International Journal in Management and Social Science
Volume 09 Issue 11, November 2021 ISSN: 2321-1784 Impact Factor: 7.088
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

GROWTH PATTERN OF FISHES IN COLD WATER

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ABSTRACT

Fish can also be divided into three groups by anglers: warm-water fish, cool-water fish, and cold-water fish. It refers to fish species that can survive in a standard indoor aquarium without a heater when used in the context of aquariums. Fish ecology can benefit from growth patterns as a management and handling technique for aquatic habitats, for instance. The current study examines 108 fish species from 17 families and 54 genera that fall into the prospective cold water fish category, as well as their economic significance for the aquarium, aquarium food, aquarium+food+game, food, and food+game industries as reported from Arunachal Pradesh. The Museum of Arunachal Pradesh Regional Centre (APRC) of the Zoological Survey of India, Itanagar, now houses 87 fish species. The remaining 21 species were added and given priority here as possible cold-water fish based on consultation with various secondary sources.

KEYWORDGrowth; Growth-Performance; Cold Water; Fishes and Freshwater

INTRODUCTION

It refers to fish species that can survive in a standard indoor aquarium without a heater when used in the context of aquariums. The majority of ornamental fish species, if not all of them, can survive in conditions as cold as or even colder than room temperature, with the majority of stenothermic tropical species having essential thermal minimums of between 10 and 12 °C. These fish can live in cold aquariums;however, they may have different preferred temperatures. Koi, goldfish, and pond loaches, for instance, are frequently thought of as cold-water fish because of their capacity to endure extremely low temperatures, but their preferred temperature ranges and/or physiological optimal temperatures are 32 °C (90 °F), 24 °C to 31 °C (75 to 88 °F), and 26 °C to 28 °C (79 to 82 °F), respectively.

Fish can also be divided into three groups by anglers: warm-water fish, cool-water fish, and cold-water fish. Warm-water fish, or species that prefer to live in somewhat warm water, include largemouth bass, sunfish, and bullhead catfish in North America. Although they can survive in a wide variety of temperatures, cool-water species like smallmouth bass and walleye are more prevalent in cooler rivers or the deeper regions of ponds and lakes. Cold-water species, including char, trout, salmon, grayling, and burbot, are most active in cold water and become stressed at high temperatures. Since these classifications are informal, various authorities may acknowledge various distinctions between the categories' preferred ranges of temperatures.

Fish ecology can benefit from growth patterns as a management and handling technique for aquatic habitats, for instance. In reality, the growth pattern is regularly used to analyze the life histories of several fish species or the same species from various geographic locations. On the one hand, the growth pattern has been widely utilized to assess stock biomass, population dynamics, and biogeographical linkages. When conducting a field survey, growth patterns can be used to convert length to weight and vice versa, particularly when only length or weight measurements are available. More specifically, in the laboratory, the parameter a and b are used to determine whether the fish growth is allometric or isometric, sparking discussions about the biology of these species. One of the most crucial factors in life history theory is fish individual progress. Indeed, the process of an organism's growth is quite complex. Fish growth is influenced by environmental variables as well as genetic characteristics in addition to behavior. Gerdes discovered that for Coldwater fishes, environmental factors account for 70–80% of growth and genetic factors account for the remaining 20%.

Among the freshwater fishes of India, cold water fish are significant. The cold-water fisheries deal with fishing in water that is between 5 and 25 degrees centigrade in temperature. Even in the summer, the water temperature for cold water fisheries should not exceed 25°C. In India, the Himalayan and peninsular regions experience these conditions. India has many natural resources, including highland rivers and streams, lakes at both high and low altitudes, and man-made reservoirs located in both the Himalayan and Western Ghats.

LITERATURE REVIEW

Minrui Huang et.al (2021) Fishes are being seriously and increasingly threatened by global climate change, which leaves the future of both global fisheries and the diversity of wild fish in question. For signaling and forecasting the effects of climate change on fish populations, communities, and even aquatic ecosystems, it is crucial to understand how fish growth adapts to changing surroundings. However, research on this topic is still lacking, and some findings are conflicting. By examining data on the environment, species, and response patterns from 1187 documents published between 1976 and 2018, this study aimed to review the state of current research. This analysis helped to identify important questions that are currently being ignored as well as potential causes for these divergences. According to the findings, 75% of investigations (mainly in temperate and subtropical regions) were carried out in the field, while the remaining studies were all controlled experiments.

