amount of excreta in males than that of females. This result is similar to previous observations (Babu *et al.*, 1993). Litter sample analysis shown no oocyst and no fowl odours in the shed. So this level of moisture is not harmful.

At 42 days it was 26.52 per cent, 28.52 per cent, 27.81 per cent which is in similar trends to that of at 21 days. This level of moisture directly correlated with the higher body weight of males than that of females and there is a significant ($p<0.05$) variation in the moisture level in all the three groups. These levels of moisture in all three groups were slightly higher than that of the recommended moisture level. Interestingly litter also emitted slight ammonical odour and litter sample analysis shown small number of coccidial oocyst at this moisture level. This agrees to the findings of previous workers (Carlile, 1984). So litter upto this level is not recommended and should be changed before this age.

At 63 days moisture level was 38.81 per cent, 37.99 per cent and 37.33 per cent. The typicality of our finding at different age lies from this age. From 63 days onwards the trend changes. Highest moisture percentage was found in female group followed by T_3 and T_1. There is a significant ($p<0.05$) difference between T_1 and T_2 group. Moisture per cent in T_3 group varies non-significantly ($p>0.05$) at this age. This may be due to from 63 days female Vanaraja chicken gain more body weight than corresponding male groups though non-significantly ($p>0.05$). According to age the litter moisture level increases continuously. The litter material was completely wet and completely caked (Thaxton *et al.*, 2003). High ammonical odours was also emitted. Birds were found to be lying at corners with high levels of discomfort and were gasping heavily (Tablante *et al.*, 1999). Litter sample analysis also shown high burden of coccidial oocyst (Stayer *et al.*,1995). This level of moisture is highly not recommended.

The above observations were depicted below in both tabular and graphical form for better comparision.

Conclusion :

From above study it is concluded that litter moisture level increases significantly ($p<0.05$) with advancement in ages. But at 42 days of age the level is higher than that of the recommended level so litter materials should be changed before attaining this age. In accordance with sex male group litter had significantly ($p<0.05$) higher moisture level than that of female and mixed groups. So from above study we can pen a line that litter moisture is an important parameters in view of birds health and it should be properly monitored and should be changed at a regular interval for a disease free flock.

LITERATURE CITED

Babu, L.K., Sahoo, G., Mishra, S.C., Mishra, P. R. and Nayak, J.B. (1993). Effect of litter thickness on the hygiene and mineral value of poultry litter. *Indian J. Poult. Sci.,* **28** (1):71-73.

Carlile, F.S. (1984). Ammonia in poultry houses: A literature review. *World's Poult. Sci. J.,* **40**: 99-113.

Pitt, R. E. (1993). *Forage moisture determination*. Publication 59. NRAES, Ithaca, NEW YORK, U.S.A.

Rao, V.S.R. (1986). Litter-Its management and utility in broiler. *Poult. Advis.,* **19** (7-12) : 31-40.

Shakila, S. and Naidu, M. A. (1998). A study on the performance of the broiler on different litter materials. *Indian Vet. J.,* **78** (8): 705-707.

Stayer, P., Pote, L. and Keirs, R. (1995). A comparison of Eimeria oocysts isolated from litter and fecal samples from broiler houses at two farms with different management systems during one growout. *Poult. Sci.,* **74**: 26-32.

Tablante, N.L., P.Y. Brunet, E.M. Odor, M. Salem, J.M. Harter-Dennis and Hueston, W.D. (1999). Risk factors associated with early respiratory disease complex in broiler chickens. *Avian Diseases,* **43**: 424-428.

Thaxton, Y. V., Balzli, C.L. and Tankson, J.D. (2003). Relationship of broiler flock numbers to litter microflora. *J. Appl. Poult. Sci.*, **12**:81-84.

Watkins, S. (2001). Litter conditioning for a healthy flock. *Avian Adv.,* **3** (2) : 10-13.

