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RECOMMENDATIONS FOR STOCKING SILVER CARP IN GOVINDSAGAR (H.P.) AND NAGARJUNASAGAR (A.P.) TOGETHER WITH AN ACCOUNT OF THE SCOPE AND LIMITATIONS OF SILVER CARP STOCKING IN RIVERS AND RESERVOIRS IN INDIA

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Distribution of silver carp

The silver carp (Hypophthalmichthys molitrix) is a native of South and Central China (Yang - tze, West River, Kwangsi, Kwangtung). It was transplanted to Japan, Formosa, Thailand, Malaya and Ceylon (Hora and Pillay, 1972). It has since established itself in Tone River in Japan (Konradt, 1968) and Formosa (Tang,1963).

Introduction of silver carp in India

A small consignment of 360 early fingerlings of silver carp was brought to India for the first time in 1959 from Japan. After rearing it in fish farm at Cuttack for a few years, the fish was successfully induced-bred by the administration of pituitary hormone.

Maturity of silver carp in India and China

The original lot of silver carp fingerlings reared in Cuttack ponds became fully mature when they were about 2 years; but the subsequent India-born generations, however, started showing indications of maturing at the yearling stage. The yearling breeders are in the weight range 585-2,045 g (Alikunhi et al., 1965).

It merits mention that silver carp matures when they are 5-6 years old in North China, 4-5 years in Central China, 2-3 years in south China and just a year only in India under optimum conditions, showing unmistakably the impact of latitude (and hence temperature) on the age at maturity. The same factor also operates on growth, though in the reverse order: i.e. slower growth rate in the higher latitude and faster in the lower.

Fecundity of silver carp in pond ecosystem

The fecundity of induced-bred silver carp is of the order of 1,67,000/kg body weight in India as observed at Cuttack (Alikunhi et al.,1965).

Food and feeding of silver carp in Indian environment

The silver carp has a specialised structure of gill rakers adapted to micro-plankton feeding (Inaba and Namuna, 1955). The gill structure is considered effective for phytoplankton feeding.

The gut analysis of silver carp of the pond ecosystem carried out at Cuttack shows a wide feeding range which includes Chlorophyceae, Chrysophyceae, Bacillariophyceae, Dinophyceae, myxophyceae among phytoplankton; and protozoa, rotifera, cladocera, ostracoda and copepoda among zooplankton (Parameswaran, unpublished). The fish, at all stages, feed on plankton with a distinct preference for phytoplankton. No appreciable difference in food preference was noticed between the fry, juveniles and adults. No qualitative variation in the food items ingested was observed. Examination of the gut contents of fish(from different parts of the alimentary canal) suggested that but for a few euglenoids and myxophyceae all the items showed indications of digestion as reflected by broken walls or empty cells of the phytoplankters and disintegrated condition of the zooplankton. The observations at Cuttack also unmistakably point to the silver carps' preference to rotifers, smaller constituents of cladocera and smaller constituents of copepoda, especially nauplii. It also merits mention that the fish is an overactive feeder as reflected by the 'gorged' and 'full' condition of the gut all through the year and in all size ranges (Parameswaran, unpublished). The observations of Karamchandani and Misra (unpublished) on silver carp in a reservoir ecosystem (Kulgarhi reservoir) shows a similar over-intense feeding intensity as well as a wide feeding range which includes sand mixed with mud, decayed organic matter, blue green algae, green algae, diatoms, dinoflagellates, rotifers and copepods. These workers have also reported that silver carp show positive preference to rotifers besides phytoplankton. The observations on silver carp in Getalsud reservoir also reflect a wide range of plankters with a significant percentage Myxophyceae 55%; Bacillariophyceae 6.5%; Dinophyceae 2.5%; protozoa 1.5%; Rotifera 2.5%; Cladocera 6.5%; dig.org.matter 26.0% (Natarajan et al.,unpublished). In sewage-fed ponds in India the gut contents of silver carp revealed blue-green algae (61.29%), organic detritus (15%), rotifers (4.44%), copepods (4.2%) and diatoms (1.33%) (Apurba Ghosh et al.,1973).

