	<i>B. shacra</i>	
			Narmada, Chambal, Son, Tapti, Tawa, Shipra, Sindh	<i>B. vagra</i>	Das <i>et al.</i> (2013)
11.	Himachal Pradesh	Bilaspur	Satluj	<i>B. modestus</i>	Mehta and Uniyal (2005); Jagtap (2013)
		Kangra and Mandi District	Beas River	<i>B. barila</i>	Jagtap (2013); Sharma (2019)
		Kangra and Mandi District	Son Stream, Beas River	<i>B. bendelisis</i>	Jagtap (2013); Sharma (2019); Pal <i>et al.</i> (2024)
		Sirmour, Solan	Yamuna	<i>B. shacra</i>	Mehta and Uniyal (2005); Jagtap (2013)
		Kangra and Mandi District	Beas River	<i>B. vagra</i>	Jagtap (2013); Sharma (2019)
		Kangra and Mandi District	Beas River	<i>B. bola</i>	Sharma (2019)
		Kangra and Mandi	Beas River	<i>B. barna</i>	Sharma (2019)

		District			
12.	Meghalaya			<i>B. barila</i>	Goswami <i>et al</i> (2012)
				<i>B. barna</i>	Goswami <i>et al</i> (2012)
				<i>B. bendelisis</i>	Goswami <i>et al</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al</i> (2012)
				<i>B. tileo</i>	Goswami <i>et al</i> (2012)
				<i>B. vagra</i>	Goswami <i>et al</i> (2012)
13.	Sikkim			<i>B. barila</i>	Goswami <i>et al</i> (2012)
				<i>B. barna</i>	Goswami <i>et al</i> (2012)
				<i>B. bendelisis</i>	Goswami <i>et al</i> (2012)
				<i>B. shacra</i>	Goswami <i>et al</i> (2012)
				<i>B. tileo</i>	Goswami <i>et al</i> (2012)
				<i>B. vagra</i>	Goswami <i>et al</i> (2012)
14.	Kerala	Kammadam, Kasargod District, Kerala	Karyamkode River	<i>B. ardens</i>	Plamoottil and Johnson (2022)
		Athirapally, Kerala	Chalakuddy River, Vamanapuram River, Payankutty River, Manimala River	<i>B. bakeri</i>	Singh <i>et al</i> (2016)
		Northern Kerala Region		<i>B. canarensis</i>	Plamoottil and Johnson (2022)
		Chully, Kasargod	Eramkunnuchaal Stream	<i>B. cyanochlorus</i>	Plamoottil and Vineeth (2020)
		Wynad	Chuzalipuzha River	<i>B. gatensis</i>	Singh <i>et al</i> (2016)
		Northern Kerala regions		<i>B. malabaricus</i>	Knight <i>et al</i> (2015); Plamoottil and Johnson (2022)
15.	Jammu		Chenab River, Tawi River, Aans Nullah	<i>B. bendelisis</i>	Singh and Kumar (2019); Dutta (2015)
		Udhampur District, Jammu	Tawi River and its tributaries	<i>B. modestus</i>	Dutta (2015)
		Udhampur District, Jammu	Tawi River and its tributaries	<i>B. radiolatus</i>	Dutta (2015)
		Udhampur District, Jammu	Tawi River and its tributaries	<i>B. shacra</i>	Dutta (2015)
			Chenab River, Kota stream, Tawi River, Aans Nullah	<i>B. vagra</i>	Dutta (2015); Singh and Kumar (2019)
16.	Odisha	Ganjam district, Odisha	Ganjam, Taptapani	<i>B. barna</i>	Baliarsingh <i>et al</i> (2014)
		Ganjam district, Odisha	Ganjam, Taptapani	<i>B. bendelisis</i>	Baliarsingh <i>et al</i> (2014)
				<i>B. bola</i>	
		Ganjam district, Odisha	Ganjam, Taptapani	<i>B. vagra</i>	Baliarsingh <i>et al</i> (2014)
17.	Maharashtra			<i>B. barna</i>	
				<i>B. bendelisis</i>	
				<i>B. evezardi</i>	Archarya and Iftekhhar (2000)
		Western Ghats in Maharashtra		<i>B. gatensis</i>	
18.	Tamil Nadu		Bhavanisagar Reservoir, Stanley Reservoir	<i>B. bendelisis</i>	Raja <i>et al</i> (2015); Manickam <i>et al</i> (2014)
			Stanley Reservoir	<i>B. canarensis</i>	Manickam <i>et al</i> (2014)
		Nilgiri Hills, Tamil Nadu	Stanley Reservoir	<i>B. gatensis</i>	Manickam <i>et al</i> (2014)
19.	Punjab	Panchkula, Chandigarh, Punjab	Ghaghar River	<i>B. bola</i>	Gupta and Arora (1975)
				<i>B. modestus</i>	
		Sultanpur		<i>B. radiolatus</i>	Johal and Tandon (1979)
20.	Bihar	East Champaran	Sugaon Lake	<i>B. bendelisis</i>	Kumari <i>et al</i> (2021)