➔DOI : 10.15740/HAS/AJBS/11.2/292-297
e ISSN-0976-8343 | ■ Visit us : *www.researchjournal.co.in*
ASIAN JOURNAL OF BIO SCIENCE
Volume **11** | Issue 2 | October, 2016 | 292-297

RESEARCH **P**APER

Linking *Cirrhinus mrigala* (Hamilton, 1822) size composition and exploitation structure to their restoration in the Yamuna river, India

PRIYANKA MAYANK **AND AMITABH CHANDRA DWIVEDI**

Regional Centre, ICAR-Central Inland Fisheries Research Institute, ALLAHABAD (U.P.) INDIA
Email : saajjjan@rediffmail.com

Article Info : Received : 15.03.2016; Revised : 27.08.2016; Accepted : 13.09.2016

Fish size is an integral component of river and stream system and represents an evident of structure, function, depth and health of the river/stream. *Cirrhinus mrigala* is a member of Indian major carp group. The species is of commercial significance due to its aquaculture potential and high consumer preference. Studies were undertaken during the period August 2011 to July 2012 from the Yamuna river at Allahabad, India. The size composition of *C. mrigala* varied from 16.8 to 94.3 cm total length. The mostly large size fishes were recorded in the monsoon season. The maximum exploitation was recorded in 46.1-52.0 cm size group with 16.72 per cent and minimum in 94.0-100 cm with 0.30 per cent in pooled samples. In the stock, female fishes were more exploited (48.66%) compared to male fishes (51.34%). The size composition and exploitation structure of *C. mrigala* indicated that very necessary to restoration or enhancement through stocking of this species in the Yamuna river, India. Presently, there is no local or regional arrangement for reporting restoration.

Key words : Restoration, Size composition, Exploitation structure, *Cirrhinus mrigala*, Yamuna river

How to cite this paper : Mayank, Priyanka and Dwivedi, Amitabh Chandra (2016). Linking *Cirrhinus mrigala* (Hamilton, 1822) size composition and exploitation structure to their restoration in the Yamuna river, India. *Asian J. Bio. Sci.*, **11** (2) : 292-297.**DOI : 10.15740/HAS/AJBS/11.2/292-297.**

INTRODUCTION

Knowledge of size composition is crucial to use in restoration and fisheries stock assessments from inland water bodies. Fish size is an integral component of river and stream system and represents an evident of structure, function, depth and health of stream/river. Mostly large size and perennial river has large size of fishes in water bodies. The large size fishes required more depth compared to small size fishes (Dwivedi and Nautiyal, 2010). Fish represent one of the key elements to evaluate the rivers ecological status (Hermoso *et al.,* 2010 and Lynch *et al.,* 2016). Habitat structure and size can have major implication for the ecology and demography of populations (Merilä, 2014).

The natural distribution of *Cirrhinus mrigala* is in the India, Bangladesh and Pakistan. *C. mrigala* had been successfully transplanted to many countries such as Nepal, Malaysia, Sri Lanka, Mauritus, Philippines, South Rodesia, USSR, Africa and Viettien (Chondar, 1999). *C. mrigala* is also a member of backbone of culture fisheries in India (Dwivedi *et al.,* 2004). Its fishing is target stock in the Yamuna river which reduce abundance and biomass. It is commonly known as Mrigala/Nain. It is large size fish species with very fast growing fish (Mayank *et al.,* 2015). It is also commercially exploited in the Ken, Paisuni and Tons rivers (Dwivedi and Nautiyal, 2013), in the Ganga (Pathak *et al.,* 2015) and in the Yamuna river

(Mayank and Dwivedi, 2015 a). Commercial fisheries have declined throughout India (Dwivedi *et al.,* 2009 a; Mayank *et al.,* 2015 and Pathak *et al.,* 2015). It is bottom dweller and struggle in the Yamuna river with *Cyprinus carpio, Oreochromis niloticus* and *L. calbasu* for space, feeding and breeding ground (Pathak *et al.,* 2014; Imran *et al.,* 2015 and Mayank and Dwivedi, 2016). The size composition and exploitation structure studies by Dwivedi *et al.* (2009) and Pathak *et al.* (2015) in *Cyprinus carpio,* Dwivedi *et al.* (2011) in *Rita rita,* Imran *et al.* (2015) in *Labeo calbasu* and Tripathi *et al.* (2015) in *Eutropiichthys vacha*.

The world large rivers are important resources to adjacent human being population points (Harting *et al.,* 2009). Loss of functional habitat in riverine systems is a worldwide fisheries issue (Manny *et al.,* 2014 and Lynch *et al.,* 2016). The literature on restoration of inland water bodies are and diverse (Frissell and Ralph, 1998; Cooke *et al.,* 2005; Falk *et al.,* 2006; Miller and Hobbs, 2007; Allan *et al.,* 2012 and Hering *et al.,* 2015). The large size fishes have become very important models for the study of restoration. But nothing is known about *C. mrigala* from the Yamuna river at Allahabad, India. The aim of this study was to investigate the size composition and exploitation structure of *C. mrigala* in respect of restoration need from the Yamuna river at Allahabad, India. Record and assessment of the present research work is necessary to formulate informed decisions about restoration and management of large rivers.

