Risk analysis and sustainability of *Pangasianodon hypophthalmus* culture in India

Lakra, W.S. and Singh, A.K.

National Bureau of Fish Genetic Resources, Canal Ring Road, P.O. Dilkusha, Lucknow 226002, Uttar Pradesh India, email: aksingh56@rediffmail.com

Pangasianodon hypophthalmus was introduced into India possibly during 1997 clandestinely via Bangladesh and adopted for culture in the state of West Bengal. Because of its remarkable growth rate (almost one kg in 90 days), there has been much enthusiasm among fish breeders and farmers particularly in West Bengal and Andhra Pradesh for its culture and propagation. It is estimated that over 200,000 tonnes of *P. hypophthalmus* catfish are produced in the country per annum. Therefore, a study was conducted to assess the risk and benefits of the *P. hypophthalmus* culture in India. The details of the biological characters of introduced *P. hypophthalmus* were collected from field studies. The information and data on culture, food and feeding habits, maturity, breeding and reproduction under grow-out and hatchery conditions, diseases of concern, if any, the gut contents and maturity stages of escapee fish in the wild were generated for assessing its potential to compete with other fish species.

Culture and seed production

Information from grow-out farms revealed that the fish is cultivated both under monoculture as well as polyculture with Indian major carps and Chinese carps. However, monoculture was found to be more profitable to the farmers. Therefore,

most of the farmers preferred monoculture practice. Farmers located in Krishna and West Godavari districts of Andhra Pradesh are culturing *P. hypophthalmus* in big ponds ranging from four ha to 40 ha. It was found that there is a shift in culture practice from carps to sutchi catfish in some of the areas in Andhra Pradesh. The total area of fish culture of *P. hypophthalmus* was estimated to be over 20,000 ha covering roughly 15% of the total culture area, which has increased over the years. Due to closure of shrimp ponds on account of disease, farmers suffered heavy losses and many adopted *P. hypophthalmus* farming as an alternative crop in the same areas that were disease affected.

The state of West Bengal was found to be the hub of seed production of *P. hypophthalmus* in the country. About 300 to 500 million *P. hypophthalmus* seed is produced every year with the bulk of it being sent to Andhra Pradesh and the rest to Orissa, Tamil Nadu, Maharashtra, Kerala, Karnataka, Bihar, Rajasthan and Uttar Pradesh. The seed production of *P. hypophthalmus* is not only used for aquaculture but is also sold for the aquarium trade. Different varieties of fingerlings (striped and albino) are produced for aquarium trade. The culture production of *P. hypophthalmus* ranges from 7 tonnes per hectare per year to 20 tonnes per hectare per year and the average production are found to be higher than carp production in the same areas.

Food and feeding

This catfish is an omnivorous fish feeding on crustaceans, molluscs, plant debris and small fishes. However, farmers use several local ingredients for feeding the fish under culture. Most of the farmers fed cooked de-oiled rice bran (DOB) and broken rice at the rate of 5% of the body weight. The locally available agricultural waste product is also used along with DOB for feeding. Even discarded potatoes are also used along with DOB. Bag feeding is practiced by most of farmers.

Maturity and breeding

P. hypophthalmus is a riverine fish attaining maturity at an age beyond 3 years however, under captive conditions it has been found to mature at an age of 2 years and above. Males and females are easily distinguishable; females are identified by their big, soft and swollen and reddish pink distended belly and males by their reddish genital opening and oozing of milt, when the abdomen is pressed. Breeding starts from April and continues until mid September. One brooder can be used at least two times during the same breeding season. After the hormone injection (pituitary extract/Ovaprim) the fishes release eggs which are fertilised. The spawn is rinsed in milk powder solution in Aluminium 'hundi' to remove the adhesive gelatinous covering of the fertilised eggs. The fertilised eggs are then transferred to a Chinese hatchery 20 minutes afterwards for hatching and rearing.

