

Coldwater fish and fisheries in Bhutan

by
T. Petr

27 McLeod Street, Toowoomba Qld 4350, Australia

ABSTRACT

A total of 41 indigenous fish species are known from rivers and lakes of Bhutan. Eight exotic species, including the coldwater brown trout, and seven species of cyprinids introduced for warmwater aquaculture, are also present. Brown trout was introduced in 1930 and until the early 1980s it was raised in two trout hatcheries for stocking into rivers and streams. The stocking was discontinued in 1983 on the assumption that it was suppressing indigenous coldwater fish, especially asla (*Schizothorax progastus*) which is held in high esteem by the Bhutanese. No information is available on the distribution of asla in rivers and lakes, or on its proportion in fish catches. The suspected, but not proven, competition between brown trout and asla should be fully assessed prior to any attempt at restarting stocking of brown trout. Coldwater fishery in Bhutan has a predominantly subsistence character. At present, Bhutan does not have a functioning coldwater fish hatchery or any table fish production farms. In 1990 the total fish production was estimated to be 331 t, part of it coming from warmwater pond aquaculture in the southern lowlands. The production probably declined in the subsequent years due to disturbances in the south, which impacted on the warmwater fishery. Construction of new hydroelectric power dams resulting in new reservoirs offers considerable scope for expanding fish production.

1. INTRODUCTION

The Kingdom of Bhutan is a landlocked country in the eastern part of the Himalayas, situated between 26° and 29°N latitude (Fig. 1). It extends about 305 km from east to west and 145 km from north to south, covering an area of approximately 47,000 km². Bhutan borders China to the north and India to the east, south and west. Bhutan can be divided into three zones, namely: the southern foothills and plains with altitudes less than 2000 m; the Inner Himalayas with altitudes varying between 2000 and 3000 m; and the Great Himalayas which have altitudes between 3000 and 7500 m.

Major river systems from west to east are the Amo, Wang, Chang (Sankosh), Tongsa and Manas⁴. The total length of rivers and their tributaries is estimated to be about 7200 km. Bhutan has over 590 natural lakes of various sizes, the majority of them being small and located above an altitude of 2200 m. The estimated total area of these lakes is about 4250 ha. There is one man-made reservoir in Bhutan, the Chukha, with an area of 150 ha. It is situated on the River Wang, not far away from the border with India. Its primary function is hydropower production.

2. COLDWATER FISH AND FISHERIES

The rivers and lakes have predominantly coldwater and torrential stream fauna except in the foothills and plains (Dubey, 1978). A total of 41 indigenous fish species have been identified from the rivers and one lake of Bhutan, as compared to 179 species found in Nepal, which has similar geographic and climatic conditions. One exotic fish species (brown trout - *Salmo trutta*) was introduced in cold waters, and seven exotic species are now used in warmwater aquaculture in southern lowlands (Table 1). Among the coldwater species, the indigenous asla (*Schizothorax progastus*) and Himalayan trout (*Barilius* spp) are the most common in all rivers. Other indigenous species of economic interest are *katle* (*Acrossocheilus*

hexagonolepis), found up to 1200 m altitude, and the mahseers *Tor tor* and *T. putitora*, which Dubey (1978) found in streams in the foothills.

Table 1. Provisional list of fish of Bhutan (Dubey, 1978; Dhendup and Boyd, 1994)

