



## Note

# A combination of two species fish culture with *Labeo gonius* (Hamilton, 1822) and *Cyprinus carpio* Linnaeus, 1758 under mid-hill condition in Meghalaya, North-east India

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## ABSTRACT

One of the major issues in promoting aquaculture in mid altitude region is the dearth of suitable fish species for enhancing fish production. The prevailing cold climatic conditions in the state of Meghalaya restricts the fish growing period to about 7-8 months in a year. The six species composite fish culture as commonly practiced in the lower altitude warmer region do not always perform well in mid altitude region. Therefore, a study was undertaken to evaluate a two species fish culture system with *Labeo gonius* (Hamilton, 1822) and *Cyprinus carpio* Linnaeus, 1758, for enhancing fish production from the mid-hill region. The paper highlights the performance of the two species in small ponds over a period of one year. The specific growth rate (SGR) ranged from 0.248 to 1.038 g day<sup>-1</sup> and 0.520 to 1.831 g day<sup>-1</sup> for *L. gonius* and *C. carpio* respectively. The combination yielded an average fish production of 2,550 kg ha<sup>-1</sup> year<sup>-1</sup>.

Keywords: *Cyprinus carpio*, Fish culture, *Labeo gonius*, Mid altitude

The North-eastern region of India is located between lat. 21.57°N - 29.30°N and 8 long. 9.46°E - 97.30°E. The region covers an area of 2.62 lakh km<sup>2</sup>, which accounts for 7.9% of total geographical area of the country. The altitude in the region varies from almost sea level to over 7,000 m (23,000 ft) above mean sea level (msl). Areas with altitudes exceeding 2,000 m (6,562 ft) receive snowfall during winters and have cool summers and below 2,000 m (6,562 ft) msl, winter temperatures reach up to 15°C (59°F) during the day with nights dropping to 0°C while summers are cool, with a mean maximum of 25°C (77°F) and a mean minimum of 15°C (59°F) (Dikshit and Dikshit, 2014). With the exception of Assam and Tripura, other six states are predominantly in hilly region which are mostly inhabited by different tribal communities. Fish culture in the lower altitude (less than 400 m above msl) records the highest production while the high altitude aquaculture (>1200 m above msl) produces meagre quantity of fish. The mid altitude (400-1200 m above msl) region which cover a large part of North-eastern hill (NEH) states provide immense potential for aquaculture. However, promoting mid altitude aquaculture among farmers in the hill states of the North-east is a major challenge due to several reasons. One of the major bottlenecks in promoting the mid-hill aquaculture is the dearth of quality fish seeds of suitable species for farming. Since water temperature in the hills falls below 20°C, there is an urgent need to find alternate fish species which can tolerate relatively lower temperature for sustainability, although it is known that each species has a unique set of biological factors

that influence its culture potential. It has been observed that in mid-hill aquaculture (400-1200 m above msl), the growing period of most fish species is restricted to only about 7-8 months in a year due to cold climatic condition (Fig. 1). Meghalaya is one of the important tribal states in the North-eastern part of the country where 95% of the population consume fish and utilise fish for various social functions. According to the available statistics of the State Fisheries Department, Govt. of Meghalaya, the state annually produces about 13,013 t of fresh fish (2018-19) against an estimated requirement of 27,000 t. The production is principally from culture based fisheries in ponds and tanks (96%) and the rest 4% represents capture fisheries from bheels, reservoirs and lakes. The state requires an estimated 139.75 million fish seeds but unfortunately the state is able to produce only about 9.69 lakh seeds. As a consequence, most of the fish consumed in the state are imported from other Indian states such as Andhra Pradesh, Assam and West Bengal.

Aquaculture in the region is basically carp based polyculture, a considerable share of which comes from the homestead and community ponds. While several fish species are found in the natural waters of the region, at present only about 10-12 food fish species are being cultured by the fish farmers of the North-eastern region of India (Das, 2017; Das and Singh, 2017). Catla (*Labeo catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) known as Indian major carps (IMCs), are important carp species cultured traditionally in ponds and tanks due to their higher growth and consumer preference. The exotic