Disease and management

Catfish culture is faced with severe disease problems. Heavy mortalities have been noticed and the fish exhibited off-feeding, circular motions, edging and other morbid conditions. All sizes of fish ranging from 5 g to 1.5 kg have been found disease affected and causing heavy losses to farmers. Parasitic diseases have been found to be very common but occurrences of 'red disease' in *P. hypophthalmus* catfish from grow out farms have also been confirmed which was haemorrhagic septicaemia. In some specimens swelling of the liver has been observed. Microscopic examinations of gill by squash preparation of infected fish reveal presence of *Trichodina* parasitic infection of moderate degree.

Harvesting and marketing

P. hypophthalmus ranges from 8 months to one year, in general. However, according to marketability farmers harvest the fish from 6 months onwards. In most of the farms multiple harvests are in practice. Fishes weighing above 1.5 kg are the preferred size for harvest and marketing. The packing and loading of harvested *P. hypophthalmus* for trade are well organised and it is ice packed. The chilled storage condition is most widely used active packaging technology. By using this technique, the product's shelf-life becomes up to 20 days[1].

Occurrence of *Pangasianodon hypophthalmus* in natural waters

A few specimens of *P. sutchi* have been caught from the wild in Andhra Pradesh and also from wetlands in West Bengal. Bench mark surveys indicated the availability of *P. sutchi* in natural waters. The present occurrence of P. sutchi in natural waters is in need of further study with regards to the conditions it can survive in and its impacts on native fish fauna. However, gut analysis of the collected specimens from wild showed presence of shell and plant debris in the stomach. The gonads of the wild caught specimens have not been found fully developed and mature.

Risks associated with culture of *P. hypophthalmus*

Biodiversity

The locations of culture and hatchery sites of *P. hypophthalmus* in India have been found to be close to open waters and hence there exists every chance of its escape. Escapee fish have been recorded from wetlands of West Bengal as well as Kolleru lake area of Andhra Pradesh. The culture activity is spreading fast in India and now it is not only restricted to Andhra Pradesh and West Bengal, rather it has extended to other coastal areas including fishery hotspots of Western Ghats and also in the northern and north- eastern parts of the country. It has potential to mature and breed naturally in wild and hence escapee fish may colonise and form feral populations in different agro-climatic conditions impacting the ecosystem and in turn affecting the biodiversity. In India, the breeding of local *P. pangasius,* which has a similar spawning period which will be overlapped by *P. hypophthalmus* in case of its establishment in the wild. The presence of similar numbers of chromosomes in both the species (2n=60) may facilitate hybridisation leading to genetic pollution which in turn could dilute the gene pool of local *P. pangasius* whose population has declined critically[2]. An experimental trial for cross breeding between *P. pangasius* with *P. hypophthalmus* has already been successfully attempted in Bangladesh[3,4]. The husbandry practices are now improving and hatcheries have begun selection for traits favourable to aquaculture or aquarium purpose for *P. hypophthalmus*. Hence, escapee fish may become a concern in future[5].

Environmental issues

Irrational use of antibiotics and chemicals in *P. hypophthalmus* farms in India is of great environmental concern. Frequent outbreaks of bacterial diseases have put considerable pressure on farms to use a variety of antibiotics and chemicals and also at hatcheries. In fact, the contamination with banned chemicals and antibiotics which is in practice might occur at any stage throughout the production chain. It is therefore, necessary to have a nationwide campaign to improve sanitation and ensuring quarantine warranty, environmental purity and food safety.