RESEARCH METHODOLOGY

The specimens for the present study were drawn from the commercial catches landed at Sadiapur fish landing centre, Allahabad. This landing centre, situated on the bank of the Yamuna river, is mainly fed by the catches of the Yamuna river. The Yamuna river is a right bank largest tributary of the Ganga river. *Cirrhinus mrigala* (Hamilton, 1822) was collected using a variety of methods including drag netting (mahajal, chaundi, darwari), cast netting, gill netting and hook and line. The 335 fish samples were collected at random during the months August 2011 to July 2012 form the Sadiapur wholesale fish market. Sizes of fishes were measured by simple measuring scale. The total lengths (TL) of fishes were measured from tip of the snout to the largest rays of the caudal fin. The size composition varied from 16.8 to 94.3 cm size group (total length). Collected data were classified at 6.00 cm intervals. The number of samples segregated according to size group then converted into percentage.

RESEARCH FINDINGS AND ANALYSIS

The size composition of *C. mrigala* varied from 16.8 to 94.3 cm total length. The mostly large size fishes were recorded in the monsoon season. The monsoon season is the breeding period of *C. mrigala* in the Indian subcontinent. The maximum exploitation was recorded in 46.1-52.0 cm size group with 16.72 per cent and minimum in 94.0-100 cm with 0.30 per cent in pooled samples (Fig. 1). The 16.1-22.0, 22.1-28.0, 28.1-34.0 and 34.1-40.0 cm size group fishes were exploited with 2.09 per cent, 10.75 per cent, 11.34 per cent and 5.67 per cent, respectively. The middle size group fishes were (40.1-70.0 cm) shared with 61.20 per cent. The largest size fish stock was very poor in the Yamuna river. Above 64.0 cm size group fishes can be protected in the monsoon season because this size groups had most experience for heavy recruitment. In the stock, female fishes was more exploited (48.66%) compared to male fishes (51.34%). *C. mrigala* is suffering to fishing pressure in the Yamuna river. Fishing pressure changes the biodiversity, size composition, growth rate, age composition, sex ratio, income of fisher and maturation (Arlinghaus *et al.,* 2010; Dwivedi and Nautiyal, 2012 and Pathak *et al.,* 2015).

The size composition of male *C. mrigala* varied from 16.8 to 86.0 cm total length. In case of male, the maximum exploitation was also recorded in 46.1-52.0 cm size group with 19.63 per cent and minimum in 82.1-88.0 cm with 1.23 per cent (Fig. 1). The 40.1-46.0 and 52.1-58.0 cm size groups exploited with 12.88 per cent each. The size composition of female *C. mrigala* varied from 16.8 to 94.3 cm total length. In case of female, the maximum exploitation was recorded in 58.1-64.0 cm size group with 14.53 per cent and minimum in 94.0-100 cm with 0.58 per cent (Fig.1). The experienced mature female fish stock was healthy in the river in monsoon season but very high fishing pressure we observed in this season. Dramatically size groups and landing of *C. mrigala* were increased in the Yamuna river in monsoon season. The small size group fishes 6.1-22.0, 22.1-28.0, 28.1-34.0 and 34.1-40.0 cm were exploited with 2.32 per cent, 8.14 per cent, 12.21 per cent and 6.98, respectively.

