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A Review on the Biology, Growth and Recruitment Pattern of Various Catfish Species

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Abstract: ***Present study describes a review on the biology and growth characteristics of major catfishes. Most of the works were based on Length frequency method, Length weight Relationship and biological aspects of important catfishes. Here, most of the researchers incorporated length frequency method for discovering the growth and recruitment pattern of catfish species due to its accuracy. Linear growth pattern is observed in most of the cases. Length weight relationship is used to find out the general well - being of the fish and the condition of the fish observed is nearly good. Deviation from cube law exhibited in most of the catfishes was due to some external factors. Gut content analysis and GSI ratio were used to evaluate feeding habits and find out whether seasonal and geographical variation occurred. Reproductive capacity of the fish species is analysed by fecundity, Gonadosomatic Ratio (GSR) and ova diameter studies. Ova diameter of catfishes varied in a single ovary represents its multiple spawning characteristic. Occurrence of eggs in the mouth of fishes denotes its mouth brooding parental behaviour.***

Keywords: Catfishes, Length frequency, Length weight relationship, food and feeding, Ova diameter

1. Introduction

Catfishes occur all over the world except Antarctica and are named for their cat - like whiskers around the mouth called as barbels or whiskers. However, they are more significant by their prominent skull and swim bladder rather than whiskers (Lutz, et al 2021). There are more than 3000 catfish species discovered and they are coming under the order siluriformes and are distributed in freshwater, brackish water and marine environments (Lutz, et al 2021). Besides, majority of the catfish species have no scales over the body except some species. Catfishes are suitable for aquaculture due to its hardy structure, ability for artificial spawning, adaptability for different culture methods and tolerance to low dissolved oxygen levels. However, very little species are used for culture activities including channel catfish, blue catfish, walking catfish, African catfish and so on. Marine species of catfishes are coming under the families Ariidae and Plotosidae. Diverse studies regarding the biology of catfishes were carried out by eminent researchers across the world owing to its striking characteristics.

This study encompasses a review work on the biology and population characteristics of different catfishes across the globe. Facts for this work collected from several national and international databases and articles. This article is based on the review of length - based growth pattern, Length weight relationship and condition factor, Food and feeding habits and reproductive strategies of major catfish species across the world. The foremost aim of this work is to find out the importance of catfish as a food fish and its suitability of modern aquaculture practices. This paper encompasses what has been done previously on the biological studies regarding catfishes and it helps to formulate different ideas for the future studies.

2. Literature Review

2.1 Stock assessment and population dynamics

Stock assessment of marine catfishes of India was undertaken by Menon et al (1992) and they recommended proper management measures for thedwindling catfish resources. This work also encompasses detailed information on state wise catfish catch and species composition in India. Determination of age and growth of fish help us to recognize age at first maturity, recruitment pattern, population dynamics and growth - related aspects. Most of the prominent works on age and growth of catfishes were conducted using length frequency method owing to its precision. Age and growth studies have been carried out by Khatun et al, (2022) on the River catfish, *Eutropiichthys vacha* and Ali et al (2013) on the thinspine sea catfish, *Plicofollis tenuispinis*. They have done the analysis using length frequency method of Petersen (1895) in which, peaks of length distribution were assumed to represent the different age groups. Chu et al (2011) investigated age and growth of spotted catfish *Arius maculates*by means of length frequency method for the estimation of growth parameters. Krishnan and Dobiyal (2015) used ring formation in the vertebrae of the catfish *Amblyceps mangois* for the growth of fish and linear growth is observed during the study. Here, back calculation of the age was estimated using the length frequency method due to its accuracy. Bashar et al (2021) analysed length based stock assessment of *Eutropiichthys vacha* from Kaptai lake of Bangladesh. From their findings it is stated that food availability, natural mortality rate and favorable environmental conditions affect recruitment pattern of fish. Same assumptions have been made by Namrata et al (2013) while working on the length - frequency studies on Catfish *Macrones Vittatus*. Most of the prominent workers use length frequency methods in stock assessment studies because of the accurate result.

2.2 Length weight relationship and condition factor

Length weight relationship is inevitable for the fishery biology and population studies on fin fishes and shellfishes. Length weight relationship is a mathematical relationship between length and weight of fishes through which growth pattern can be formulated by means of an equation (Ramesh et al, 2016). the length - weight relationship is articulated by an equation: W = aLn or, when it is expressed by a logarithmic formula: Log W = Log a + n Log L, where W = Weight of fish, L = Length of fish, a = Constant, n = Equilibrium constant (Le Cren, 1951). The length weight equation is based on cube law where weight of a fish is proportionate to the cube of the length and it represents isometric growth. When the length weight relationship of a particular fish exhibits isometric growth it follows cube law, but it is not always observed in most of the cases due to the external factors such as availability of food, suitable environmental condition, competition and so on (Goswami and Sarma, 1996). Countless works were carried out based on the length weight relationship and condition factor of aquatic organisms. Soomro et al (2007) investigated length weight relationship of freshwater catfish *Eutropiichthyes vacha* from Indus River. A comparative study on seven indigenous catfish species from different parts of Malaysia showed either positive or negative allometric growth pattern (Yusof et al, 2011). Different parameters of length weight relationship of three Schibid catfishes (*Ailiacoila*, *Eutropiichthys vacha* and *Neotropius atherinoides*) from Padma River, Northwestern Bangladesh were explained by Hossain (2010). From this analysis isometric growth pattern (b=3) obtained from *A. coila* and allometric growth (b< 3) occurred in other two fishes such as *E. vacha* and *N. atherinoides*. Also, regression parameters and coefficient of determination (r^2) were highly significant during this study. Chowdhary and Srivastava (2013) stated that LWR values of a fish species are mainly varied according to numerous aspects such as sex, maturity, surroundings, food and feeding habits gastrostomatic ratio, competition and many other factors. Studies of Rao et al (2020) on the marine catfishes *Plicofollis tenuispinis* and *Plicofollis dussumieri* supported this argument and it stated that it is an essential element for the determination of life history traits of a particular species. Both of the catfishes exhibited negative allometric growth pattern where 'b' value obtained is less than 3. If the growth pattern followed cube law, then the b value obtained from the length weight relationship will be equal to 3. Deviation from cube law denotes poor growth condition of fishes and it happened because of the unavailability of the suitable environmental condition (Deka and Gohain, 2015).