Issues of fish health

Gill fluke infection is commonly seen in all *P. hypophthalmus* farms with infection rates varying from 60% to 90% of fish. The highest mortality due to gill fluke is manifested during the first week after stocking. The incidence of visible infections or disease in spawn and early fry at the hatcheries is low, except for gas bubble disease which is probably due to high ammonia level and eutrophic conditions. Farmers pay attention only to the direct economical loss from diseases other than that from gill fluke infection. In fact, gill fluke has been understood to contribute significantly to the loss due to secondary bacterial infection which was followed by the initial infections with the parasite. Catfish diseases have been considered as the major problem in its culture. Due to the open culture of *P. hypophthalmus*, risk of disease and parasite transfer to wild stocks would be possible. Recently, the bacteria *Edwardsiella ictaluri*, a disease native to North America and reported from ictalurid catfish, was identified in farmed *P. hypophthalmus* cultured in the Mekong River Delta. This is the first instance of this disease being observed in pangasiids. *Edwardsiella ictaluri* has been isolated from *P. hypophthalmus* in Vietnam, which has not been reported from the co-habitant *P. bocourti*[6]. A previous report of bacillary muscle necrosis reported from Vietnam[7] has now been identified as being attributable to *E. ictaluri*[6]. It remains unclear as to whether the bacteria are introduced or local but previously unknown, however transmission of pest could be an issue in the future. A report from New Zealand on risk assessment of Vietnamese *P. hypophthalmus* has highlighted the possible transfer of *Edwardsiela ictahuri* in aquaculture areas in Vietnam which is a concern of OIE listed disease[8]. It is pertinent to mention that infection of *P. hypophthalmus* does not result in clinically apparent disease. Therefore, septicaemic fish are quite likely to be harvested for human consumption. There remains the possibility that some fish could be carrier of *E. ictaluri* without displaying clinical signs. In India, the septicaemic fish infections were observed at some of the *P. hypophthalmus* farms. If such infected fish is harvested and processed for consumption, it will have a serious concern with human health. Further, there is no treatment of the effluent water from culture ponds and lacking knowledge of farmers, dead fish and/or diseased fish from aquaculture and aquarium facilities are released directly to public canals and rivers. Hence, there is prevailing threat of disease risks associated with culture of *P. hypophthalmus*.

Socio-economic issues

Easy management of culture operations in recent years attracted farmers to catfish culture. *P. hypophthalmus* is now available at a low cost of Rs 30-40/ kg. Carp production is declining due to the fact that farmers are cultivating *P.*

hypophthalmus in carp as well as shrimp aquaculture farms. It is important to point out that demand for carps is still greater and it costs more, at Rs.50-70/kg. Farmers are producing *P. hypophthalmus* at a lower investment but the cost of production is escalating considering the cost of antibiotics and other chemicals. This situation is impacting marginal farmers, consumers, culture environment and socio-economic conditions.

Conclusion

The study was based on interaction with aquaculturists, state fishery officials, fish dealers in the markets, laboratory studies of diseased samples in the states of West Bengal and Andhra Pradesh and desktop analysis of the world literature related to the culture of *P. hypophthalmus*. Based on the study the following scenario emerges for *P. hypophthalmus* culture in India:

- The culture of *P. hypophthalmus* was found to be prevalent in the states of West Bengal and Andhra Pradesh.
- Further spread of *P. hypophthalmus* farms in fishery sensitive and biodiversity rich areas such as Western and Eastern Ghats can harm indigenous fish diversity.
- *P. hypophthalmus* is a riverine fish and it has a great potential to mature and breed in rivers.
- The escapee *P. hypophthalmus* may enter the natural waters and compete with wild fish affecting the ecosystem balance.
- Use of fishmeal, trash fishes in *P. hypophthalmus* feed will deplete resources on which other local fish depend as food.
- *Pangasianodon hypophthalmus* is prone to diseases such as haemorrhagic septicemia, bacillary diseases, *Flavobacterium columnarae*, *Trichodina* and can impact farmed and wild stocks.
- Inappropriate use of antibiotics and chemicals practiced in *P. hypophthalmus* culture can have adverse impacts on the environment and human health.

Consequently, the culture of *P. hypophthalmus* in India warrants a very cautious and regulated approach. It is suggested to discourage and prevent the practice of free and widespread culture of *P. hypophthalmus* in the country as it could be a threat to our aquatic biodiversity.