		District, Bihar			
		East Champaran District, Bihar	Sugaon Lake	<i>B. bola</i>	Kumari <i>et al</i> (2021)
21.	Uttar Pradesh			<i>B. barna</i>	
			Ganga, Yamuna drainages, Kosi river	<i>B. shacra</i>	Vishwanath (2021)
22.	Gujarat	Rajpipla, Gujarat	Narmada River	<i>B. bendelisis</i>	Singh <i>et al</i> (2016)

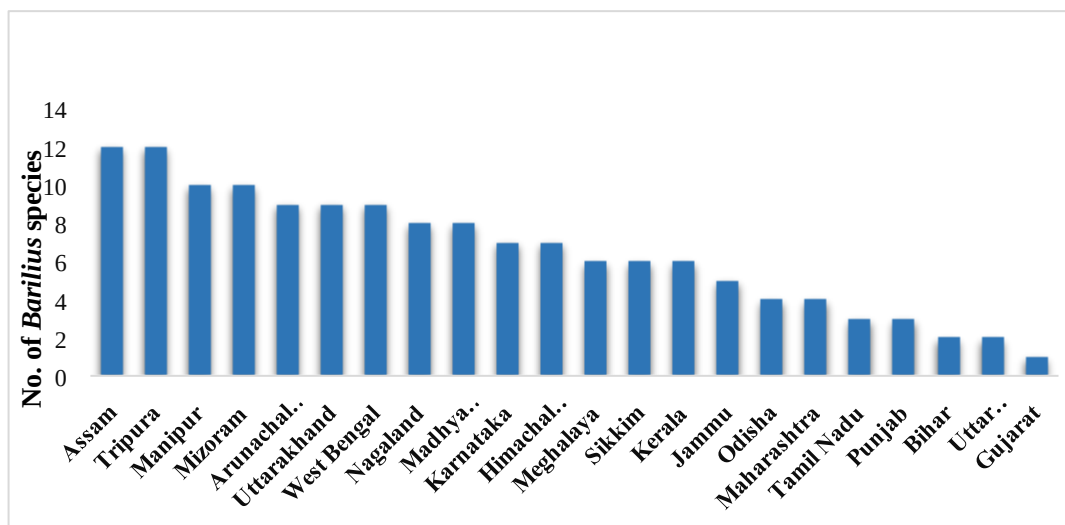


Fig. 2: Total number of *Barilius* species present in the Indian states.

urgent need for conservation measures to protect these fish species in vital freshwater ecosystems from habitat loss, climate change, and overexploitation.

The Western Ghats, a UNESCO World Heritage site, is one of the most ecologically significant regions of India, hosting approximately 30% of the country's total biodiversity (Meena, 2020). However, increasing anthropogenic pressures, such as habitat destruction and industrialization, pose significant threats to native fish species (Yadav, 2000). Among the six states constituting the Western Ghats (Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu), *Barilius* species (5 species) has been recorded. Karnataka hosts the maximum number of *Barilius* species (7 species), followed by Kerala (6 species), Maharashtra (4 species), Tamil Nadu (3 species), and Gujarat (1 species). Notably, *Barilius ardens* is restricted to the Western Ghats, occurring exclusively in the Sita-Swarna River System in Karnataka and the Karyamkode River in Kerala.

The Eastern Indian states- Bihar, Jharkhand, Odisha, Andhra Pradesh, and West Bengal show varied distributions of *Barilius* species. Among these, *Barilius* species are present in Bihar, Odisha, and West Bengal, with the highest diversity recorded in West Bengal (9 species), followed by Odisha (4 species) and Bihar (2 species). *Barilius torsai* is endemic to West Bengal, further emphasizing the importance of region-specific conservation strategies.

