

# A report on the occurrence of two exotic cold-water fishes in the natural water bodies of Arunachal Pradesh-Northeast India

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## Abstract

The introduction of aquatic exotic species without proper background research especially in the biodiversity-rich area is a threat to our native fish diversity since the exotic species are responsible in reducing native fish populations through predation, displacement, and food competition and also may cause genetic erosion of indigenous species by producing hybrids. The present communication is about the report of two exotic salmon which are occurred out of their culture areas in the Arunachal Pradesh state.

**Keywords:** Biodiversity, Exotic Species, Fish, Natural Water Bodies

## Introduction

The species either plant or animal including its seeds, eggs, spores capable of propagating in an area outside of their natural geographic range are known as exotic or introduced species or alien species or foreign species or non-indigenous species, or non-native species or allochthonous species. Such species are found apart from the ecosystem they evolved from either intentionally or accidental by human's activity or by natural process. Many plants and animals disperse naturally into new habitats, but the most damaging invasions are usually caused by human activity, whether deliberate or accidental. Non-native species are not always harmful, and in fact, most of the introduced species are harmless but when an exotic species become established and spread beyond the place of introduction profusely causing harm to the new ecosystem, they are called invasive species. In the extreme case, such non-native species can lead to the extinction of native species by predation, habitat displacement and dispersal of new diseases in that niche and competition for limited resources. The impact of introduced species is highly variable depending on the type of species.

Arunachal Pradesh is one of the northeastern states of India having an area of 83,743 km<sup>2</sup>, situated between 26° 28' to 29° 30' N and 90° 30' to 97° 30' E, is a part of Eastern Himalayan Region hot spot. The topography of

the state consists of varied watershed pattern where the mountainous ranges are sloping towards the plains of Assam ranging with an elevation from 50m in the foot-hills & gradually ascending to 7000m. The undulating topography of this area gives rise to a large number of torrential hill streams, rivulets, rivers and mostly drain into the mighty River Brahmaputra in Assam. Due to these diverse physiographic features, the region is enriched with diverse forms of fishes and makes a rewarding platform for ichthyological studies.

The use of exotic species for fisheries and aquaculture has been practiced to meet the rising demand for high nutritional food. Many species have been introduced in different geographical locations for various regions, until now, more than 300 species of exotic fishes have been introduced in India for various purposes (Kumar, 2000). A considerable part of the introduced fish comes from aquarium keeping. India's own Blue Revolution would not have been successful without the introduction of three exotic species (Grass carp, Silver carp and Common carp). However, the exotics are a competitor for indigenous fishes for food and habitat. They may prey upon native fishes, introduce new diseases and parasites results in the production of hybrids and cause genetic pollution and degradation of the quality of the aquatic ecosystem. All these will subsequently lead to the loss of precious biodiversity (Nyman, 1991). The potential

risks are not only the effects on the quality or level of biodiversity, but also on the socio-economic aspects of the human community that depend on aquatic ecosystem for their sustenance (Philipp *et al.*, 1995). Indiscriminate use of any alien fish species without following protocols may results unwanted change in the native ecosystem.

*Cold water fishery programme of Arunachal Pradesh:* The programme in the state has been initiated as early as 1967 by the establishment of first Trout Hatchery along the Nuranang stream in Tawang District at an altitude of about 12000 ft by the Fishery Department of Government of Arunachal Pradesh with two exotic species, the Rainbow trout and Brown Trout seed (*Oncorhynchus mykiss* and *Salmo trutta fario*) imported from Jammu & Kashmir. Another trout hatchery was established at Shergaon, West Kameng district located at an elevation of 8000 ft. with seed imported from Himachal Pradesh during 1974-75. Effort has been made by the Department of Fisheries and ICAR-DCFR for the rehabilitation of trout populations in these streams, especially the Nuranang stream and Choskorong Kho River, adjoining the two Government established trout hatcheries at Nuranang and Shergaon villages, respectively (Figure 1). The Sela Lake connected upstream is now the source of trout brood stock in the Government trout hatchery. (Baruah *et al.*, 2017). Exotic trout farmers should adhere to the principles contained in the FAO Code of Conduct for Responsible Fisheries and

the FAO Technical Guidelines for Responsible Fisheries (FAO Fisheries and Aquaculture Department).