Acknowledgements

The financial support from DAHD&F, Ministry of Agriculture, Government of India is thankfully acknowledged. The co-operation and support provided by Dr. Ram Gopal Rao, Additional Commissioner Fisheries, Government of Andhra Pradesh and Dr. Madhumita Mukherjee, Joint Director Fisheries, Government of West Bengal in data collection during the field visits of the investigators is gratefully acknowledged. The help provided by Dr. Phani Prakash in diseased fish sample collection and Dr. V.S. Basheer, Senior Scientist, NBFGR in some of the field data collection is also thankfully acknowledged.

References

Mohan, C.O., Ravishankar, C.N., Srinivasagopal, T.K. 2008. Effect of O2 Scavenger on the Shelf-life of Catfish (*Pangasius sutchi*) Steaks during Chilled Storage. Journal of the Science of Food and Agriculture Vol.: 88(3): 442-448.

Sarkar, U.K., Paul, S.K, Kapoor, D., Deepak, P.K. and Singh, S.P. 2006. Captive breeding of Pangasius catfish *Pangasius pangasius* with Ovaprim –an attempt towards sustainable seed production and conservation of wild populations. Aquaculture Asia July-Sept, 2006: 8-10.

Khan, M.H.K., Mollah, M.F.A. 2004. Further trials on induced breeding of *Pangasius pangasius* (Hamilton) in Bangladesh. Asian Fish Science 17: 135–146.

Hossain, M. 2006. Evaluation of Mixed Feeding Schedules with Varying Dietary Protein Content on the Growth Performance and Reduction of Cost of Production for Sutchi Catfish, *Pangasius hypothalmus*, Sauvage, with Silver Carp, *Hypophthalmichthys molitrix*, Valenciennes. Journal of Applied Aquaculture Vol. 18(1): 63-78.

Nguyen, V.S., Nguyen, V.H., Dinh, H., Pham, D.K., Bui, T.L.H., Vu, H.D. and Nguyen, D. 2007. Selective breeding for growth and fillet yield of river catfish (*Pangasianodon hypophthalmus*) in the Mekong Delta, Vietnam". Aquaculture Asia Magazine, April-June, 2007: 26-27.

Crumlish, M., Dung, T.T., Turnbull, J.F., Ngoc, N.T.N. and Ferguson, H.W. 2002. Identification of *Edwardsiella ictaluri* from diseased freshwater catfish, *Pangasius hypothalmus* (Sauvage), cultured in the Mekong Delta, Vietnam. Journal of Fish Diseases 25(12) 733-736.

Ferguson H.W., Turnbull J.F., Shinn A.P., Thompson K., Dung T.T. & Crumlish M. 2001. Bacillary necrosis in farmed *Pangasius hypothalmus* (Sauvage) from the Mekong Delta, Vietnam. Journal of Fish Diseases 24 509–513.

Reed, C. 2008. Import risk analysis: Frozen, skinless and boneless fillet meat of *Pangasius* spp. fish from Vietnam for human consumption. Biosecurity New Zealand Ministry of Agriculture and Forestry Wellington New Zealand Ministry of Agriculture and Forestry Te Manatu Ahuwhenua, Ngaherehere Pastoral House 25 The Terrace P O Box 2526 Wellington New Zealand . Internet: http://www.maf.govt.nz.

Life of a river in the Himalaya: An ecological study of Trisuli River system in Nepal

Thapa, S., Yonzon, P.B., Rai, A.K.

Resources Himalaya Foundation, Conservation Chautari, Kathmandu, Nepal. Email: akrai@resourceshimalaya.org

There are three major river systems in Nepal – the Koshi in the east, Gandaki in the centre, and Karnali in the west. All of them drain into the Ganges River basin, flowing through northern India and emptying in the Bay of Bengal.

The Trisuli River, one of the seven major tributaries of Gandak River Basin, originates in the Gosainkunda Lake (approximately 4,500 altitude) of Rasuwa District in Central Nepal. According to Hindu legend, the Trisuli River originated by Lord Shiva driving his trident 'Trisul' in the hill just above the Gosainkunda to create three springs when he needed a cool place to rest in the Lake Gosainkunda. The Gandaki River system is the main tributary and mixes with other rivers such as Buri Gandaki, Marsyangdi and Seti Rivers as it