International Journal of Applied Research 2016; 2(5): 874-879

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(5): 874-879
www.allresearchjournal.com
Received: 18-03-2016
Accepted: 19-04-2016

Shampa Jain
Department of Zoology, Government M.H. College of Home Science, Jabalpur, Madhya Pradesh, India.

Arjun Shukla
Department of Zoology, Government Model Science College, Jabalpur, Madhya Pradesh, India.

Zubair Azad
Department of Zoology, Government M.H. College of Home Science, Jabalpur, Madhya Pradesh, India.

Shivani Rai
Department of Zoology, Government M.H. College of Home Science, Jabalpur, Madhya Pradesh, India.

Correspondence
Arjun Shukla
Research Scholar Department of Zoology, Government Model Science College, Jabalpur, Madhya Pradesh, India.

An overview of evolutionary concept, food supplements, growth pattern and diversity of ichthyofauna in central India

Shampa Jain, Arjun Shukla, Zubair Azad, Shivani Rai

Abstract
The communication enumerates a review on growth pattern, evolution and biodiversity of the rivers in M.P., and also states food supplement practices and conservational approach. Works on the river Narmada in M.P. have been surveyed and analysed to identify the problems related to management and conservation. The nutrition is one of the most critical areas in fish nutrition as fish can extract minerals from both water and diets. This includes the nature and composition of food items and feeding habits of fishes for their proper development and higher growth rate.

Keywords: Evolution, Fish, Diversity, Conservation, Food.

Introduction
The Narmada, also called Rewa is the life line of central India and the fifth largest river and covers a drainage basin totalling approximately 98,796 km^2 in the Indian subcontinent. The bank of Narmada River is covered by tribal people, and their daily wastes are drained into this holy river, which alters the biological parameters of the river. Biodiversity is the variation in the genetics and life forms of populations, species, communities and ecosystem. Biodiversity affects the capacity of living system to respond to changes in the environment and is essential for providing goods and services from ecosystems. Fish diversity depends on geographical position, varied aquatic ecological conditions, health of aquatic bodies and optimum exploitation of the commercial fish species, enforcement of laws, rules and regulations and their implementation and fish habitat restoration programs. Fish biodiversity can be defined as variety of fish species. Fish biodiversity encompasses freshwater ecosystems, including lakes, ponds, reservoirs, rivers, streams, groundwater and wet lands as well as marine ecosystems including oceans and estuaries. Fish biodiversity includes all unique species, their habitats and interaction between them.
A common approach for increasing fresh water fish production was done by [1,2] that was direct application of fertilizers, which increase the production of plankton that serves as natural food items in fish diet. So, success of any fish culture largely depends on a continual supply of food through natural fertilization or as supplementary food. Protein requirements generally are higher for smaller fish. As fish grow larger, their protein requirements usually decrease. Proteins are composed of carbon (50%), nitrogen (16%), oxygen (21.5%), and hydrogen (6.5%). Luo [3] works on aquaculture and suggest that Protein is the most important factor affecting growth performance of fish and the most expensive component in fish feeds and feed cost.
In earlier times, even biologists did not make such a distinction. Sixteenth century natural historians classified seals, whales, amphibians, crocodiles, even hippopotamuses, as well as a host of aquatic invertebrates, as fish. Later biologists were more discriminating, eliminating first the invertebrates and then the amphibians, reptiles, and mammals from the narrowing concept of a fish [4]. Today we recognize a fish as an aquatic vertebrate with gills, limbs, if present, in the form of fins, and usually with a skin covered in scales of dermal origin. Even this modern concept of the term "fish" is used for convenience, not as a taxonomic unit, because fishes do not compose a monophyletic group. The common ancestor of the fishes is also an ancestor to the land vertebrates, which we exclude from the term "fish," unless we use the term in an exceedingly non-traditional way.