M A Parisi et.al (2020) As big, bottom-release dams are constructed, cold-water pollution (CWP) is being more recognized as a serious hazard to aquatic populations. Cold water releases, which can lower the temperature of downstream waters by up to 16°C, generally happen during the summer when storage dams release unexpectedly cold and anoxic hypolimnetic waters. These hypothermic conditions may endure for several months, depending on the length of the discharge. The kind and scope of CWP effects on ectothermic species may depend on their ability to withstand or quickly adapt to abrupt temperature fluctuations. This study evaluated how juvenile silver perch (Bidyanusbidyanus) respond to a sudden drop in water temperature in terms of physiological function and locomotor performance. It also looked at how well they could use phenotypic plasticity to thermally compensate for the depressive effects of low temperatures.

frequently involves identifying and prioritizing areas that maintain a suitable level of coolness during the summer. Even if they are acceptable for moving animals for the most of the year, this implies a low regard for ephemerally warm locations. Here, with a focus on riverine fish, we construct an alternative conceptual framework called the development regime that takes seasonal and geographic variation in physiological performance into account. We demonstrate that development opportunities spread up and down river networks on a seasonal basis using temperature models for 14 river basins, and that downstream habitats that are suboptimally warm in the summer may actually supply the majority of growth potential expressed annually. Using an agent-based simulation, we show how the usage of warmer downstream habitats during the shoulder seasons can support annual fish production. Our research underscores the danger of conservation methods that fail to recognize the importance of warm habitats and indicates a synergy between cold and warm habitats that may be essential to the survival of cold-water fisheries.

SaharChauffourMejri et.al (2021) The identification of important nutrients, such as essential fatty acids (EFA), is necessary to increase the survival of captive fish species throughout their early developmental phases (larvae and juveniles). Because lipids are primarily used to preserve cell membrane integrity in fishes (homeoviscous adaptation), the physiological requirements are likely to vary among species, especially among those employing various thermal settings. The Florida pompano (Trachinotuscarolinus), a warm-water marine species, and the winter flounder, a cold-water marine species, have optimal qualitative EFA requirements during larval and early juvenile stages. This review paper will concentrate on recently published research and the key findings from our laboratories in this area (Pseudopleuronectesamericanus).

Angel Lazaro-Velasco et.al (2019) Since it was shown that water temperature plays a significant role in the process of sex differentiation in Nile tilapia, it has been proposed as an option to removing the usage of steroids. But the use of cold water to feminize animals has rarely been studied, and it has never been paired with exogenous estrogens. This study examined the effects of low estrogen concentrations and cold-water temperature on growth metrics, gonadosomatic index, and fat muscle content to see if the proportion of females might be raised. Two trials were conducted, with the water temperatures for each experiment being 27.5°C and 21.5°C, respectively. Four treatments (each in triplicate)—control (no estrogens), estradiol-17 E2, 17-ethinylestradiol EE2, and diethylstilbestrol DES—were examined in each trial. With

METHODOLOGY

By reading published works that aggregate information on the cold-water fishes of Afghanistan, Pakistan, India, Nepal, Bhutan, China, and Myanmar, a list of possible cold-water fish was created. Economic worth was then given priority. After carefully examining each species' potential, other potential fish species—other than those mentioned in the aforementioned references—were added here with regard to the two aforementioned criteria. There were also conventional cold-water exotic fishes used as food or game fish. The majority of the possible cold-water fishes listed here and kept in the APRC museum were gathered by the authors during the many scientific expeditions they undertook over the previous three years. Although 21 species were listed and given priority here as prospective cold-water fish, they were consulted from secondary sources and were not present in the APRC museum. The California Academy of Sciences' online fish catalog was followed in updating the scientific names of valid taxa that were present in this list.