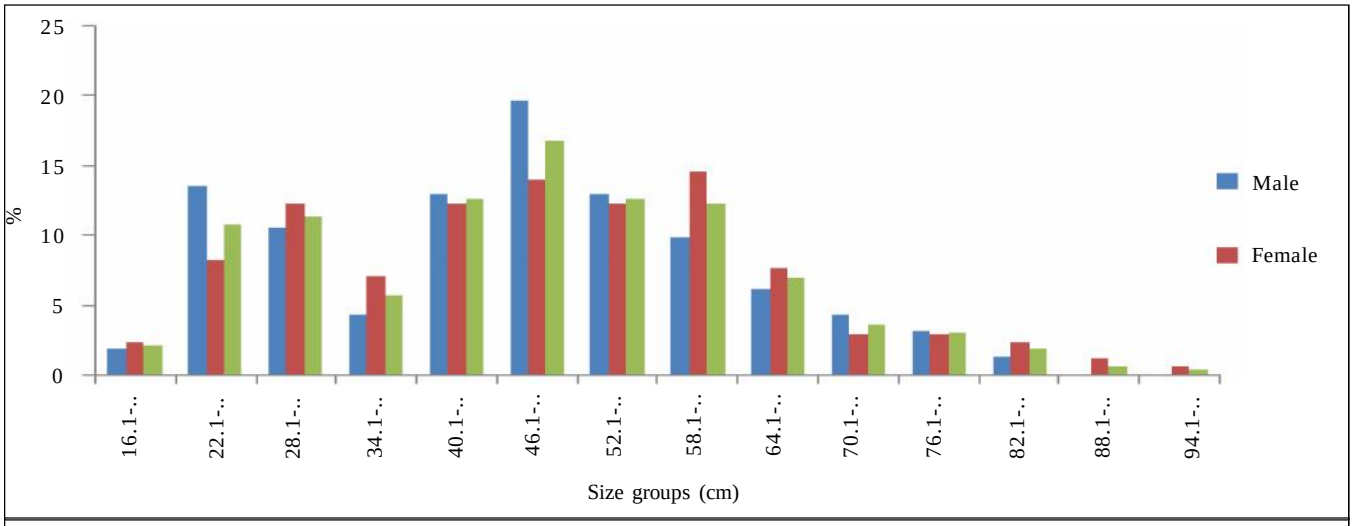

Fig. 1: Exploitation structure of *C. mrigala* from the Yamuna river, India

The comparison of maximum size of *C. mrigala* obtained in the catch from the Ganga river with 1010 mm (Jhingran, 1959) and the Yamuna river with 965 mm (Kamal, 1969). Present maximum size of *C. mrigala* (94.3 cm) is lower than earlier reported by Jhingran (1959) and Kamal (1969). Jhingran (1959) and Kamal (1969) reported many specimens of *C. mrigala* above 900 mm size (total length) but only 2 specimens observed in present study. Maximum size indicated that the need of restoration of *C. mrigala* in the Yamuna river. The growths of fishes are slightly checked by heavy metals accumulation in the body of fishes (Tiwari and Dwivedi, 2014; Tiwari *et al.*, 2014 and Dwivedi *et al.*, 2015). The size composition and exploitation structure of *C. mrigala* indicated that very necessary to enhancement or restoration through stocking of this species in the Yamuna river. Arlinghaus *et al.* (2015) stated that the fisheries enhancement or restoration through stocking is mostly based on fishes produced in aquaculture but may also happen via legal or illegal translocation of wild fishes. Aquaculture is a very growing industry in inland water of the India. According to Lorenzen *et al.* (2012) stocking can generate multiple benefits including increasing stock abundance and fishery yield or opportunity to catch. Present study also suggested for river restoration. Restoration of river has the potential to affect not only structural ecosystem features, including species composition and diversity, landing structure, but also ecosystem functioning. Globally, rivers/streams are being restored at a boosting to enhance overall productivity, biodiversity, restore fish habitats and ecosystem services condition (Dwivedi and Nautiyal, 2010; Strayer and Dudgeon, 2010 and Hering *et al.*, 2015). Control or eradication of exotic fish species is a commonly employed restoration strategy in many ecosystems.

Landings :

The landing scenario of *C. mrigala* as reported by Jhingran *et al.* (1970) was the most dominant species during sixties. But present catch was estimated only 6.28 per cent in the Yamuna river (Table 1). The *L. calbasu* was constituted 1.23 per cent in present study but this fish was dominated during 1973 to 1986 with 17.15 per cent (Gupta and Tyagi, 1992). Both fishes are bottom feeder. At present time *Cyprinus carpio* shared 21.67 per cent (Mayank and Dwivedi, 2015 a) which is most competitors to *C. mrigala* and *L. calbasu* for feeding, space and habitat in the Yamuna river. Siltation is main problem in the Yamuna river which is response to the

Table 1 : Comparative details of percentage composition of *C. mrigala* from the Allahabad region