Growth of fishes is temperature dependent. Consequently, fish living in temperate regions grow rapidly in summer when temperatures are high and food is abundant due to plankton diversity and abundance but nearly stop growing in winter. Annual rings in the scales, otoliths, fin rays and other bony parts reflect the seasonal growth in fishes.

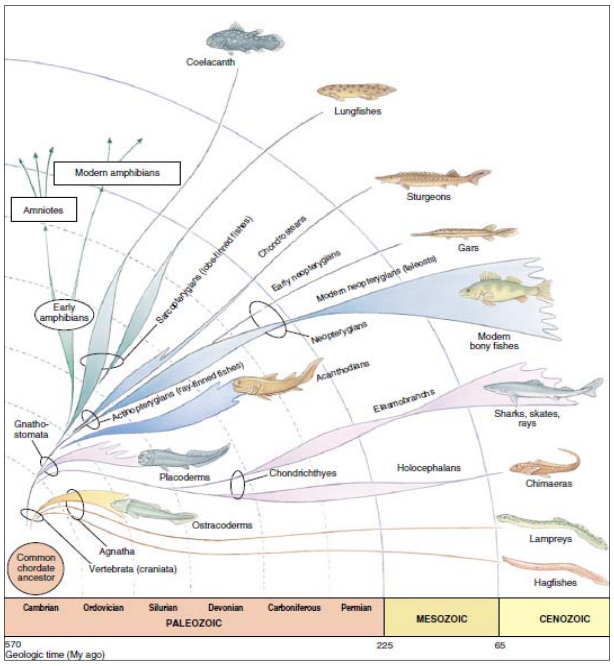


Fig 1: Represented the family tree of fishes, showing the evolution through geological time and indicate periods of adaptive radiation. Image from Helfman [5].

Evolution of Fish

Over half of all vertebrates are fishes. The most diverse and successful vertebrate group, they provided the evolutionary base for invasion of land by amphibians. The evolution of vertebrate started in the ancient seas of the Cambrian Period (570 to 505 million years ago), when the first backboned animals appeared. Wriggling through the water, jawless and toothless, these first fishes sucked up small food particles from the ocean floor like miniature vacuum cleaners. Most were less than a foot long, respired with gills, and had no paired fins; just a primitive tail to push them through the water.

For 50 million years, during the Ordovician Period (505 to 438 million years ago), these simple fishes were the only vertebrates. By the end of this period, fish had developed primitive fins to help them swim and massive shields of bone for protection. Jawed fishes first appeared during the Silurian Period (438 to 408 million years ago) and along with them came a new mode of feeding. Later, both the cartilaginous and bony fishes appeared [5]. The evolution of fishes was parallel the appearance of numerous advances in vertebrate history.

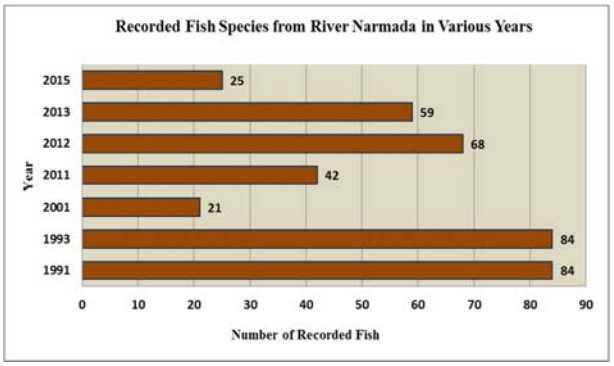
Biodiversity and Fish Fauna

Biodiversity is the quantity, variety and distribution across biological scales ranging through genetics and life forms of populations, species, communities and ecosystems [6]. Biodiversity affects the capacity of living systems to respond to changes in the environment, underpins ecosystem function and provides the ecosystem goods and services that support human well-being (e.g., nutrient cycling, clean water; [7-9]. The main factor that threatens fish biodiversity globally is fishing [10-11].