Family/Species	River/stream (pond)
Family: Salmonidae	
#Salmo trutta	Haa; Paro; Thimphu
Family: Cyprinidae	
Schizothorax progastus (asla)	Sankosh; Chamkhar; Kuru; Manas; Haa; Mangdi
Schizothorax molesworthii	Manas
Acrossocheilus hexagonolepis	Manas; Mangdi; Phepsu; Gaylegphug;
Sarbhanga Khola; Kuru; Chanchi; Phuntsholing	
Crossocheilus latius	Manas; Sarbhanga Khola; Gaylegphug
Tor putitora (mahseer)	Manas; Sarbhanga Khola; Gaylegphug
Tor tor (mahseer; jantura)	Manas; Sarbhanga Khola; Gaylegphug; Phepsu
Barilius barna	Manas; Sarbhanga Khola; Gaylegphug; Phepsu;
Sankosh; Khalikhola; Phuntsholing; Magdi	
Barilius bendelisis	Sarbhanga Khola; Gaylegphug
Barilius bola	Phepsu
Puntius macropogon	Gaylegphug
Puntius sophore	Gaylegphug
Puntius ticto	Gaylegphug; Sarbhanga Khola
Puntius titius	Sankosh; Sarbhanga Khola
Cirrhinus lata	Sankosh
Barbus spp.	Gaylegphug
Labeo dero	Manas
Labeo dyocheilus	Manas; Phepsu
Labeo pangusia	Sankosh
Garra annandalei	Gaylegphug; Sarbhanga Khola; Phepsu
Garra gotyla	Sankosh; Sarbhanga Khola; Phepsu; Magdi
Danio aequipinnatus	Manas; Sarbhanga Khola
Danio dangila	Manas; Sarbhanga Khola
Brachydanio rerio	Sarbhanga Khola
Botia dario	Gaylegphug
Semiplotus semiplotus	Phepsu
Rasbora daniconius	Gaylegphug
#Cyprinus carpio	Gaylegphug - ponds
#Catla catla	Gaylegphug - ponds
#Cirrhinus mrigala	Gaylegphug - ponds
#Labeo rohita	Gaylegphug - ponds
#Aristichthys nobilis	Gaylegphug - ponds
#Ctenopharyngodon idella	Gaylegphug - ponds
#Hypophthalmichthys molitrix	Gaylegphug - ponds
Family: Cobitidae	
Noemacheilus botia	Sarbhanga Khola

Family: Siluridae	
Batasio batasio	Gaylegphug
Mystus bleekeri	Gaylegphug
Mystus vittatus	Gaylegphug
Ompok pabda	Gaylegphug
Family: Sisoridae	
Bagarius bagarius	Manas
Nangra punctata	Manas
Family: Belonidae	
Xenentodon cancila	Phepsu
Family: Channidae	
Channa gachua	Phepsu
Channa striatus	Gaylegphug
Family: Nandidae	
Badis badis	Manas
Nandus nandus	Gaylegphug
Family: Mastacembelidae	
Mastacembelus armatus	Sarbhong Khola; Kalikhola
Note: Water temperatures exceeded 20°C at the following locations: Gaylegphug (max. 21°C), Phepsu (max. 25°C), Kalikhola (max. 26°C), Sarbhong Khola (max. 26°C).	

Brown trout (*Salmo trutta*) was first introduced in Bhutan in 1930. Until the 1980s two trout hatcheries (in Haa and Wangchutaba) produced about 20,000 trout fingerlings per annum. Brown trout has established viable and self-replenishing stocks in a number of streams and rivers, including Haa, Thimphu, Paro, and some tributaries of the Sankosh and Manas rivers, i.e. Mo, Ho, Mangdi and Chamkhar. The stocking of brown trout was discontinued in 1983 on the assumption that brown trout was feeding on and suppressing indigenous coldwater fish such as asla.

There are no full-time fishermen or fishermen's cooperatives in Bhutan. However, angling is practised, especially in Thimphu and Paro rivers. In the late 1980s fishing permits (licences) were issued by the Department of Forestry, with 398 permits issued in 1986-87. It was reported that 60% of the angling is located in the Thimphu area, whereas Paro and other districts accounted for only 30% and 10% respectively.

In 1987 there was no organised marketing of fish in Bhutan. In the capital city Thimphu, a fish stall selling fresh fish (catla, mahseer) was also selling mutton and buffalo meat.

2.1 Trout stocks and trout fishery

In 1987, the FAO fact-finding and project idea formulating mission for small-scale coldwater fisheries visited Bhutan (FAO, 1987). By that time the production of trout fingerlings in the Haa hatchery had ceased and since then there has been no restocking of rivers and lakes. The existing stocks are therefore considered to be either old fish from the last stocking (especially those in high-altitude lakes, in some of which trout was stocked only once), or fish resulting from self-reproducing populations in rivers and streams. On basis of the sold angling licences it was not possible to obtain a picture of the quantity and sizes of fish captured. Circumstantial evidence suggested that while in some lakes the brown trout was doing well, in others it was in poor condition, and from some others it had disappeared. As no information on native fish of the lakes was available, it was impossible to assess the impact of the introduced trout on native fish.