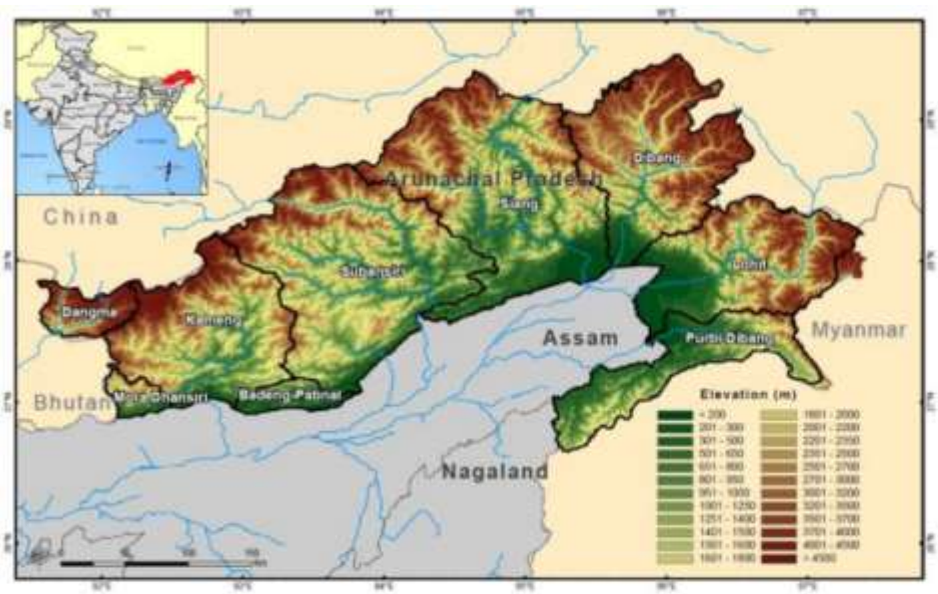

Fig 1. Topography and river basin map of Arunachal Pradesh (Courtesy: Dept. of Fishery, Govt. of AP)

Cold Water Fisheries In Arunachal Pradesh

The Arunachal Pradesh government established the first trout hatchery near the stream of Nuranang at an elevation of roughly 12000 feet in 1967, launching the state's cold-water fisheries program. Fishery Department in Tawang District with two exotic species, the Rainbow trout and Brown Trout seed (Oncorhynchus mykiss and Salmotruttafario), imported from Jammu and Kashmir, and a second trout hatchery at Shergaon, West Kameng District located at an elevation of 8000 ft. with the Brown Trout seed imported from Himachal Pradesh during 1974–1975. The state has evolved into a role model for other North Eastern states and has frequently provided Nagaland, Meghalaya, and other states with trout seeds. Oncorhynchus mykiss was discovered in a natural stream far from the hatchery region in the Papum Pare district, according to a report by Bagra et al. (2009), which suggests that the species has already become established in the wild. This is likely the result of escape from the hatcheries. According to Sen and Khynriam (2014), the aquatic biome of Arunachal Pradesh offers great habitats to at least 225 fish species that are distributed from the sub-Himalayan region to the Greater Himalayan ranges. Out of the 225 species that have been reported from the state, at least 108 species, representing 54 genera and 17 families, including two exotic species (Oncorhynchus mykiss and Cyprinuscarpio), have been considered potential cold-water fish and also have economic significance for the aquarium, food, aquarium+food, aquarium+food+game, and food+game industries, as shown below (Table 1).

Out of these 108 species, 87 species are housed at the APRC Museum with particular registration numbers under 15 families and 47 genera. As additional potential cold water fish species, the following 28 species from 8 families and 18 genera have been included. Nemacheilidae: Aborichthyscataracta, Aborichthyselongatus, Aborichthyskempi, Shisturadevdevi; Amblycipitidae: Ambycepsapangi; Cyprinidae: Bariliusarunachalensis, Garraarunachalensis, Garraarupi, Garrabirostris, GarraBhavaniaarunachalensis of the Balitoridae; Psilorhynchusarunachalensis of the Psilorhynchidae; Batasiomerianiensis of the Bagridae; and Creteuchiloglanisarunachalensis of the Sisoridae; Exostomalabiatum of the Sisoridae; Pseudechene

According to the information in Table 1, the majority of the 108 cold water fish species, or 36 species, are ornamental. This is followed by 32 species, or 29.6%, that have both ornamental and food value. Along with food fish, 15 species (13.8%) also have aquarium and sport fish. Ten species, or 9.2% of all species, have only decorative, food, or recreational value. Schizothoraxrichardsonii, Schizothoraxprogastus, Schizothoraxplagiostomus, Neolissochilushexagonolepis, Tor tor, and Tor putitora are the most significant native cold-water fishes and have both economic and commercial worth in terms of food and recreational value.