Northern India comprises six states (Haryana, Himachal Pradesh, Rajasthan, Uttar Pradesh, Punjab, and Uttarakhand) and three Union Territories (Delhi, Ladakh, and Jammu & Kashmir). *Barilius* species are distributed across four states-- Himachal Pradesh, Uttarakhand, Uttar Pradesh, Punjab and the Union Territory of Jammu. Uttarakhand hosts the highest number of *Barilius* species (9 species), followed by Himachal Pradesh (7 species), Jammu (5 species), Punjab (3 species), and Uttar Pradesh (2 species). Notably, *Barilius pectoralis* is endemic to Uttarakhand.

In Central India, comprising Madhya Pradesh, Chhattisgarh, and Telangana, only Madhya Pradesh hosts *Barilius* species, with 8 species recorded.

Based on endemism and geographical distribution, *Barilius* species can be categorised as widespread, regionally endemic, or shared among multiple biogeographic regions. Three species can be regarded as widespread species which include *Barilius bendelisis*, *Barilius bola*, and *Barilius vagra*. 13 species are endemic to a particular geographical region, among which, seven species, i.e., *B. lairokensis*, *B. kamjongensis*, *B. ngawa*, *B. profundus*, *B. arunachalensis*, *B. chatricensis*, and *B. barnoides* are endemic to North-eastern region; four species, i.e., *B. malabaricus*, *B. ardens*, *B. canarensis*, and *B. cyanochlorus* are endemic to Western Ghats; *B. torsai* is endemic to eastern state of West Bengal; and *B. pectolaris* is endemic to Northern state of Uttarakhand. Some species can be considered as interregionally distributed species, among which *B. bakeri* and *B. gatensis* occur in both North-eastern region and Western Ghats; *B. barila* spans the North-eastern states, Western Ghats, Northern India, and Central India; *B. barna* is found in the North-eastern states, Northern India, Western Ghats and Eastern India; *B. dimorphicus* is common to North-eastern states and Northern India; *B. dogarsinghi* is common to North-eastern states and eastern states; *B. evezardi* occur in Western and Central India; *B. modestus* is common to Northern India and Central India; *B. radiolatus* is common to North-eastern states, Northern India, and Central India; *B. shacra* is common to four region, i.e., North-eastern, Northern, Eastern and Central Indian States; and *B. tileo* is common to North-eastern states, Eastern States, and Northern India.

The distribution and endemism of *Barilius* species across India highlighted the ecological significance of various biogeographic regions, particularly the Northeastern region and the Western Ghats, both of which are recognized as global biodiversity hotspots. With 27 fish species are commonly occurring in 22 states, *Barilius*

exhibits substantial species richness, with notable richness in Assam, Tripura, Uttarakhand, and Karnataka. Several species demonstrate strict regional endemism, underscoring the need for targeted conservation strategies to preserve their habitats of particular aquatic ecosystem. Additionally, the presence of inter-regionally distributed species reflects the ecological connectivity among these freshwater ecosystems. However, unsustainable fishing practices, including the use of fine-mesh nets and destructive techniques, continue to drive population declines (Raghavan *et al.*, 2018). Urgent conservation measures must be initiated based on present data of distribution patterns, and ecological requirements of *Barilius* fish species to safeguard as conservation, protection and rehabilitate these fish species in freshwater bodies of India.

Conclusion

This study emphasizes the remarkable species richness and endemism of *Barilius* species in India, especially in biodiversity hotspots like the Northeastern region and the Western Ghats. While several species of *Barilius* span different biogeographic zones, 13 species demonstrate strict regional endemism, making them essential for maintaining freshwater biodiversity. However, due to overfishing, pollution, and habitat loss, several *Barilius* species face serious conservation threats despite their ecological significance. These issues are made worse by riverine habitat fragmentation, hydrological changes brought about by dam construction, and climate change-induced variations in water temperature and flow regimes further exacerbating these challenges. To ensure the long-term survival of *Barilius* species, conservation strategies should focus on creating protected areas, sustainable fisheries management, and habitat restoration. Enhancing taxonomic and ecological studies is crucial for uncovering cryptic species and effectively evaluating population trends. The existing data on *Barilius* species is limited, indicating a substantial opportunity for the identification of new species.

Thus, further ichthyological research is necessary to enhance our understanding of their ecological significance and biodiversity within Indian freshwater ecosystems. By mitigating habitat degradation, enforcing strict laws of sustainable fishing, and improving scientific documentation, effective conservation measures can be implemented to safeguard these ecologically important fish species for future generations.

Ethical Statement

No animals or microbes have been sacrificed for this study, hence Ethical Approval is not required.

Author Contributions

Each author has contributed equally to the study's planning, analysis, writing, and editing. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

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