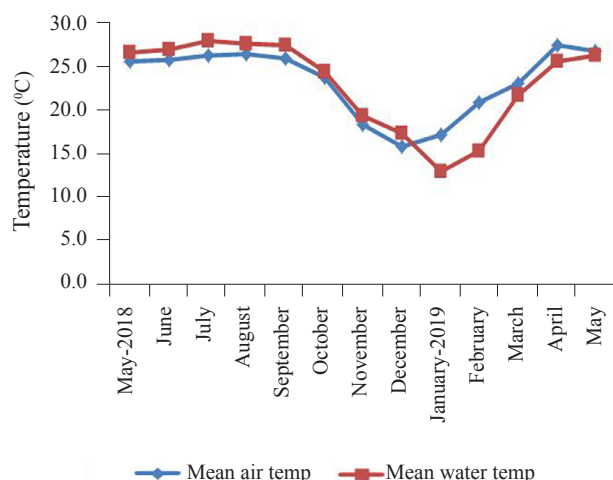


Fig. 1. Monthly mean air and water temperature recorded during May 2018 to May 2019

silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) having higher growth potential are also added along with the three IMCs for increasing the production under composite carp culture (Anon., 2006). Among all, the common carp is an important fish species of the region, which is mostly grown together with IMCs and exotic carps in a polyculture system. Although the best growth is obtained at water temperature of 23–30°C, the fish can survive cold winter periods making it one of the most suitable fish species for hill aquaculture in the North-eastern region (Das, 2017). In our earlier studies, an indigenous minor carp, Kurhi (*Labeo gonius*) locally known as Khaski in Meghalaya was evaluated for growth and maturation and found to perform better than the IMCs at relatively lower temperature (Das *et al.*, 2010). Thus, this fish species has been identified as an important species for diversification of aquaculture practices especially in the mid-hill region. The species is mainly distributed in some North-eastern states like Assam, Meghalaya, Arunachal Pradesh and Tripura and is also categorised in the Lower risk-Near threatened (LR-NT) category (CAMP, 1998). The fish is also observed in valley regions of Manipur. The maximum reported size of *L. gonius* is 150 cm (Day, 1878), however around 50 cm is more typical in commercial catches. In one year, it can reach up to 40 cm and 750 g in weight. However, small sized fishes of 100–300 g are easily marketable as compared to 700–800 g for IMCs (Das *et al.*, 2010). This herbivorous and bottom feeding species is more suitable for short duration fish culture in small seasonal ponds. The species is compatible with IMCs and Chinese exotic carps in composite fish culture system. It fetches better price in the local market, thus there is growing demand for its seeds among the farmers

of Meghalaya. *L. gonius* is being successfully reared and induced bred in mass scale at mid altitude (900 m above msl) regions for promotion of the species in mid-hill aquaculture (Das, 2018).

Most tribal farmers of the region are resource poor and possess small to medium sized fish ponds for aquaculture where fish growth can be expected only for about 6–8 months in a year under the prevailing climatic conditions. Therefore, there is tremendous scope for increasing productivity through introduction of suitable fast growing fish species appropriate to the mid altitude region. In the present study we therefore investigated the possibility of introducing two species fish culture incorporating *L. gonius* and *C. carpio* under mid-hill condition. A 12 months long experiment on survival and growth of *L. gonius* in combination with *C. carpio* was undertaken in three small ponds measuring 400 m<sup>2</sup> with an average depth of 1.5 m in the fish farm of ICAR Research Complex for NEH Region, located at Umiam (lat. 90°55' 15 to 91°16" and long. 25°40" to 25°21"; 900 m above msl) in Ribhoi District of Meghalaya during May 2018 to May 2019. Before stocking of fish fingerlings, all the ponds were prepared by maintaining a water depth of 1.5 m for fish culture following recommended standard package of practices (Anon., 2006). *L. gonius* and *C. carpio* with initial average weight of 10.5 and 9.3 g respectively were stocked in all the three ponds at 1:1 ratio at a uniform stocking density of 10,000 nos. ha<sup>-1</sup>. The fishes were fed once daily with supplementary feed (19% protein and 6.5% lipid), prepared locally with rice polish and mustard oil cake at 5% of the body weight. Water quality parameters were monitored every fortnight and were found to be within the optimal ranges. Water temperature was recorded daily with the help of a digital thermometer for the entire period of the experiment (Table 1). Dissolved oxygen content varied between 4.4 to 8.8 mg l<sup>-1</sup> while pH ranged from 6.6 to 8.5 during the culture period. At the end of 12 months culture period *L. gonius* attained an average final weight of 216.7 g with 78% mean survival, whereas *C. carpio* recorded a mean survival percentage of 83% and attained an average final weight of 427.4 g. An average production of 2,550 kg ha<sup>-1</sup> of fish was obtained during the one year culture cycle. Similar results were also observed by Das (2017) in local common carp and amur common carp culture in mid-hill condition where they attained 440 g and 500 g respectively. Jena and Das (2011) compared the growth performance of different fish species viz., *L. rohita*, *C. mrigala* and *L. gonius* under polyculture system and found *L. gonius* as a feasible species with major carps exhibiting survival percentage between 75.5 to 79.8.