Growth of silver carp in pond ecosystem in India

An average growth rate of 2.04 kg in 3½ months was observed for the original lot of silver carp fingerlings when stocked @ 250 fingerlings/ha in 0.08 ha pond (Alikunhi and Sukumaran, 1964). In large stocking ponds they attained an average length of 66 cm (4.7 kg) when two years old. Sukumaran et al.(1969) carried out planned experiments to study the relative growth rate of silver carp in combination with catla and other indigenous and exotic carps in ponds not subject to fertilisation or feed at Cuttack. These studies, though confined to pond ecosystem, are important as they throw light on the relative performance of silver carp i a vis a vis catla and are in a way complementary to the earlier studies (Alikunhi and Sukumaran, 1964). These observations indicated that silver carp registered an average growth rate of 466 g/6 months (range: 239-548 g) in combination with catla, rohu and common carp in ratios silver to catla, 1:1, 1:2, 2:1, 1:3, 3:1, 1:4, 4:1 in the year 1963-64 (single replication); an average growth rate of 328 g/6 months (range: 153-677 g) in combination with catla and grass carp in ratios silver carp to catla 2:1, 1:2, 1:4, 4:1 (with two replications) in the year 1965-66; and an average growth rate of 422 g/6 months (range: 199-987 g) in combination only with catla in ratios, silver carp to catla, 1:2, 2:1, 1:4, 4:1 (with two replications) in 1966-67.

Performance of silver carp in Indian reservoirs

An experimental consignment of 239 fingerlings of silver carp was stocked in Kulgarhi reservoir (M.P.) in 1969. Going by weight at capture (in the absence of average weight of stocking size, no correction could be made for the weight at capture to arrive at net growth), the fish registered in Kulgarhi reservoir a growth of 2 kg in 10 months, 5 kg in 19 months and 5 kg in 24 months (Rao and Dwivedi, 1972). In Getalsud reservoir (on Subernareka drainage) the fish registered a net growth of 393 g in 5 months, 2.1 kg in 17½ months and 4.4 kg in 28 months (Natarajan et al., unpublished).

Scope and limitations of silver carp stocking in Indian rivers and reservoirs

The foregoing observations indicate that silver carp has a wide feeding range which includes phyto and zooplankton and organic detritus. The Indian major carp C.catla also shows a wide feeding range (Hora and Pillay, 1962, Jhingran, 1966) with a near similarity to silver carp. In fact it is time we reassess the feeding preferences of C.catla. The studies carried out under

All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs have shown that C.catla can no longer be considered as a monotypic species. Detailed studies carried out under Reservoir Project at Rihand point to the existence of three sub-species in C.catla which could be easily distinguished morphologically. Of these two sub-species show feeding preferences to phytoplankton (largely myxophyceae) while the third to zooplankton. This discovery now provides an altogether new dimension to the status of catla in culture and capture fishery management and it is this aspect that needs proper evaluation vis à vis the propagation of silver carp in India. It merits mention that in the 23 experiments conducted in Kila fish farm at Cuttack to study the compatability or competition between silver carp and catla (Sukumaran et al.,1969) catla showed better performance than silver carp only in two ponds of which one, it merits particular notice, showed persistent myxophyceae bloom.

Records are not wanting regarding the spectacular growth of catla under optimum ecological conditions (Hora, 1944; Chacko, 1948; Chacko and Ganapati, 1950) in Indian waters. But catla came under a cloud when silver carp arrived on the Indian scene. The experiments carried out by Alikunhi and Sukumaran (1964) and Sukumaran et al. (1969) have conclusively shown the superiority of silver carp vis à vis catla in growth rate, yield and survival. The apparent superiority of silver carp over catla is to be expected for more than one reason:

1 The new environment advantage

2 Warmer ecotope with resultant over-intense - feeding intensity

3 Possible food-web dislocation by silver carp going against catla in a limited biotope like pond; and

4 Existing harvesting pattern in pond culture practices

The basic question that is to be sorted out is whether superiority of silver carp to catla is real or apparent. Faster growth rate for a basically cold water fish in warmer biotope is to be expected in poikilothermous animals. Silver carp is no exception to this rule. But is silver carp really superior to catla in food conversion efficiency. A cold water fish set in warm environment, silver carp sets about consuming far in excess than catla and this is reflected by 'gorged' gut of silver carp all through the year (going by Cuttack Substation data). On available evidence from Kulgarhi reservoir (Karamchandani; unpublished) silver carp possibly consumes nearly thrice as much as catla. Food

conversion efficiency of silver carp, perhaps, is of the same order as catla. It is also likely that silver carp shortcircuits the food-web resulting in the poorer performance of catla. For instance silver carp shows preference to smaller zooplankters especially rotifers and nauplii. It is quite likely too much of grazing of copepod nauplii by silver carp disturbs copepod life history and its abundance especially in a limited habitat like pond and thus causing an apparent poorer performance of catla. The results obtained from Kulgarhi lake (M.P.), a small impoundment, are revealing in this respect (Karamchandani, unpublished) 1. That growth rate of catla was twice as superior to silver carp when silver carp was not on the scene. 2. With the introduction of silver carp the growth rate of catla slumped. 3. The growth rate of silver carp, at its best, was not half as good as catla in pre-silver carp introduction phase. 4. There is a qualitative change and sharp drop in abundance of plankton. These results are instructive both from the point of view of population ecology as well as general ecology. The study also reveals the need for caution in introduction of silver carp in small impoundments.