## Results

### Systemic Account

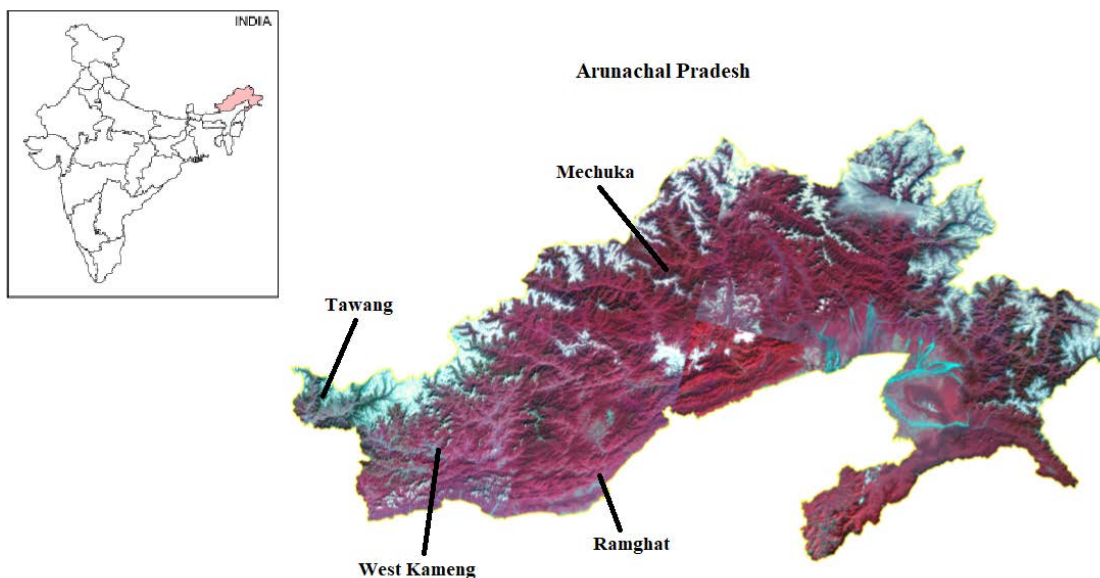
Phylum	CHORDATA
Class	ACTINOPTERYGII
Order	SALMONIFORMES
Family	SALMONIDAE
Genus	<i>Salmo</i> Linnaeus 1758

### *Salmo trutta* Linnaeus, 1758

1758. *Salmo fario* Linnaeus, *Systema Naturae*, Ed. X. Holmiae. v. 1: i-ii + 1-824.

1987. *Salmo trutta*: Lelek, *Threatened fishes of Europe*. Aula-Verlag, Wiesbaden. 9: 105.

Common Name: Brown Trout.



**Figure 1.** Map of Arunachal Pradesh showing different sites where the exotic salmon are reported.

*Materials examined:* 1 ex, Yangyup river, a tributary of Siyom river, Mechuka, Shi-Yomi District, Arunachal Pradesh with the geographical coordinates of 28.5314 North 94.1242 East (Not registered)

*Distribution:* It has wide geographical range of distribution. The native range of the fish is Europe, northern Africa, and western Asia (Page and Burr 1991).

*Remarks:* The species is identified as Invasive and other problematic species, genes and diseases category as per IUCN and also listed in the Global Invasive Species Database (2019). The effects of Brown Trout on local population were done by researchers like Nyman (1970), Waters (1983) and DeWald *et al.*, (1992) and showed that the species been implicated in reducing native fish populations through predation, displacement, and food competition. McAfee 1966 opined that the species is responsible for the near-extinction of some species. There are also reports of hybridization with natives though occurs very rarely (Brown 1966). However, introductions failed to establish populations in natural water bodies since natural reproduction of the species is low or nonexistent in most of the states where it has been introduced. However, if the fish population is maintained with periodic stoking the species may also reproduce in the natural water (Courtenay *et al.*, 1984).

The fish was introduced in India in the year 1863 from the UK and to the state 1967 as a game fish and for cold water fishery programme. In India, very negligible research has been done on the impact of the species on the local fish population, especially in biodiversity rich areas (Singh *et al.*, 2013; Swain *et al.*, 2017). Since there is no concrete evidence to prove that the species has established in the natural water bodies in India, the species has been using for aquaculture purpose by the different state fisheries departments of India, including Arunachal Pradesh. However, the release of the brood of such species in natural water bodies by risking the fragile ecosystem should not be done especially in the biodiversity hot spots area because of its other confirmed report of negative effects on the natural ecosystem and also because of the unpredictability of nature. Under the cold-water fishery programme, the state fishery department along with Directorate of Coldwater Fisheries Research, ICAR established trout stocks in the districts, so getting the species from nearby river and stream is anticipated.

Genus *Oncorhynchus* Suckley 1861

*Oncorhynchus mykiss* (Walbaum 1792)

1792. *Salmo mykiss* Walbaum, *Ichthyologiae* pars III. Ant.

Ferdin. Rose, *Grypeswaldiae* [Greifswald]. Part 3: [i-viii] + 1-723, Pls. 1-3.

1993. *Oncorhynchus mykiss*: Stearley, R.F. and Smith, G.R.:

*Trans. Am. Fish. Soc.* **122**(1): 21.