Fish species	1958-59 to 1965-66 (Jhingran *et al.*, 1970)	1973-86 (Gupta and Tyagi, 1992)	2011-2012 (Present authors)
C. mrigala	23.5	6.76	6.28
Labeo calbasu	4.5	17.15	1.23

turbidity. Turbidity of the Yamuna river decreased by browsing nature of *C. carpio*. The feeding behaviour of bottom dweller fishes are highly trouble by low turbidity. Present landing scenario and circumstances of three bottom dweller species indicated that the habitat restoration is also very necessary in the Yamuna river. Habitat restoration is an obvious way of improving a fishery (Arlinghaus and Mehner, 2003 and Hickley *et al.,* 2004). In general, restoration effects differed between the response variables despite the local differences in water bodies or river and project distinctiveness. In the Yamuna river, *C. mrigala* is suffering for heavy fishing pressure. Lynch *et al*. (2016) stated that the when sustainably harvested or farmed, inland fish can be considered part of the green food movement for more environmentally friendly sourcing of food.

Conclusion :

It may be concluded that the size composition indicated that the stock of *C. mrigala* in the Yamuna river is poor to earlier reports. Exploitation structure was un-systematic. Present situation was observed due to overexploitation of this fish in past. Current situation indicated that the restoration is very necessary.

LITERATURE CITED

Allan, J.D., Mclntyre, P.B., Smith, S.D.P., Halpern, B.S., Boyer, G.L., Buchsbaum, A., Burton, G.A., Jr., Campbell, L.M., Chadderton, W.L, Ciborowski, J.J.H., Doran, P.J., Eder, T., Infant, D.M., Johnson, L.B., Joseph, C.A., Marino, A.L., Prusevich, A., Read, J.G., Rose, J.B., Rutherford, E.S., Sowa, S.P. and Steinman, A.D. (2012). Joint analysis of stressors and ecosystem services to enhance restoration n effectiveness. *Proc. National Acad. Sci.,* doi: 10.1073/pnas.1213841110.

Arlinghaus, R. and Mehner, T. (2003). Management preferences of urban anglers: habitat rehabilitation measures versus other options. *Fisheries*, **28**: 10-17.

Arlinghaus, R., Mastsumura, S. and Dieckmann,U. (2010). The conservation and fishery benefits of protecting large pike (*Exos lucius* L.) by harvesting regulations in recreational fishing. *Biological Cons.,* **143**: 1444-1459.

Arlinghaus, R., Lorenzen, K., Johnson, B.M., Cooke, S.J. and Cowx, I.G. (2015). Management of freshwater fisheries: addressing habitat, people and fishes. In: *Freshwater fisheries ecology.* edited by J.F. Craig. John Wiley & Sons Ltd. 1st Ed., pp. 557-579.

Chondar, S.L. (1999). *Biology of finfish and shellfish*. *SCSC* Publishers (India) Howrah, pp. 514.

Cooke, G.D., Welch, E.B., Peterson, S. and Nichols, S.A. (2005). *Restoration and management of lakes and reservoirs*. Boca Raton, FL: Taylor & Francis.

Dwivedi, A.C., Tewari, N.P. and Singh, K.R. (2004). Present structure of capture and culture fishery of the Faizabad district (U.P.). *Bioved.,* **15**(1 & 2): 95-98.

Dwivedi, A.C., Singh, K.R., Khan, S. and Mayank, P. (2009 a). Dynamics of exploited fish populations and sex ratio of *Cyprinus carpio* var. *communis* (Linnaeus) in the Yamuna river at Allahabad. *Asian J. Animal Sci.*, **3**(2): 198-202.

Dwivedi, A.C., Mayank, P., Masud, S. and Khan, S. (2009 b). An investigation of the population status and age pyramid of *Cyprinus carpio* var. *communis* from the Yamuna river at Allahabad. *Asian J. Animal Sci.*, **4** (1) : 98-101.

Dwivedi, A.C. and Nautiyal, P. (2010). *Population dynamics of important fishes in the Vindhyan region, India*. LAP LAMBERT Academic Publishing GmbH & Co. KG, Dudweiler Landstr. 99, 66123 Saarbrucken, Germany, 220pp.

Dwivedi, A.C., Mayank, P. and Tripathi, S. (2011). Size composition, exploitation structure and sex ratio of catfish, *Rita rita* (Hamilton) in the lower stretch of the Yamuna river at Allahabad. *Flora & Fauna,* **17**(2): 295-300.