Table 1: Showing different works on various rivers of M.P. including fish diversity and richness:

S. No.	Sampling area	Recorded species	Reference
1.	Narmada river, Jabalpur	25	Shukla and Sharma [12]
2.	Narmada river, Jabalpur	23	Azad and Shukla [13]
3.	Western Zone of Narmada river	21	Balapure [14]
4.	Western zone of Narmada river (Punasa, Omkareshwar, Mandleshwar and Barwani)	84	Rao [15]
5.	Western zone of Narmada river (14 stations: Satmatra, Eklera, Kasrawad, Bagud, Piplud, Bhilkheda, Pendra, Nangaon, Pichhodi, Kathoda, Sondul, Jangarwa, Chikhalda and Koteshwar in the stretch of 15 k.s.)	51	Bakawale and Kanhere [16]
6.	Narmada river, Hoshangabad District	68	Dongre [17]
7.	Narmada river (Maheshwar, Khalghat, Barwani)	59	Chouhan [18]
8.	Western Zone of Narmada river	42	Sharma [19]
9.	Sardarsarovar dam, Narmada river	84	Singh [20]
10.	Gaur river, Jabalpur	33	Punikar [21]
11	Tapti river, Betul District	20	Solanki [22]
12.	Betwa river at SacredGhat	60	Vyas [23]

Study of biodiversity of fish fauna and their identification, is one of the interesting field of biological research, which gives us an idea about the morphological variation and population diversity of fauna in polluted and non-polluted site of any particular habitat. Soni and Bais [24] and Thakur and Sharma [25] did limnological work on Sagar-Damoh, water bodies and reported some physical and chemical components, Choudhary [26] observed 39 species after the impoundment of Gandhi Sagar reservoir and Saxena [27] reported 42 species from upstream region and 35 species from downstream region in river Satluj. Jhingran [28] described the morphological variation and population density of fish in Bangladesh and Andhra Pradesh, Thakur [29] reported distribution of fresh water fishes in Madhya Pradesh. The graph showing fish diversity of river Narmada at various sites.



Fish diversity of river essentially represents the fish faunal diversity and their abundance. Rivers conserve a rich variety of fish species which supports the commercial fisheries. Sharma [19] have observed by survey of Narmada River and have reported 42 species belonging to 25 genera 7 order and 14 families. Chouhan [18] have observed by survey of Narmada River and have reported 59 fish species, 34 genera 7 order and 17 families. Dongre [17] reported 68 species from in the southernmost part of Hoshangabad division of river Narmada and the recorded fish species were classified in 9 order and 22 families.

Bakawale and Kanhere [16] attempted to collect, classify and identify fish of river Narmada in its Western Zone. The fish diversity is correlated with biological and various physico-chemical parameters that regulate the productivity and distribution of different species of the fishes. Their study operated on a stretch of the river approximately 15 km during one year and their survey indicated that 51 species of fish were found in that zone of the river.

Shukla and Sharma [12] studied on fish diversity of river Narmada during post-monsoon season to spring season. The fish is one of the most important vertebrate provide rich protein source in human diet and several animals and important elements in the economy of many countries. They attempt a successful study on river Narmada at Jabalpur region and recorded 25 species of fishes where they noticed abundance of major carp, minor carp and cat fishes. The species belonging to order Cypriniformes was the dominating throughout their investigation.

Azad and Shukla [13] studied that biodiversity is essential for stabilization of ecosystem. Fish diversity of river essentially represents the fish faunal diversity and their abundance. River conserves a rich variety of fish species which supports to the commercial fisheries. They study for 6 month during 2015 in river Narmada at Jabalpur region and observed 23 species belonging 10 families.

In India, there are about 2,500 species of fishes, of which 930 freshwater and 1,570 marine, were estimated by [30]. Rao [15] have undertaken pre impoundment survey in Narmada River in three districts pertaining to the river and have enlisted 84 fish species belonging to 45 genera, 20 families and 6 orders. Another survey of fish fauna on river Narmada was carried out and reported 21 fish species belonging 16 genera, 6 families and 4 orders [14].