Picture courtesy Bagra *et al.*, 2009

*Common name:* Rainbow trout.

*Materials examined:* 5 ex., Poma River, Ramghat, Papumpare district, RGUMF-0166, 26°57'38" N 93°24'26" E 129, Alt.129 msl.

*Distribution:* The native range of the fish is the Eastern Pacific Ocean and the freshwater, mainly west of the Rocky Mountains, from northwest Mexico, to the Kuskokwim River, Alaska (MacCrimmon 1971). Currently the rainbow trout has been widely introduced into suitable environments throughout the United States and around the world. Many of these introductions have established wild, self-sustaining populations (Fuller *et al.*, 1999).

*Remarks:* *Oncorhynchus mykiss* are primarily freshwater fish, although sea-run populations, often known as steelhead, exist in some areas. The species has been introduced worldwide because of its flexibility and adaptability to new habitats, including hatcheries, lakes, rivers, ponds, and artificial impoundments. Few considerations seem to limit its distribution; however, successful spawning in rivers in Europe is uncommon as per NOBANIS -Invasive Alien Species Fact Sheet. Studies have been done on the capability of natural hybridization with native species (Hitt *et al.*, 2003; Boyer, *et al.*, 2008; Corsi *et al.*, 2013) and found that it leads to the eradication of local species and threatened with genomic extinction. The species has also been included in the Global Invasive Species Database (2019) because of its ability of hybridisation, disease transmission, predation and competition with native species. As per the database, some species, have become virtually extinct because of this and also some other native fish also affected by hybridization with the species in many countries.

*Salmo gairdnerii*, that have been introduced to India in the year 1907 from Sri Lanka and Germany has been synonymized to *Oncorhynchus mykiss*, and the former retain as a valid name. Five juvenile specimens of Rainbow trout were reported from Poma River near Ramghat by Bagra *et al.* (2009). The place where this fish was caught was near the border of Assam Arunachal Pradesh, where the Rheophilic Poma River just enter the plains of Assam with a different name, Boro River (Figure 1). Getting juveniles of the species in a different river system at Ramghat, Poma River, and far away from place of their actual stocking ie, Tawang district of the state is scientifically inexplicable and will seriously rise an issue if the fish has really established in the natural water bodies of the state. Very recently an adult fish of the species has been collected by the author from a natural stream named Dhinikho river from Shergaon village, which is anticipated since there is a government trout hatchery nearby.

## Discussion

Both the exotic cold-water fish were introduced to the state of Arunachal Pradesh for captive rearing in targeted water bodies in Tawang, West Kameng and West Siang districts because of their adaptability to tolerate water temperatures from almost freezing to roughly 24 °C (Vass 2002; Burrill, 2014). These species are equally valued for aquaculture purpose and as a sport fish. However, the native species have to compete throughout their life span with introduced species for food and space along with predation pressure where they are released. There is always a chance of unintentional escapes from fish farms, which might also happen in reality in the state. Finding of both the species other than the area where they are introduced confirmed they are escaping in the natural water bodies. Bagra *et al.*, (2009) opined that it is probable that the species have been able to establish

natural populations in the river since the size of the specimens they have collected were juveniles. Thorough research is needed to confirm the report since it will be a big concern for the ecologist and fishery scientist. If the species has actually established and already started natural hybridization with the local population in the natural water bodies, it absolutely needed a serious investigation and ecologist should not take it lightly. There are frequent reports in the media of getting alien fishes from the natural water bodies, especially that of fish species which are used in aquarium. Any exotic fishes introduced in one area may find their way to natural water bodies through various means. If such probability is not taken seriously, it may lead to the contamination in the gene pool of indigenous fish species of natural aquatic bodies. The entire northeastern region of India needs to get more attention since the region falls under biodiversity hot spot region of the world under two regime, eastern Himalaya and northeastern. The biodiversity rich ecosystem of the region may result in extirpation of indigenous species within a short span of time if the trend of indiscriminate transfer and introduction of aquatic species without doing in proper research continues. Escaping farmed exotic fishes from their confinement to the natural water and stream in either nearby or far areas will be unacceptable. The state is blessed with its own variety of well-known trout, *Schizothorax* spp. and *Raiamas bola* which is equally valuable as the exotic species. Four species of *Schizothorax* are reported from the state *viz.* Chirruh snowtrout (*Schizothorax esocinus* Heckel 1838), Blunt-nosed snowtrout (*Schizothorax molesworthii* (Chaudhuri 1913)), Dinnawah snowtrout (*Schizothorax progastus* (McClelland, 1839)) and Snow trout (*Schizothorax richardsonii* (Gray, 1832)). Instead of focusing on the exotic species if we encourage and popularize rearing of these indigenous species, chances of threatening the ecosystem by rearing exotic species and apprehensiveness of the ecologist and local people will be minimized.

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