Haa hatchery was visited in 1992 by Dhendup and Boyd (1994) who reported on the water quality of the existing ponds. The Haa hatchery ponds had concentrations of total dissolved solids of 170 mg l⁻¹ as compared to 30 to 55 mg l⁻¹ in warmwater ponds situated in Bhutan subtropical foothills. The chemical composition of water and soils in the Haa hatchery was more conducive to fish culture than that in the foothill ponds, with the Haa ponds being completely base saturated with a pH averaging 6.4, as compared to foothill ponds, where the pH values were 4.8-5.7. While the foothill ponds would require liming to improve total alkalinity in order to increase fish production, this would be unnecessary in Haa.

2.2 Indigenous coldwater fish

Only the schizothoracid cyprinid asla seems to have some fishery importance in Bhutan. No information is available on the distribution of this species in rivers and lakes, or on its proportion in fish catches. Anecdotal evidence indicates there may be some competition between trout and asla. Asla is held in high esteem by the Bhutanese, therefore a proper study of its present distribution, stocks and what component it represents in angling and other catches, is urgently needed. The suspected, but not proved, competition between brown trout and asla should be fully assessed prior to any attempt at restocking it.

Stocks of the mahseers *Tor tor* and *Tor putitora*, and of *Acrossocheilus hexagonolepis* in the lower reaches of rivers also need to be assessed, as especially mahseers are much sought after by sport fishermen.

3. DISCUSSION

The sparse knowledge on fish stocks and fisheries in cold waters of Bhutan is a hindrance to the further development of coldwater fishery in the country. The distribution of the indigenous asla is unknown, and the circumstantial evidence about its decline in catches is not based on concrete data. Deterioration of the asla and trout stocks in the River Thimphu could have resulted from a combination of overfishing and an increase in pollution. Because of the cultural and fishery importance given to asla in Bhutan any future coldwater fish enhancement activities should include stocking of fingerlings of this species into suitable stretches of rivers. Such stretches, however, need to be identified as there is little knowledge on the present distribution of asla in Bhutan rivers and streams. The lack of knowledge on competition between asla and trout prevents any decision on stocking strategies for the brown trout, which, however, is self-reproducing in some rivers and streams.

The no longer functioning trout hatchery at Haa may need to be replaced by a new hatchery somewhere else. The FAO mission, which visited the country in 1987, suggested the possibility of establishing a new hatchery near the Chukha Reservoir on the River Wang (altitude 1828 m), with the reservoir offering good quality cold water (FAO, 1987).

A 20-year masterplan for the development of Bhutan's hydroelectric potential, sponsored by the World Bank, with the UNDP and Norwegian Government assistance, suggests that in the near future there will be more reservoirs in Bhutan, in which coldwater fishery could be developed (Anon. 1990). It is estimated that the country could produce around 20,000 MW of power without interfering too greatly with the environment (Anon. 1994). Presently, the Chukha hydropower scheme is being expanded, and by 1999 the Kurichu dam (57 m height) should result in the formation of another reservoir. In 1993 India and Bhutan signed an agreement for the construction of yet another dam on the River Sankosh, which, when completed, would be one of the ten largest hydropower plants in Asia. The reservoirs resulting from these schemes represent a challenge to the government to develop fisheries in them.

At present, the major fish producing area in Bhutan is in subtropical hills of southern Bhutan, where by 1992 approximately 175 ponds, comprising 40 ha, were used primarily for polyculture of common carp (*Cyprinus carpio*), Chinese carp (*Ctenopharyngodon idella*), *Hypophthalmichthys molitrix* and *Aristichthys nobilis*, and Indian major carp (*Labeo rohita*, *Cirrhinus mrigala*, and *Catla catla*) (Dhendup and Boyd, 1994). The project, assisted by the United Nations, was initiated in 1981, and it resulted in the setting-up of a fish seed production and demonstration centre at Gaylegphug in order to enhance development of fish culture. This was followed by integrated fish farming and by expansion of the number of ponds, which are now located in two districts of the country. In 1990 the total fish production in Bhutan was estimated to be 331 t (FAO, 1997), part of it coming from warmwater aquaculture in the southern Bhutan. Since 1990, the well trained and experienced Bhutanese staff have been able to maintain the fish broodstock and run the warmwater fish hatchery and nursery without further external inputs. However, later on some fish farms had to be abandoned due to disturbances. This has led in the second half of the 1990s to a revival of interest in coldwater fisheries in the interior of Bhutan. It is agreed, however, that more surveying and research on fishery resources needs to be done. There is very little baseline information on the distribution, abundance and migratory patterns of the individual fish species in streams, rivers and lakes. Collecting such information should be easier now that more access roads have been constructed and better maps are available. There is now a trained local staff which could carry out the field work, although some external assistance with special fields such as taxonomy may be needed.