Role of food Supplement for Pisciculture

Good and healthy nutrition in animal production systems is essential to economically produce a healthy, high quality product. Aquaculture has a great role to play in the welfare of mankind. Reducing the feeding costs could be a key factor for the successful development of aquaculture. Fish, especially when reared in high densities, require a high-quality, nutritionally complete, balanced diet to grow rapidly and remain healthy. Hepher [31] stated that natural food organisms contain low energy, while protein is in excess. Therefore fish consuming only natural food have minimal fat and maximum protein accumulation in their body and their study also clearly indicated that a combination of live food with supplementary feed provides a better nutritional profile for culture species to support quality and quantity fish production (Table: 2).

Table 2: Role of food Supplement, Food nutrition, recommended level (quantity) Importance

Food nutrition	Recommended level (quantity)	Importance
Protein	18 – 50%	Influences growth, survival and yield of fish.
Lipid	10 – 25%	High energy nutrient supply twice the energy as protein and carbohydrate
Carbohydrate	15 – 20%	Reduce feel cost and source of energy
Macro mineral: sodium, chloride, potassium and phosphorous	Very small amount	Regulate osmotic balance and aid in bone formation and integrity
Micro mineral: copper, chromium, iodine, zinc and selenium.	Minute quantity	Components in enzyme and hormone systems.
Water	<10%	
Vitamin E	1000 – 2500 mg/kg weight of fish	Antioxidant
Vitamin C	1500 – 3000 mg /kg weight of fish	Powerful antioxidant and helps the immune system in fish
Vitamin A	-	Responsible for vision
Vitamin D	-	Bone integrity

Deng [32] worked on fish diet and revealed that fish have high dietary protein requirement and similarly Sa R [33] described the significance of qualitative and quantitative feeds is well recognized and the level of dietary protein is of fundamental importance. Growth responses and survival of fish when they are fed with artificial diets depend upon several factors, the feeding levels being one of the most important. De Silva [34] well study the effect of varying feeding rates on the growth, feed consumption, efficiency and body composition of various species. Therefore, considerable research effort is needed to determine the quantity and quality of dietary protein necessary to achieve optimum growth performance of fish.

Growth pattern of fish

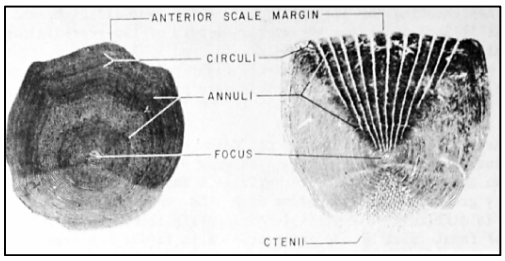


Fig 2: The cycloid scale of a whitefish (left) and the ctenold scale of sunfish, showing year marks (annuli). Both fish are two years old.

Age and growth play a very important role in the management of fishery. Age provides a means to understand the composition of fish population, while growth parameters differ from species to species and from stock to stock within the same species depending upon the habitat conditions. Sustaining power of a fish stock can be ascertained by understanding the age and growth [35-36].

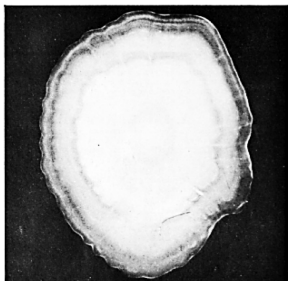


Fig 5: An otolith from a four year-old yellowtail flounder.

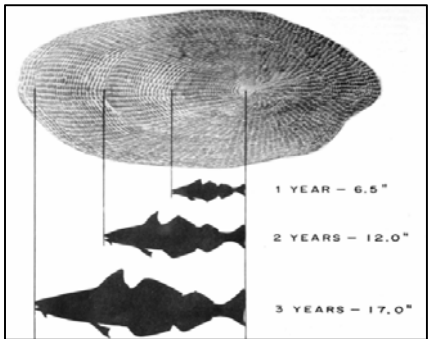


Fig 3: showing year marks on its scale and the beginnings of growth the fish

Fig 4: An otolith from a four year-old yellowtail flounder.