Dwivedi, A.C. and Nautiyal, P. (2012). Stock assessment of fish species, *Labeo rohita*, *Tor tor* and *Labeo calbasu* in the rivers of Vindhyan region, India. *J. Environ. Biol.*, **33** (2): 261-264.

Dwivedi, A.C. and Nautiyal, P. (2013). Alien fish species, *Cyprinus carpio* (common carp) as a invader in the Vindhyan region (Ken, Paisuni, Tons rivers), India. *J. Kalash Sci.,* **1**(2): 133-139.

Dwivedi, A.C., Tiwari A. and Mayank P. (2015). Seasonal determination of heavy metals in muscle, gill and liver tissues of Nile

tilapia, *Oreochromis niloticus* (Linnaeus, 1758) from the tributary of the Ganga River, India. *Zool. & Ecol.*, **25**(2): 166-171. DOI: 10.1080/21658005.2015.1020012.

Falk, D.A., Palmer, M.A. and Zedler, J.B. (2006). *Foundations of restoration ecology*. Island Press, Washington, D.C., U.S.A.

Frissell, C.A. and Ralph, S.C. (1998). Stream and watershed restoration. In: *River ecology and management: lessons from the Pacific coastal ecoregion.* edited by R. J. Naiman and R. E. Bilby, Springer, NEW YORK, U.S.A.

Gupta, R.A. and Tyagi, R.K. (1992). Analytical approach to analysis of fish stock of Ganga river system. *J. Inland. Fish. Soc. India,* **24** (2) : 20-27.

Harting, J.H., Zarull, M. A., Ciborowski, J., Gannon, J., Wilke, E., Norwood, G. and Vincent, A. (2009). Long-term ecosystem monitoring and assessment of the Detroit river and western lake Erie. *Environ. Monit. Assess.*, **158** : 87-104.

Hering, D., Aroviita, J., Baattrup, Pedersen, A., Brabec, K., Buijse, T., Ecke, F., Friberg, N., Gielczewski, M., Januschke, K., Kohler, J., Kupilas, B., Lorenz, A.W., Muhar, S., Paillex, A., Poppe, M., Schmidt, T., Schmutz, S., Vermaat, J., Verdonschot, P.F.M., Verdonschot, R.C.M., Wolter, C. and Kail, J. (2015). Contrasting the roles of section length and instream habitat enhancement for river restoration success: a field study of 20 European restoration projects. *J. Appl. Ecol.*, doi: 10.1111/1365-2664.12531.

Hermoso, V., Clavero, M., Balanco,Garrido F. and Prenda, J. (2010). Assessing the ecological status in species-poor systems: A fish-based index for Mediterranean rivers (Guadiana river SW Spain). *Ecol. Indicat.*, **10** (6) : 1152-1161.

Hickley, P., Arlinghaus, R.K., Tyner, R., Aprahamian, M., Parry, K. and Carter, M. (2004). Rehabilitation of urban lake fisheries for angling by managing habitat: general overview and case studies from England and Wales. *Ecothydrol. Hydrobiol.*, **4**: 365-378.

Imran, S., Thakur, S., Jha, D.N. and Dwivedi, A.C. (2015). Size composition and exploitation pattern of *Labeo calbasu* (Hamilton 1822) from the lower stretch of the Yamuna river. *Asian J. Bio Sci.,* **10**(2): 171-173. DOI : 10.15740/HAS/AJBS/10.2/171-173.

Jhingran, V.G. (1959). Studies on age and growth of *Cirrhinus mrigala* (Hamilton) from the river Ganga. *Proc. Nat. Inst. Sci. India,* **25 B** (3): 107-137.

Jhingran *et al.* (1970). *Fisheries of the Ganga river system* (*MS*), quoted from *fish and fisheries of India* (1982). Hindustan Publishing Corporation (India), DELHI, INDIA.

Kamal, M.Y. (1969). Studies on the age and growth of *Cirrhinus mrigala* (Hamilton) from the river Yamuna at Allahabad. *Proc. Nat. Acad. Sci. India,* **35B** (1): 72-92.

Lorenzen, K., Beveridge M.C.M and Mangel H.L.(2012). Cultured fish: integrative biology and management of domestication and interactions with wild fish. *Biol. Rev.*, **87**: 639-660.