The rationale and philosophy of fish management in culture and capture fisheries are different and it is not desirable to assess the merit or demerit of a fish for capture fisheries from results obtained from culture fisheries. While earlier maturation (one year) in silver carp may suit existing pond culture practices, it may not for capture fisheries. Catla management in capture fisheries takes into consideration its size at maturity on the second year. Going by basic premises of biology it may be safely assumed that over-all growth rate of catla is likely to be superior to silver carp from first year onwards provided they are not cultured together. This is also obvious from observations available from Kulgarhi lake. In fact early maturation of silver carp is one of the important demerits of the fish as far as growth factor is concerned.

The early maturation of silver carp in Indian biotope is also likely to provide a biological edge to this fish over catla as far as population expansion and establishment in rivers and reservoirs are concerned. The silver carp is likely to multiply faster on account of earlier maturation and warmer ecotope and outstrip catla in numerical superiority in due course of time. Once this takes place, it may mark catla's decline and perhaps elimination though it would be difficult to hazard a guess as to how long and in what manner the situation would develop into such a finale, as this is bound up with such other factors as size of drainage and impoundment, extent and availability of spawning habitat, and degree of competition for reproduction, food, and space. The results of comparative experiments

on catla and silver carp by Sukumaran et al.(1966) and Alikunhi and Sukumaran (1964) are too revealing and disturbing to draw any other conclusions.

The above observations need not however preclude stocking of silver carp in certain selected drainages and impoundments in India. Silver carp, being a cold water fish has, in fact, a very important and specific role to play in upland lakes and impoundments which are marked by colder water regime. / No attempt should be made to stock silver carp in Ganga river system, the chief abode of Gangetic major carps. Brahmaputra river system should also be excluded for the same reason. Reservoirs on these river systems also must be excluded for introduction of silver carp_/.

Lakes on river Jhelum and impoundments on river Sutlej are especially suited for silver carp. To begin with such a stocking may be attempted in Govindsagar on Sutlej. In exceptional cases silver carp may also be stocked in such of those reservoirs in Peninsular India where catla fishery is negligible and where Gangetic major carps could not establish due to dominance of catfishes and where, in addition, physical barriers would prevent the spread of silver carp. Nagarjunasagar, a large impoundment, on river Krishna comes under this category where the high dam on the upstream part of Nagarjunasagar, namely, Srisalam dam would limit the silver carp from moving upstream. In addition Dindi dam would block its movement on one of its important tributaries. In Govindsagar the plankton composition is made of dinophyceae (Ceratium, Peridinium), chlorophyceae (Volvox) and myxophyceae (Microcystis) among phytoplankton; and copepoda (Cyclops, Diaptomus), cladocera (Daphnia, Diaphanosoma, Chydorus, Leptodora), rotifera (Keratella, Brachionus) and protozoa (Actinosphaerium, Arcella) among zooplankton. In Nagarjunasagar the plankton composition is made of myxophyceae (Microcystis, Anabaena, Phormidium) and Bacillariophyceae (Synedra, Fragilaria, Tabellaria, Navicula) among phytoplankton; and copepoda (Cyclops, Diaptomus), cladocera (Daphnia, Diaphanosoma, Chydorus), rotifera (Brachionus, Lecane, Keratella, Filina, Trichocerca) and protozoa (Arcella) among zooplankton. At present the annual yield of Nagarjunasagar is of a very low order (catch/ha 1.75-8.60 kg) and major carps formed only about 10% in the total catch. Of this C.catla formed only 1.95-4.11%. On limnological evidence the reservoir is capable of a fish yield of the order of 88 kg/ha. In Govindsagar the annual fish yield was of the order of 50 kg/ha in 1976-77. On limnological evidence the reservoir is capable of a fish yield of 276 kg/ha implying thereby a five-fold increase in fish yield from present level. Though catla occupies an important place in the fishery of Govindsagar at present (29.66% in 1976-77), the water

temperature is likely to drop further with inflow of colder Beas water into reservoir through Beas-Sutlej link. Further, catla is largely restricted to Lunkar khad in lentic zone at present in Govindsagar. The introduction of silver carp in both these reservoirs is likely to improve the fishery in a significant manner. In fact, a small batch of silver carp fingerlings had already escaped into Govindsagar in 1971-72 when floods inundated Deoli fish farm. Available information shows that some of them have since bred in the reservoir.