Scales of fishes are remarkable structures. Much information can be obtained about the growth history and longevity of individual fish by close examination of their scales or other bony structures. Scales start to form when a fish is about an inch long. The number of scales covering the body remains constant throughout life, and in general, scale growth is proportional to fish growth. As the scale grows, circuli (ridges) form on the edge. Circuli form a concentric pattern over the course of a year that is related to environmental and growth conditions. During the colder months, when fish eat little and growth ceases, the circuli are crowded together and may be incomplete and in the spring, when feeding and growth resume, new circuli form that are spaced further apart. Scale characteristics may be used for identifying steelhead of wild and hatchery origin as well as aging [37]. Knowledge of length-weight relationship and population dynamics of the fish are vital in fishery science [38-39]. It is known that with the increase in the length of fish, the weight also increases, thereby showing that the weight of fish is a function of length [40].

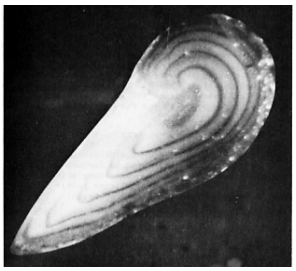


Fig 6: The cross section of a fin ray haddock showing grwoth zones

In fishes that do not have scales, it is often possible to determine age from seasonal bands laid down in otoliths. Otolithsor earstones, structures formed of calcium in the heads of bony fishes, function as organs of balance. Although there are three pairs of otoliths altogether, only one pair is large enough to be of use in age determination. Otolith form varies in different species from a flat oval to spindle shape. Growth, as in the scale, is concentric around a central kernel or nucleus [41]. Fin rays have been used for age determination in a number of species besides the sturgeon, such as catfish, bullheads, and suckers. Zonation is similar to that found in otoliths with a light band forming in the early part of the growing season followed by a narrow, dark band in fall and winter. Age in years is determined by counting the dark bands.

From nutritional point of view, there is accumulation of fat in the abdominal parts of the body and the gonads [42]. Hile [43] also provided a useful comparison of the weight of an individual fish relative to its length, strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which the fish lives [44].

Conclusion

The review revealed that, freshwater supports a rich diversified fish fauna. However fish diversity of lentic system is in declining mode due to anthropogenic activities, human disturbance and pollution. This review reports the various aspects of fishes which emerge out an urgent need exists for studying the life history traits, natural and nutritional value of fish feed. It is essential to develop methodologies for determining mineral requirement in relation to the composition of surrounding water. The demography of the most important threatened fishes, as lack of information on these aspects have significantly affected conservation efforts.