DATA ANALYSIS

In India, the state is well renowned for its abundant resources of ornamental fish. Since quite some time, native wild caught ornamental fish have been sent to states like Assam and Kolkata for this lucrative business, which is currently under the jurisdiction of law enforcement officials. 78 cold water fish species were discovered to have ornamental fishery potential throughout the current investigation. Local fish species include Channa, Colisa, Barilius, and Botia spp. are in high demand on both the domestic and global markets. Even while the price for breeders or collectors can be as little as 3/4 per piece, the price of each fish even increases to US$ 4.825 per piece on the international aquarium fish market. However, the cost of native ornamental fishes on the domestic market ranged from Rs 3 to Rs 50 per piece (Mandal et al., 2007). If we can artificially propagate these highly sought-after fish through ornamental fish farming, it might be a good source of income for many households.

The state's numerous rivers and rivulets provide sufficient opportunity for the development of sports fisheries and can provide thrilling angling possibilities. Sport fishing is fishing for fun or competition, as opposed to commercial fishing, which is fishing for a living. By creating a sport fishing region, the state can generate a sizable amount of cash from these leisure activities. Sport fishing is already a billion-dollar industry in the United States. The state of Arunachal Pradesh also includes a lot of river terrains that are unexplored by humans and may offer opportunities for international sport fishing tourists. There are a few locations in the state where anglers can catch trout and Mahseer, including Bhalukpong and Tipi on the Kameng River, Pasighat on the

Siang River, and Tezu on the Lohit River. Up to 25 fish species have the potential to be used for sport fishing, according to this study.

The inhabitants of north eastern India generally believe that all fish are intended for human consumption. There is no such thing as trace fish in this area; simply the application of preferring one fish species over another. Popular cold-water fish with high food value, such as Schizothoraxrichardsonii, Schizothoraxprograstus, Tor tor, Tor putitora, and Neolissochilushexagonolepis, can be purchased at the local fish market for more than 800/kg. However, a variety of different species of fish, such as Barilius spp., Botia spp., Puntius spp., Garra spp., Lepidocephalichthys spp., Schistura spp., etc., are frequently available in the local market and can be purchased for prices that are just as exorbitant as those of their larger counterparts (300/500 gm). The locals in the state consume a total of 72 different types of cold-water fish as food, including conventional species that are in high demand.

On various water bodies throughout the state, different levels of intensity of subsistence fishing are practiced. Near the actual catch locations, the majority of the fish that are captured are eaten. The lentic water bodies, such as homestead ponds, lakes, and reservoirs, located in middle and high-altitude ranges, can be taken into consideration for aquaculture purposes, primarily for the production of food and ornamental fish. Large lakes and reservoirs, as well as the numerous rivers and streams that crisscross the state's topography, can be used for fishing operations, mostly to catch game fish and food fish. However, sustainability and environmental concerns should be given first priority before using any of the state's aquatic fisheries resources, as two invasive species, Oncorhynchus mykiss and Cyprinuscarpio, have already established themselves in the state's natural water bodies.

Table 1. List of voucher specimens of potential cold-water fish of Arunachal Pradesh

SN	Family	Species list	Economic value	Altitude(m)	APRCReg.no.ZSI/V/APRC	consulted
1.	Nemacheilidae	*AborichthyscataractaArunachalam et al, 2014	A	1550	P-1103	1
2.	Nemacheilidae	*AborichthyselongatusHora, 1921	A	600	P-347	2,3
3.	Nemacheilidae	*AborichthyskempiChaudhuri, 1913	A	1053	P-870	2,3
4.	Nemacheilidae	*Acanthocobitisbotia (Hamilton, 1822)	A	573	P-918	2,3