The foregoing observations indicate the need for care and caution in introducing silver carp in our rivers and reservoirs. This is all the more so in view of the growing awareness to preserve the genetic purity and germ plasm of our own indigenous quality fishes. It would not be out of place to point out here the gradual decline in abundance of our own precious stocks like Schizothorax spp. in Dal Lake, Jhelum river etc. on account of introduction of exotic common carp. Nor can we afford to ignore the adverse ecological impact of exotic water hyacinth in our precious waters.

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NAGARJUNASAGAR RESERVOIR

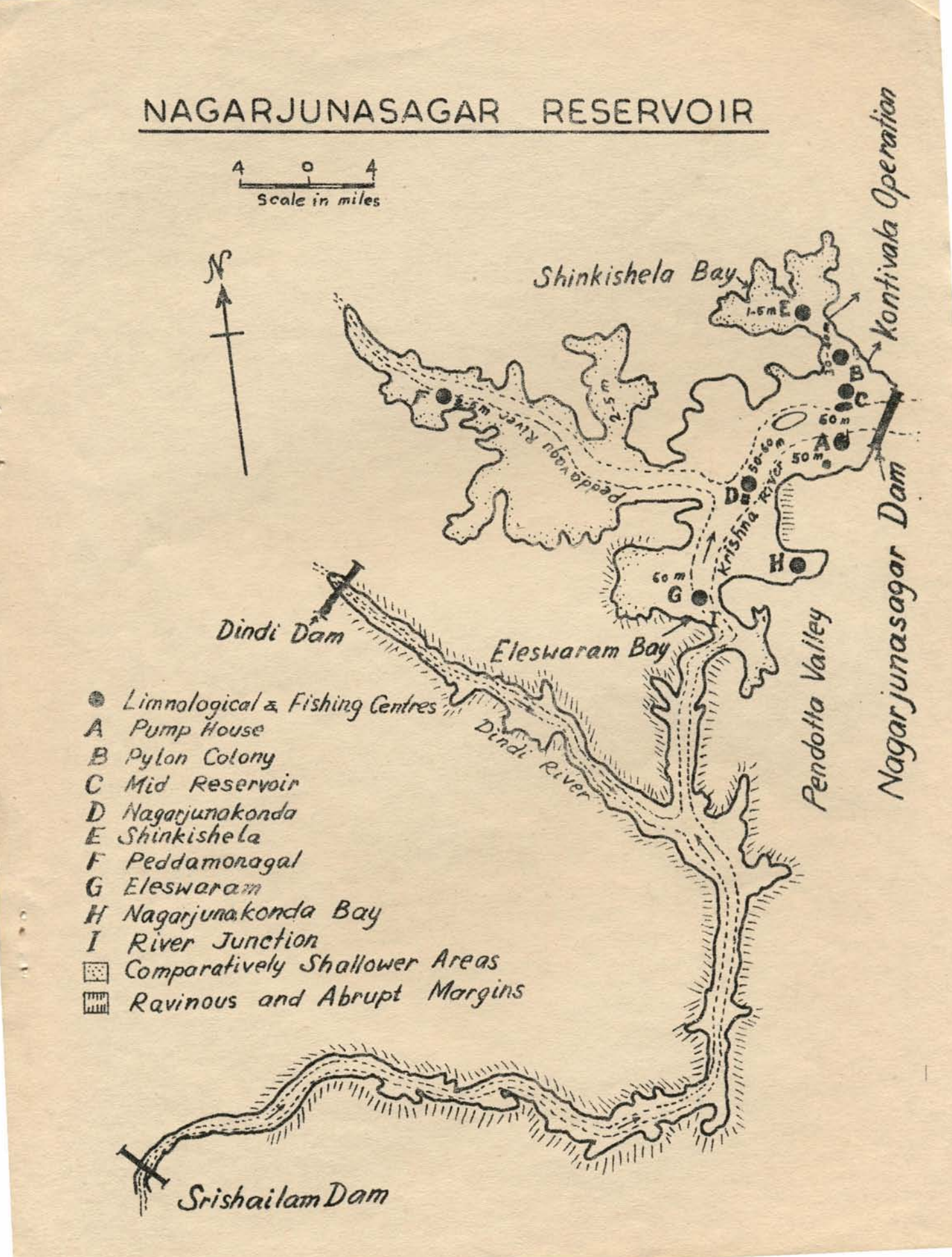

FIG. 12 - GOBINSAGAR RESERVOIR AREA