Reference

1. Schroeder GL. Carbon pathways in aquatic detrital systems [A]. In: Moriarty DJW, Pullin RSV. Detritus and Microbial Ecology in Aquaculture [M]. Manila: International Centre for Living Aquatic Resources Management. 1978, 217-236.
2. Hepher B. Ten years of the research of fish pond fertilization in Israel. ii- Fertilization dose and frequency of fertilization. Bamidgeh. 1963; 15:78-92.
3. Luo Z, Liu YJ, Mai K, Tian LX, Liu DH, Tan XY, Optimal dietary protein requirement of grouper *Epinephelus coioides* juveniles fed is energetic diets in floating net cages. Aquaculture Nutrition. 2004; 10:247-252.
4. Long JA. The rise of fishes: 500 million years of evolution. Baltimore, The Johns Hopkins University Press. 1995.
5. Helfman GJ, Collette BB, Facey DE. The diversity of fishes. Malden, Massachusetts, Blackwell Science. 1997.
6. Mace G, Masundire H, Baillie J, Ricketts T, Brooks T, Biodiversity. In: Hassan, R., Scholes, R., Ash, N. (Eds.), Ecosystems and Human Well- Being: Current State and Trends (Findings of the Condition and Trends Working Group). Island. 2005, 77-122.
7. Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P, Van Den Belt M, The value of the world's ecosystem services and natural capital. Nature. 1997; 387:253-260
8. Hooper DU, Chapin FS, Ewel JJ, Hector A, Inchausti P, Lavorel S, Lawton JH, Lodge DM, Loreau M, Naeem S, Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecol. Monogr. 2005; 75:3-36.
9. Diaz S, Fargione J, Chapin FS, Tilman D, Biodiversity loss threatens human well-being. PLoS Biol. 2006; 4:1300-1305.
10. Dulvy NK, Sadovy Y, Reynolds JD, Extinction vulnerability in marine populations. Fish Fish. 2003; 4:25-64.
11. Garcia S, Boucher J, Cury P, Thebaud O, Andriantsoa M, Astudillo A *et al.*, Workshop 10, Paris Conference: Biodiversity, Science and Governance. 2006, 24-28.
12. Shukla A, Sharma S. Overview of Ichthyofaunal Diversity of the River Narmada in Jabalpur Region. Anusandhan. ISSN-0975-3443. 2015; 9:25-28.
13. Azad Z, Shukla A. Ichthyofaunal Diversity, Habitat Ecology and Their Conservation Issues of River Narmada in Jabalpur Region (M.P). International Journal of Current Research. 2015; 7(12):24044-24047.
14. Balapure S. Comparative study of Fish Biodiversity in Narmada and Tapti River, Dissertation Report, Department of Limnology, B. U. Bhopal, 2001.
15. Rao KS. Study on pre-impoundment fisheries potential of Narmada River in Western Zone. J Inland Fish Soc of India. 1991; 23(1):34-91.
16. Bakawale S, Kanhere RR. Short Communication: Study on the Fish Species Diversity of the River Narmada in Western Zone. Research Journal of Animal, Veterinary and Fishery Sciences. 2013; 1(6):18-20.
17. Dongre S, Bhavsar C, Verma RG. Fish Diversity of Tribal District Satpura Valley, Betul of Madhya Pradesh in India. International Referred Research Journal. 2012; 3(37). ISSN- 0974-2832, RNI-RAJBIL 2009/29954.
18. Chouhan M, Siddiqui A, Sharma S. Fish Biodiversity of Narmada River in Some Selected Stations of Madhya Pradesh, India. International Journal of Advanced Research. 2013; 1(3):20-25.
19. Sharma S, Mudgal LK, Siddiqui A, Chouhan M. Biodiversity of Fish Species Communities of Narmada River, M.P. India. Proceedings International Conference on Ecosystem Responses to Global Environmental Change. Nepal. 2011, 119-125.
20. Singh AK. Pre impoundment studies on Sardar Sarovar Area of Narmada River (West Zone) with special reference to fisheries Ph.D. Thesis, Vikram University, Ujjain, India. 1993.
21. Paunikar S, Tiple A, Jadhav SS, Talmale SS. Studies on Ichthyofaunal Diversity of Gour River, Jabalpur, Madhya Pradesh, Central India. World Journal of Fish and Marine Sciences. 2012; 4(4):356-359.
22. Solanki. A survey of fish and fisheries of the Tapti river of Betul district of Madhya Pradesh research link. 2008, 72.
23. Vyas V, Damde D, Parashar V. Fish biodiversity of Betwa River in Madhya Pradesh, India with special reference to a sacred ghat. International Journal of Biodiversity and Conservation. 2012; 4(2):71-77.
24. Soni DD, Bais. Fishes of Sagar District of Madhya Pradesh, Bharti Journal. 1986; 15(17):59-68.
25. Thakur SS, Sharma A. Fish Diversity of Yashwant Sagar Reservoir Indore, Madhya Pradesh. Him J Env Zool. 2004; 18(2):117-119.
26. Choudhary DK. Case study of Gandhi Sagar reservoir fisheries (M.P.) Nes letter, C.I.F.E. Bombay. 1977, 31.
27. Saxena PK. Impact of pollution on the fisheries of river satluj. Environ Manag Int. 1997; 1(1):69.
28. Jhingran VG. Fish and Fisheries of India. Hindustan Publishing Corporation Delhi. 1985.
29. Thakur SS. Seasonal variation of pH and alkalinity and their interrelationship Sagar Lake. *Geobios,* nest. Report Science Acad. 1986; 2(5):187-190.
30. Kar D. In Environment Pollution and Management APH Publishing Corporation, New Delhi (Kumar A., Bohra C., Sing L.K. eds.). 2003, 203-211.
31. Hepher B. Nutrition of pond fishes. Formerly of fish and aquaculture station, Dor, Israel. The press syndicate of the University of Cambridge, England. 1988.
32. Deng J, Mai K, Ai Q, Zhang W, Wang X, Xu W. Effects of replacing fish meal with soy protein concentrate on feed intake and growth of juvenile Japanese flounder, *Paralichthy solivaceus*. Aquaculture. 2006; 258:503-513.
33. Sa R, Pousao-Ferreira P, Oliva-Teles A. Effect of dietary protein and lipid levels on growth and feed utilization of White Sea bream (*Diplodussarus*) juveniles. Aquaculture Nutrition. 2006; 12:310-321.
34. De Silva SS, Gunasekera RM, Keembiyahetty C. Optimum ratio and feeding frequency in *Oreochromis niloticus* young. In: Conference of the Asian Fisheries Society, May 26-31, 1986, Manila, Philippines. Edited by Maclean JL, Dizon LB, Hosillos LV. 1986, 727-732.
35. Gulland JA. Fish stock Assessment: A manual of basic methods. Chichester UK Wiley Inter-sciences. FAO/Wiley Ser Food Agric. 1983; 1:223.
36. Nikolskii GV. Theory of Fish Population Dynamics as the Biological Background for Rational Exploitation and Management of Fishery Resources. Bishan, S. and P. S. Mahendra, (Eds.), W. Germany Science Publishers,