2.3 Food and feeding strategies

Earlier studies on the food and feeding habit of some fresh water catfishes in India have been undertaken by Mojumder and Dan (1979). A study on the food and feeding habit of the catfish *Arius maculates* was conducted by Manikantarajan et al (2014), of the Parangipettai coast of India for a period of one year. A comparative account on the gut content analysis of the *Wallago attu* and *Mystus seenghala* was observed by Barbare et al (2013). Abbas (2010) have noticed a relationship with mouth size and food selectivity of the fish *Eutropichthys vacha* as well as its predatory habits. Besides, conscientious evaluations on the food and feeding strategies of Asian catfish *Pangasianodon hypophthalmus* excavates that, the fish reared in cages showed excellent Feed Conversation Rate (FCR) and Specific Growth Rate (SGR) values of 1.36 - 2.50 and 1.13 - 1.50 respectively and showed highest lipid and protein content in their muscles (Ozhasinoglu at al, 2016). Seasonal variations in the feeding strategies of the slender - spined catfish *Arius platypogon* were studied by Cruz - Escalonaet al (2000). D'Anatro et al (2013) explained geographic and seasonal variation of digestive morphology in the catfish *Iheringichthys labrosus*. Some authors explained about the linkages between food and feeding habits and spawning season. Ramesh and Kiran (2016) stated that poor feeding activities occurred during spawning season while estimating the feeding strategies of catfish *Clarias batrachus.* They used point method to find out feeding habits of catfishes where they categorised each stomach based on their degree of fullness. Some others elucidated feeding habits of fishes with the help of frequency of occurrence as well as volumetric methods in which frequency of occurrence of a particular food material in the stomach of fishes were discovered.

2.4 Reproductive parameters

In order to understand reproductive strategies of a fish it is imperative to know its fecundity and also it is inevitable for the conservation and appropriate management measures of the resources (Hassan et al, 2022). Likewise, the knowledge of gonadosomatic index, size at first maturity and spawning period are also regarded as a vital element for the reproductive studies of fishes. Most of the catfishes, especially *Arius sp*ecies exhibit low fecundity. The estimated fecundity in *A. caelatus* ranged from 44 to 81 eggs with an average of 63 eggs per fish (Raje, 2006). Such studies were carried out in *Arius sp*. by several workers (Ambily and Bijoy Nandan, 2017, Mansor et al, 2012; Dan, 1977) and they unveiled that *Arius sp* have extremely low fecundity. According to Mansor et al (2012) variation in oocyte diameter occurred in a single ovary of *Arius argyropleuron* denotes its multiple spawning periods.

Fecundity of fishes is attributed to the diameter of oocytes and hence the fishes with small oocyte diameter showed highest fecundity (Kaul, 1994). Some authors opined that Ariids produce the largest eggs among the teleosts (Wallace and Selman, 1981; Gomes and Araujo, 2004). Eyo et al (2013) gave a detailed account on the relationship between fecundity and biometric indices of silver catfish. They stated that fecundity is very important for the evaluation of reproductive capacity of individual fish species. Studies of Suneetha (2007) on the morphological variation on the estuarine catfish *Arius jella* depicted the mouth brooding habit of the species.

3. Conclusion

From this study it is obvious that due to the significant features, several studies were conducted on the biology and population characteristics of different species of catfishes. Recruitment pattern of catfishes are mainly attributed to the availability of food, environmental factors and mortality rates. From the analysis of length weight relationship and

condition factor it is apparent that isometric growth pattern occur in majority of the catfish species and is a symbolization of good growth condition. Variation from isometric growth also occurs in some fishes due to poor growth due to the external factors. Seasonal and geographical variation occurs in the feeding strategies of the catfishes. Furthermore, Catfishes exhibited excellent Food Conversion Ratio and Specific growth rate. Subsequently, from the reproductive studies it can be stated that majority of catfishes showed low fecundity. Parental behaviour is prominent in most of the catfishes. Research findings of many workers clinched that, the studies of developmental stages of gonads, gonadosomatic index and histological examination of gonads will give an accurate idea about the spawning season. This work concluded that catfishes are a suitable species for aquaculture, due to its significant characteristics as well as an excellent source of dietary nutrients.

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