4. REFERENCES

Anon. 1990. World Bank funds Bhutan hydro study. Water Power & Dam Construction, January 1990: 6.

Anon. 1994. Bhutan sits on power "goldmine". Water Power & Dam Construction, February 1994: 3.

Dhendup, T. and C.E. Boyd. 1994. Chemical features of water and soil in fish farming areas of Bhutan. J. Aqua. Trop. 9: 35-41.

Dubey, G.P. 1978. Survey of the waters of Bhutan. Physiography and fisheries potential. Report. FAO, Rome. 38pp.

FAO. 1987. Small-scale cold-water fisheries: fact-finding and project idea formulating mission to mountainous regions of Bhutan, India and Nepal (31 March-12 May 1987). Report. Based on the work of T. Petr, X. Lu and K.G. Rajbanshi. FAO, Rome. 63pp.

FAO.1997. FAO Yearbook. Fishery Statistics, Catches and Landings. Vol 80. FAO, Rome. 713pp.

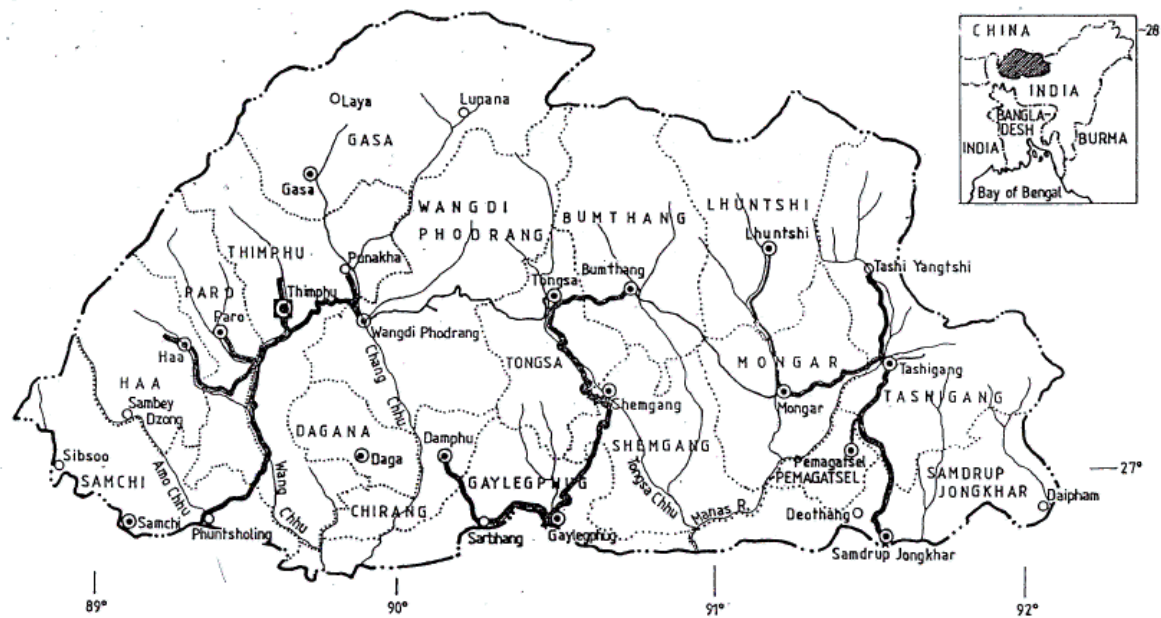


Fig. 1. Map of Bhutan

¹ In Bhutan, the name for a river is Chu, or Chhu, which may be appended to the name of the river, such as Amo Chu, or Amo Chhu.

http://www.fao.org/docrep/003/x2614e/x2614e02.htm#P5_0