Dehradun, India and Otto Koeltz Kooenigstein. 1980, 323.
37. Seelbach PW, Whelan GE. Identification and contribution of wild and hatchery steelhead stocks in Lake Michigan tributaries. Michigan Department of Natural Resources, Fisheries Research Report 1950, Ann Arbor. 1988.
38. Lizama, MDAP, Ambrosio AM. Condition factor in nine species of fish of the characidea family in the upper Parana River floodplai, Brazil. Brazilian J Biol. 2001; 62(1).
39. Ahmad KKU, Amin SMN, Haldar GC, Dewan S. opulation dynamics and stock assessment of *Catla catla* (Hamilton) in the Kaptai reservoir Bangaladesh. Asian Fisher Soc. 2003; 16:121-131.
40. Kulbicki M, Doherty P, Randall JE, Bargibant G, Menou JL, MouTham G *et al.* Lacampagne CORAIL 1 No Co Riolis the Chesterfield Islands (from 15 August to 4 September, 1988): Preliminary Investigations on data Ichthyological Populations. Rapp. Sci. Technol. Biological Mar., (ORSTOM, Noumea, New Caledonia). 1990, 57-88.
41. Brian C. The life story of the fish. Harcourt, Brace and Comp any, New York. 1948, 284.
42. Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Percafluviatilis*). J Anim Ecol. 1951; 20:201-219.
43. Hile R. Age and growth of the Ciso, *Leucichthys artedi* (Le Sueur) in the lakes of the north-eastern highlands. Wisconsin Bull. of United State Bur Fisher. 1936; 48:211-317.
44. Anene A. Condition factor of four Cichlid species of a man-made lake in IMO state, southeastern Nigeria. Turk J Fisher Aquat Sci. 2005; 5:43-47.