5.	Amblycipitidae	*AmblycepsapangiNath and Dey, 1989	A	615	P-630	2,3
6.	Amblycipitidae	AmblycepsarunachalensisNath and Dey 1989	A	-	P-413	2,3
7.	Amblycipitidae	Amblycepsmangois (Hamilton, 1822)	A	-	P-005	3,4
8.	Cyprinidae	Amblypharyngodonmola (Hamilton, 1822)	A, F	-	P-374	2
9.	Badidae	Badisbadis (Hamilton, 1822)	A	1540	P-616	3,4
10.	Balitoridae	Balitorabrucei Gray, 1830	A	173	P-860	2,3
11.	Cyprinidae	Banganaariza (Hamilton 1807)	F	-	NA	5
12.	Cyprinidae	Banganadero (Hamilton, 1822)	F, G	1500	P-287	2,3
13.	Cyprinidae	*BariliusarunachalensisNath, Dam and Anil Kumar, 2010	A, F. G	-	P-502	6
14.	Cyprinidae	Bariliusbarila (Hamilton 1822)	A, F	-	NA	5
15.	Cyprinidae	Bariliusbarna (Hamilton, 1822)	A, F, G	199	P-970	2,3
16.	Cyprinidae	Bariliusbendelisis (Hamilton, 1807)	A, F, G	650	P-265	2,3
17.	Cyprinidae	Bariliustileo (Hamilton, 1822)	A, F, G	143	P-997	2,3
18.	Cyprinidae	Bariliusvagra (Hamilton 1822)	A, F, G	676	P-552	2,3
19.	Bagridae	Batasiobatasio (Hamilton 1822)	A	-	NA	2,3
20.	Bagridae	*Batasiomerianiensis (Chaudhuri, 1913)	A	408	P-1022	7
21.	Balitoridae	*BhavaniaarunachalensisNath et al., 2007	A	-	P-488	8
22.	Cyprinidae	Cabdiomorar (Hamilton, 1822)	F	500	P-010	2,3
23.	Cyprinidae	Chaguniuschagunio (Hamilton, 1822)	F, G	650	P-256	2,3
24.	Channidae	Channagachua (Hamilton, 1822)	A, F, G	1540	P-606	9
25.	Channidae	Channaorientalis (Bloch and Schneider, 1801)	A, F, G	700	P-040	2, 3
26.	Channidae	Channa punctatus (Bloch, 1793)	A, F, G	650	P-240	2,3
27.	Channidae	Channa striata (Bloch, 1793)	A, F, G	373	P-041	2
28.	Schilbeidae	Clupisomagarua (Hamilton 1822)	F	-	NA	3
29.	Sisoridae	*Creteuchiloglanisarunachalens	A, F	1600	P-844	7

		isSinha and Tamang, 2014				
30.	Sisoridae	*Creteuchiloglaniskamengensis (Jayaram, 1966)	A, F	1586	P-863	2,3
31.	Sisoridae	*CreteuchiloglanispayjabDarshan et al, 2014	A, F	1932	P-921	10
32.	Cyprinidae	#CrossocheilusburmanicusHora 1936	F	-	NA	11
33.	Cyprinidae	Crossocheiluslatius (Hamilton, 1822)	F	650	P-255	2,3
34.	Cyprinidae	Cyprinionsemiplotum ((McClelland, 1839)	F, G	348	P-964	2,3
35.	Cyprinidae	Cyprinuscarpio (Linnaeus, 1758)	A, F	1555	P-525	2,3
36.	Cyprinidae	*Daniodangila (Hamilton, 1822)	A	1512	P-750	2,3
37.	Cyprinidae	Danio rerio (Hamilton, 1822)	A	1540	P-541	2,3
38.	Cyprinidae	Davariodevario (Hamilton, 1822)	A	118	P-730	2,3
39.	Cyprinidae	Devarioaequippinnatus (McClelland, 1839)	A	1124	P-869	2,3
40.	Cyprinidae	Esomusdanricus (Hamilton 1822)	A	-	NA	2
41.	Sisoridae	*Exostomalabiatum (McClelland, 1842)	A, F	1594	P-751	2
42.	Cyprinidae	Garraannandalei (Hora, 1921)	A, F	1000	P-615	2,3
43.	Cyprinidae	*GarraarunachalensisNebeshwar and Vishwanath, 2013	A, F	406	P-959	12
44.	Cyprinidae	*GarraarupiNebeshwar et al., 2009	A, F	529	P-1027	14
45.	Cyprinidae	*GarrabirostrisNebeshwar and Vishwanath, 2013	A, F	-	P-1111	12
46.	Cyprinidae	Garragotylagotyla (Gray, 1830)	A, F	676	P-548	12
47.	Cyprinidae	*GarrakalpangiNebeshwar et al. 2012	A, F	573	P-1084	16
48.	Cyprinidae	Garralamta (Hamilton 1822)	A, F	-	NA	2
49.	Cyprinidae	Garralissorhynchus (McClelland, 1842)	A, F	272	P-565	2

