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ScienceDirect
Aquaculture 273 (2007) 520–531
Aquaculture
www.elsevier.com/locate/aqua-online

Effects of silver carp and the small indigenous fish mola *Amblypharyngodon mola* and punti *Puntius sophore* on fish polyculture production

A. Kadir [a], M.A. Wahab [a], A. Milstein [b,*], M.A. Hossain [a], M.T.I. Seraji [a]

[a] *Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh*
[b] *Fish and Aquaculture Research Station Dor, M. P. Hof Ha Carmel, 30820 Israel*

Received 6 May 2007; received in revised form 10 July 2007; accepted 12 July 2007

Abstract

A sustainable semi-intensive pond aquaculture technology including major carp species as cash-crop and small indigenous fish species (SIS) as food for the farmers' families is being optimized in Bangladesh. The inclusion of silver carp (*Hypophthalmichthys molitrix*), a cheap large species affordable by poor farmers, is now being considered. As part of a study on the effects of this filter feeder on polycultures including the large carps rohu (*Labeo rohita*), catla (*Catla catla*) and common carp (*Cyprinus carpio*) and the SIS punti (*Puntius sophore*) and mola (*Amblypharyngodon mola*), an experiment was carried out under farm conditions to test the effects of silver carp and of each SIS species on the growth, survival and yield of the large and small species and on pond ecology.

The experiment was performed in 38 farmers' fishponds of different sizes, from 220 m^2 to 1200 m^2. The results show that the larger the fish pond the better rohu performance, the larger punti fry weight and the lower punti fry harvested biomass. Pond size did not affect other fish species. The addition of 250 mola and/or punti per 100 m^2 fishponds affected rohu and catla and did not affect common and silver carps. The addition of mola alone reduced rohu's parameters by 15%. The addition of SIS in the three combinations tested (250 mola, 250 punti, 125 of each species) reduced catla's parameters by 20–24%. Punti fry were larger when both SIS were stocked and punti fry biomass was larger when only punti were present. Total mola harvested biomass and yield were larger when the entire SIS stocked were only mola.

The addition of 10 silver carp over the 99 large carps stocked per 100 m^2 fishponds negatively affected rohu and catla growth and yield by about 15–21% and 45–50% respectively but not their survival, did not affect common carp performance, did not affect punti and mola reproduction in the ponds, reduced punti yields by 25%, reduced mola performance by about 35%, and silver carp own biomass increased total yield and total income in about 12% each. These effects are explained and discussed considering fish interactions through the food web. The decreased income from selling the more expensive large carps is more than compensated by that obtained from silver carp, which allows the option to the farmer to sell part of the silver carp to complete the cash income that would have been obtained from large carps only if silver carp would not be stocked, and consume the rest with the family.

Keywords: Catla; Food web; Mola; Polyculture; Punti; Rohu; Silver carp; SIS small indigenous species

* Corresponding author. Tel.: +972 4 6390651x23; fax: +972 4 6390652.
E-mail address: anamilstein@int.gov.il (A. Milstein).

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doi:10.1016/j.aquaculture.2007.07.012

1. Introduction

The inland fisheries resources of Bangladesh are considered to be one of the richest in the world. The annual growth of aquaculture production is about 30% (Mazid and Sinha, 1999) which is comparable to those of China and India. The total fish production in Bangladesh during 2003–2004 was 2.102 million MT, of which 78% were from inland waters including 55% from aquaculture. Three quarters of the total produced in 2003–2004 was consumed in the country and 54,141 MT of fish and fisheries products were exported, allowing a total income of Taka 2363.4 million (equivalent to 34.5 million U$ dollar) which contributed over 5% of the total export earnings (DoF (Department of Fisheries), 2005). The contribution of this sub-sector is almost 5% of the total GDP (Bangladesh Bureau of Statistics (BBS), 2006).