Lynch, A. J., Cooke, S. J., Deines, A. M., Bower, S. D., Bunnell, D.B., Cowx, I.G., Nguyen, V.M., Nohner J., Phouthavong, K., Riley, B., Rogers, M. W., Taylor W. W., Woelmer W., Youn S. and Beard Jr. T. D. (2016). The social, economic and environmental importance of inland fish and fisheries. *Environ. Rev.*, doi: 10.1139/er-2015-0064.

Manny, B. A., Roseman, E. F., Kennedy, G., Boase, J. C., Craig J. M., Bennion D. H., Read J., Vaccaro L., Chiotti J., Drouin R. and Ellison R. (2014). A scientific basis for restoring fish spawning habitat in the St. Clair and Detroit rivers of the Laurentian Great lakes. *Restorati. Ecol.*, doi: 10.111/rec.12159.

Mayank, P. and Dwivedi, A.C. (2015 a). Role of exotic carp, *Cyprinus carpio* and *Oreochromis niloticus* from the lower stretch of the Yamuna river. In: *Advances in biosciences and Technology* edited by K.B. Pandeya, A.S. Mishra R.P. Ojha and A.K. Singh Published by NGBU, Allahabad, ISBN: 978-81-926925-9-3, pp 93-97.

Mayank, P. and Dwivedi, A.C. (2015 b). *Biology of Cirrhinus mrigala and Oreochromis niloticus*. LAP LAMBERT Academic Publishing GmbH & Co. KG, Dudweiler Landstr. 99, 66123 Saarbrucken, Germany, pp. 188.

Mayank, P., Tyagi, R. K. and Dwivedi, A. C. (2015). Studies on age, growth and age composition of commercially important fish species, *Cirrhinus mrigala* (Hamilton, 1822) from the tributary of the Ganga river, India. *European J. Exp. Biol.*, **5** (2): 16-21.

Mayank, P. and Dwivedi, A.C. (2016). Stock assessment and population structure of alien fish species, *Oreochromis niloticus*

(Linnaeus) from the lower stretch of the Yamuna river, India. *J. Exp. Zool., India*, **19** (1): 163-167.

Merilä, J. (2014). Lakes and ponds as model systems to study parallel evolution. *J. Limnol.,* **73**(Sl.): 29-41.

Miller, J. R. and Hobbs, R.J. (2007). Habitat restoration- do we know what we,re doing? *Restorat. Ecol.,* **15**: 382-390.

Pathak, R.K., Gopesh, A., Dwivedi, A.C. and Joshi, K.D. (2014). Age and growth of alien fish species, *Cyprinus carpio* var. *communis* (Common carp) in the lower stretch of the Yamuna river at Allahabad. *Nat. Acad. Sci. Lett.,* **37** (5) : 419-422.

Pathak, R.K., Gopesh, A. and Dwivedi, A.C. (2015). *Invasion potential and biology of Cyprinus carpio (Common carp).* LAP LAMBERT Academic Publishing GmbH & Co. KG, Dudweiler Landstr. 99, 66123 Saarbrucken, Germany, ISBN: 978-3-659-78532-0.

Strayer, D.I. and Dudgeon, D. (2010). Freshwater biodiversity conservation: recent progress and future challenges. *J. North American Benthol. Soc.,* **29**: 344-358.

Tiwari, A. and Dwivedi, A.C. (2014). Assessment of heavy metals bioaccumulation in alien fish species *Cyprinus carpio* from the Gomti river, India. *European J. Exp. Biol.,* **4** (6): 112-117.

Tiwari, A., Dwivedi, A.C., Shukla, D.N. and Mayank, P. (2014). Assessment of heavy metals in different organ of *Oreochromis niloticus* from the Gomti river at Sultanpur, India. *J. Kalash Sci.,* **2** (1): 47-52.

Tripathi, S., Gopesh, A., Joshi, K.D. and Dwivedi, A.C. (2015). Size composition, exploitation pattern, sex ratio and sex structure of *Eutropiichthys vacha* (Hamilton, 1822) from the middle stretch of the river Ganga at Allahabad, India. In: *Advances in biosciences and Technology* edited by K.B. Pandeya, A.S. Mishra R.P. Ojha and A.K. Singh published by NGBU, Allahabad, ISBN: 978-81-926925-9-3, pp. 116-120.