50.	Cyprinidae	*GarramagnidiscusTamang, 2013	A, F	429	P-622	16
51.	Cyprinidae	*GarraquadratirostrisNebeshwar and Vishwanath, 2013	A, F	522	P-1128	12
52.	Sisoridae	Glyptothoraxcavia (Hamilton, 1822)	A	-	P-400	2
53.	Sisoridae	Glyptothoraxconirostris (Steindachner, 1867)	A	-	P-060	11
54.	Sisoridae	Glyptothoraxpectinopterus (McClelland, 1842)	A	-	P-404	3, 11
55.	Sisoridae	Glyptothoraxtelchitta(Hamilton, 1822)	A	127	P-878	2
56.	Sisoridae	Glyptothoraxtrilineatus (Blyth, 1860)	A	296	P-585	17
57.	Heteropneustidae	Heteropneustesfossilis (Bloch, 1794)	F, G	1500	P-289	2,3
58.	Cyprinidae	Labeocalbasu (Hamilton, 1822)	F	650	P-250	2
59.	Cyprinidae	Labeodyocheilus (McClelland 1839)	F	-	NA	2
60.	Cyprinidae	Labeogonius (Hamilton, 1822)	F	650	P-243	2,3
61.	Cyprinidae	Labeopangusia (Hamilton, 1822)	F	600	P-224	2,3
62.	Cyprinidae	Laubucalaubuca (Hamilton, 1822)	A	650	P-251	2,3
63.	Cobitidae	Lepidocephalichthysguntea (Hamlton, 1822)	A, F	600	P-348	2,3
64.	Mastacembelidae	Mastacembalusarmatus (Lacepede, 1800)	A, F	500	P-079	2,3
65.	Bagridae	Mystusbleekeri Day, 1877	A, F	172	P-979	2
66.	Bagridae	Mystuscavasius (Hamilton, 1822)	A, F	143	P-1000	2
67.	Bagridae	Mystusvittatus (Bloch, 1794)	A, F	500	P-351	2
68.	Nandidae	Nandusnandus (Hamilton, 1822)	A, F	1500	P-290	2
69.	Cyprinidae	Neolissochilushexagonolepis (McClelland, 1839)	F, G	1500	P-286	2,3

70.	Cyprinidae	*Neolissochilushexastichus (McClelland 1839)	F, G	-	NA	11
71.	Siluridae	Ompokbimaculatus (Bloch 1794)	F	-	NA	2
72.	Siluridae	Ompokpabda (Hamilton, 1822)	F	168	P-686	2
73.	Salmonidae	Oncorhynchusmykiss (Walbaum 1792)	F	-	NA	2
74.	Cyprinidae	Osteobramacotio (Hamilton 1822)	F	-	NA	2
75.	Sisoridae	Parachiloglanishodgarti (Hora, 1923)	A, F	1586	P-864	2,3
76.	Cyprinidae	Pethiaconchonius (Hamilton, 1822)	A	1540	P-540	2,3
77.	Cyprinidae	Pethiaticto (Hamilton, 1822)	A	1594	P-755	2,3
78.	Sisoridae	#PseudecheneissirenicaVishwanath and Darshan, 2007	A	429	NA	15
79.	Sisoridae	Pseudecheneissulcata (McClelland 1842)	A, F	173	P-851	2,3
80.	Psilorhynchidae	Psilorhynchusbalitora (Hamilton, 1822)	A	650	P-258	2,3
81.	Psilorhynchidae	*Psilorhynchusarunachalensis (Nebeshwar, Bagra and Das, 2007)	A	1586	P-865	18
82.	Siluridae	*Pterocryptisgangelica Peters,1861	A, F	300	P-915	2
83.	Cyprinidae	Puntius chola (Hamilton, 1822)	A, F	132	P-716	2,3
84.	Cyprinidae	Puntiussophore (Hamilton, 1822)	A, F	650	P-263	2,3
85.	Cyprinidae	Raiamas bola (Hamilton, 1822)	A, F, G	229	P-1024	2
86.	Cyprinidae	Rasboradaniconius (Hamilton, 1822)	A	199	P-967	2
87.	Cyprinidae	#Rasbora rasbora (Hamilton, 1822)	A, F	-	NA	2,3
88.	Cyprinidae	Salmophasiabacaila (Hamilton 1822)	A, F	-	NA	2
89.	Cyprinidae	Salmostomaphulo (Hamilton, 1822)	A	143	P-996	11