Besides several species of large carps, Bangladeshi water bodies have many small indigenous fish species (SIS). These small fish are regarded as undesirable species in the present aquaculture management practices and are mostly eradicated using piscicides. This reduces the availability of cheap fish that the poor can afford. It also increases malnutrition among poor people because SIS, which are rich in vitamins and micronutrients (Thilsted et al., 1997), are eaten whole while large fish are eviscerated before eating. Together with this, most of the rural people of Bangladesh have neither capacity to buy a large fish in the market nor can afford sacrifice their pond grown large carp to feed the family. To provide the poor farmers with both financial and nutritional support, a polyculture technology with both large carps and SIS is being developed. If small fish and large carps are cultured together, farmers would have the opportunity to harvest small fish periodically throughout the year for family consumption without affecting the cash-crop carps.

The present study was carried out in the framework of a comprehensive research to develop a sustainable aquaculture technology that includes increased average productivity of high valued carps for cash as well as highly nutritious SIS for household consumption (Wahab et al., 2001, 2002; Milstein et al., 2002; Wahab et al., 2003; Alim et al., 2004, 2005). The selected SIS are the calcium rich punti (*Puntius sophore*) and the vitamin A rich mola (*Amblypharyngodon mola*) (Thilsted et al., 1997). The inclusion of silver carp (*Hypophthalmichthys molitrix*), a cheap large species affordable by poor farmers, is now being considered. As part of a study on the effects of this filter feeder on polycultures including the large carps rohu *(Labeo rohita*), catla (*Catla catla*) and common carp (*Cyprinus carpio*) and the SIS punti and mola, an experiment was carried out under farms' conditions to test the effects of silver carp and of each SIS species on the growth, survival and yield of the large and small species. The ecological processes explaining differences in growth and survival between species under varying species combinations are reviewed.

2. Methods

The experiment was performed in 38 farmers' fish ponds in the Tarakanda village of Fulpur Upazila in the Mymensingh district. Ponds in 40 farms were selected, but 2 of them had to be dropped due to errors in stocking. The ponds were of different sizes, from 220 m^2 to 1200 m^2, thus all measurements are herein reported on a 100 m^2 area basis. Before starting the experiment, ponds were drained to eradicate all predatory fishes, embankments and slopes were repaired, and agricultural lime ($CaCO_3$) at 2.5 kg/100 m^2 was applied. Ponds were filled up and fertilized with urea and triple super phosphate (TSP), each at 1 kg/100 m^2 to promote algal growth.

The experiment lasted 126 days and had 8 treatments in a 2 × 4 factorial design. The 2-level factor was with or without silver carp addition. The 4-level factor was SIS: no small fish, mola addition, punti addition and both SIS addition. On 28-Jul-05 each 100 m^2 pond was stocked with 33 rohu (43 g stocking weight), 33 catla (20 g) and 33 common carp (44 g). No other fish were added to the control treatment (Ctr-). Ten silver carp (41 g) and/or 250 small fish (mola of 1.7 g, punti of 2 g, either all punti, all mola, or half of each one) were added to the appropriate treatments (treatments CtrS, MM-, MMS, PP-, PPS, MP- and MPS where S and - indicate silver carp presence and absence respectively, MM indicates mola, PP punti and MP both SIS). Each treatment was done in 5 replicates. Large fish were weighed monthly to adjust feeding amounts. Throughout the culture season the parent (large) SIS were partially harvested, while their juveniles were carefully released back into the pond. The SIS biomass partially harvested were recorded and added up to obtain the total biomass harvested in each pond. Thus, the partial harvest of mola and punti are accounted in the data on biomass and yield. Final harvesting was done during the first 5 days of Dec-05. Fingerlings of the major carps were gathered from the local retailer, who collected them from rural nurseries that obtained the fertilized eggs from the nearby Government hatchery. Fingerlings of the small fish were collected from perennial ponds of the farmers, where farmers keep them together with major carps and the small fish naturally breed. Supplementary feed consisted of rice bran and soaked oil cake (2:1, both