In the present study, the SGR ranged from 0.248 to 1.038 g day<sup>-1</sup> in case of *L. gonius* while it was 0.520 to

Table 1. Month-wise mean water temperature of experimental fish ponds during the culture period with specific growth rate of *Labeo gonius* (SGR-GW) and *C. carpio* (SGR-CCW)

| Months         | Mean temperature (°C) | SGR GW (g day <sup>-1</sup> ) | SGR CCW (g day <sup>-1</sup> ) |
|----------------|-----------------------|-------------------------------|--------------------------------|
| June 2018      | 26.9                  | 0.339                         | 1.654                          |
| July 2018      | 27.9                  | 0.502                         | 1.194                          |
| August 2018    | 27.6                  | 0.691                         | 1.292                          |
| September 2018 | 27.4                  | 0.699                         | 1.153                          |
| October 2018   | 24.4                  | 0.470                         | 1.073                          |
| November 2018  | 19.3                  | 0.591                         | 0.908                          |
| December 2018  | 17.3                  | 0.408                         | 0.676                          |
| January 2019   | 13.3                  | 0.248                         | 0.520                          |
| February 2019  | 15.5                  | 0.481                         | 0.775                          |
| March 2019     | 21.3                  | 0.637                         | 1.341                          |
| April 2019     | 25.5                  | 0.761                         | 1.831                          |
| May 2019       | 26.0                  | 1.038                         | 1.428                          |

1.831 g day<sup>-1</sup> for common carp (Table 1). An important minor carp of Manipur in North-east India, *Bangana dero* exhibited SGR ranging from 0.65 to 0.91 (Sobita and Basudha, 2020). The maximum growth of *L. gonius* was observed in the month of May when the mean water temperature was 26°C, whereas, in the case of common carp the highest growth was observed in the month of April when the mean temperature was 25.5°C. On the other hand, the lowest SGR for both gonius and common carp were observed during the month of January due to the low mean water temperature (Table 1). From results of the present study, a strong positive correlation is evident between water temperature and growth of the fishes (Fig. 2). Water temperature is one of the important abiotic factors that affect various parameters in the life span of teleost fish. In an earlier study at the same location, low water temperature was observed to induce stress and affect somatic growth in the teleost *Channa stewartii* (Das and Majhi, 2015) while increase in temperature resulted in different level of stress in metabolism and growth in chocolate mahseer (Majhi *et al.*, 2013). Similarly, Bhuyan (2003) emphasised the importance of temperature in overall development of fish growth and found that *L. gonius* can be successfully cultivated under the mid altitude condition of Meghalaya.

In general, the cold water fish farming sector has been largely overlooked. In addition to difficult terrain, non-availability of quality fish seeds of appropriate fish species in time is identified as one of the major constraints in expanding mid-hill aquaculture. Therefore, the urgent need is to find alternate fish species which can grow in lower water temperature or grow to marketable size within short period of time (7-8 months). The NEH states are predominantly tribal states. With large population of domestic animals and huge resources of green foliage in the region, there is ample scope for vertical expansion

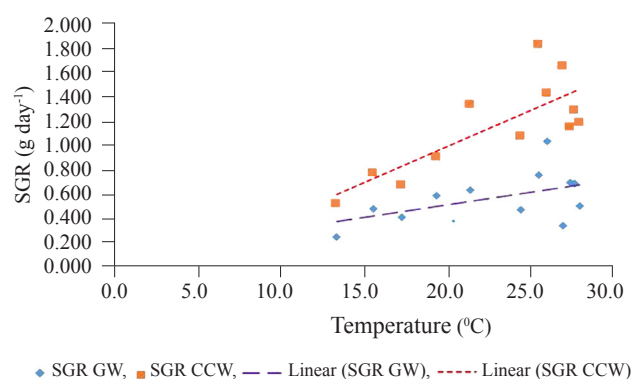


Fig. 2. Correlation between specific growth rate (SGR) and mean water temperature

of aquaculture through use of on-farm resources to meet the demand. The most common practices of six species composite fish culture recommended for low altitude region in the country may not suit the hill region, thus there is need for developing suitable site specific fish farming practices for the terrain based on the elevation and climatic conditions. The two species culture investigated under the present study together with easy availability of critical inputs for fish farming will certainly improve the fish production in the mid-hill region.

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