90.	Nemacheilidae	Schisturabeavani (Gunther 1868)	A	A	NA	19
91.	Nemacheilidae	*Schisturadevdevi (Hora, 1935)	A	450	P-601	3 ,11
92.	Nemacheilidae	Schisturarupecula (McClelland, 1838)	A	615	P-627	2,3
93.	Nemacheilidae	Schisturasavona (Hamilton, 1822)	A	218	P-982	11
94.	Nemacheilidae	Schisturascaturigina McClelland, 1839	A	143	P-999	11
95.	Cyprinidae	SchizopygopsisstoliczkaiSteindachner 1866	F, G	-	NA	3
96.	Cyprinidae	SchizothoraxesocinusHeckel 1838	F, G	-	P-207	11
97.	Cyprinidae	Schizothoraxmoleswort (Chaud hii huri 1913)	F, G	-	NA	13
98.	Cyprinidae	Schizothoraxplagiostom Heckel us 1877	F, G	-	NA	5
99.	Cyprinidae	Schizothoraxprogastus (McClelland, 1839)	F, G	1088	P-101	2,3
100.	Cyprinidae	Schizothoraxrichardsonii (Gray, 1832)	F, G	290	P-767	2,3
101.	Cyprinidae	#Semiplotusmodestus (Day 1870	F	-	NA	5
102.	Bagridae	Sperataseenghala (Sykes, 1839)	A, F	700	P-009	2
103.	Cyprinidae	Systomussarana (Hamilton, 1822)	A, F	148	P-1015	2,3
104.	Cyprinidae	#Tor progeneius (McClelland 1839)	F, G	-	NA	5
105.	Cyprinidae	Tor putitora (Hamilton 1822)	F, G	619	P-586	2,3
106.	Cyprinidae	Tor tor (Hamilton, 1822)	F, G	1500	P-294	2,3
107.	Siluridae	Wallagoattu (Schneider, 1801)	F	135	P-790	2,3
108.	Belonidae	Xenentodoncancila (Hamilton, 1822)	A	229	P-1023	2

[A: Aquarium; F: Food; G: Game; NA: Species not available in APRC Museum; #: Additional species considered as potential cold-water fish; *: Species available in APRC Museum; 1: Arunachalam et al., 2014; 2. Bagra et al., 2009; 3. Nath and Dey, 2000; 4. Sen,1985; 5. Sen and Khynriam, 2014; 6. Nath et al., 2010; 7: Tamang and Sinha, 2014; 8: Nath et al., 2007; 9:

Vishwanath and Geetakumari, 2009; 10: Darshan et al., 2014; 11: Sen, 2000; 12: Nebeshwar and Vishwanath, 2013; 13: Chaudhuri, 1913; 14: Nebeshwar et al., 2009; 15: Vishwanath and Darshan, 2007; 16: Nebeshwar et al., 2013; 17: Tesia and Bordoloi, 2012; 18: Nebeshwa et al, 2007; 19: Sen, 1985]

CONCLUSIONS

The majority of ornamental fish species, if not all of them, can survive in conditions as cold as or even colder than room temperature, with the majority of stenothermic tropical species having essential thermal minimums of between 10 and 12 °C. Warm-water fish, which prefer to live in moderately warm waters, include largemouth bass, sunfish, and bullhead catfish in North America. Indeed, the process of an organism's growth is quite complex. According to Sen and Khynriam (2014), the aquatic biome of Arunachal Pradesh offers great habitats to at least 225 fish species that are distributed from the sub-Himalayan region to the Greater Himalayan ranges. Out of the 225 species that have been reported from the state, at least 108 species, representing 54 genera and 17 families, including two exotic species (Oncorhynchus mykiss and Cyprinuscarpio), have been considered potential cold-water fish and also have economic significance in terms of aquarium, food, aquarium +food, aquarium +food+ game, and food +game, as indicated.

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