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ORIGINAL ARTICLE

STUDIES ON POPULATION DYNAMICS OF JEWEL *Cichlid Hemichromis Bimaculatus* (GILL)

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ABSTRACT

This study is aimed to investigate the population dynamics of jewel *Cichlid Hemichromis Bimaculatus* . A total of 200 individuals of the Jewel fish *Hemichromis bimaculatus* were collected monthly from November, 2010 to May, 2012 using a hand dip net of mesh size 1mm from the Crystal Aquarium, Chennai and transported to the research lab. The relationship of the fish length with weight of the gonad, gonadosomatic index of male and female and mortality were observed in *Cichlid Hemichromis Bimaculatus*.

Keywords: Population dynamics, *Cichlid Hemichromis Bimaculatus*, Gonadosomatic Index, Mortality

1.INTRODUCTION

Cichlids have a wide geographical distribution and are natives of Africa (with 900 valid species and more than 1300 estimated species), South America (with 290 valid species), Central America (Cuba and Hispania, with 4 valid species including some estuarine species), North and Central America (with 95 valid species), Asia (Southern India and Sri Lanka, with 3 estuarine species), Madagascar (with 17 valid species, some estuarine species), Middle East (Jordan, with 4 species), Iran (one species) and several regions of the USA. The family Cichlidae comprises about 150 genera and 1300 species, making it the second largest perciform family . Cichlids are found in fresh and brackish waters of Central and South America, Africa, Madagascar, the Levant, southern India, Sri Lanka and southern Iran. Cichlids are an important group of relatively large and often colourful aquarium fishes. They exhibit a broad range of morphological, ecological and behavioural variation. The family Cichlidae (Order: Perciformes; Class: Osteichthyes) consists of about 105 genera with 1300 species of freshwater and estuarine fishes (Keenleyside, 1991; Guerrero, 1997).

Hemichromis is a genus of fishes from the cichlid family, known in the aquarium trade as jewel cichlids. It is origin of native Africa. Within West Africa, *Hemichromis* species are found in creeks, streams, rivers and lakes with a variety of water qualities including brackish water lagoons. It can be attuned to community tanks. When introduced to a well established community tank, the aggressiveness of the cichlid is toned down because of the lack of space that can be occupied territorially. Several young specimens may be kept in a spacious aquarium, with stones and wood for cover until a pair forms prior to breeding. Their innate aggression makes them good candidates for keeping in a monospecies aquarium.

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Aquatic organisms are mostly used as a food. Fish is a favorite item for majority of people and considered to be an excellent soured of high value protein and nutrients. They contain saturated and polyunsaturated fatty acids such as omega-3 fatty acids.. Fishes not only generates employment and income for the rural population, but also helps to fight protein deficiency in human. The Indian freshwater fish fauna consists of about 2500 species, above 74% belong to the order *Perciformes* which is includs Perches, Scats and Cichlids. The review consideration of freshwater fish is important for the conservation and management Talwar and Jhingran (1991); Jayaram (1999, 2006); Rema Devi and Indra (2010); Silas *et al*. (2011).

India has vast potential of ornamental fishes. About 688 species have been considered as having ornamental value. About more than 288 exotic species and 250 indigenous fresh water fish species and 150 marine water species have been reported as potential and suitable for climatically in India. There is a tremendous scope for farming and trade of ornamental fish in India (Mahapatra, 1999). The export of ornamental fishes started somewhere in 50's, till 1980's the earning through export was negligible. Within the range of Rs

18.00 lakhs to Rs. 20.00 lakhs. Since 197-1998 the export value of 78.42 lakhs, 1998-1999 has an export value of 158.23 lakhs, 1999-2000 has an export value of 174. 27 lakhs, 2000-2001 has an export value of 229.31 lakhs and 2001-2002 has an export value of 314. 08 lakhs respectively. The value of international trade has increased steadily, touching US$ 350 million in 2007. The total value of ornamental fishes exported from India is Rs. 3.00 crores. Out of the 2,500 species are traded and a few 30-35 species of fresh water fish dominate the market. While more than 90% of freshwater fish are captive bred, only 25 out of nearly 8,000 marine ornamentals fishes are bred in captivity. About 120 countries import ornamental fishes Rahman (2005). The major importing countries are USA contributing 22.59%, Singapore 17. 99%, Japan 16.88%, where the export is effected through the international airports at Kolkata, Chennai, Mumbai, Trivandrum and Cochin. About 50% of export, by value of the ornamental fish takes place through Kolkata airport. The exports ornamental fishes worth about Rs. 22.8 million, to Japan (24.1%), Singapore (20.2%), USA (19.7%), China (10.5%), Taiwan (6.4%), Germany (6.1 %), UK (4.4%), Thailand (2.6%),Hong Kong (2.6%), Sri Lanka (1.3%), the Netherland(1.2%),France (0.8%), Bangladesh (0.8%), Belgium (0.7%),Malaysia (0.7%), Nepal (0.6%), Switzerland (0.2%), Finland(0.2%) and Maldives (0.1%). In the year 2009, the Indian exported ornamental fishes valued at more than Rs. 50 million (MPEDA, 2013; DAHDF, 2013). According to the report of tenth 5 year plan in India, export is almost entirely dependent on freshwater species or fishes with the major exporting centers being Kolkata, Chennai and Mumbai (Ghosh *et al.*, 2003).

A population is a group of fish of the same species that are alive in a defined area at a given time (Wootton, 1998). Population dynamics changes in the number of individuals in a population or the vital rates of a population over time. The main purpose of studies on fish population dynamics is to provide advice on the optimum exploitation of aquatic living resources especially freshwater ornamental fishes. It has been noticed that a number of commercial fisheries have been driven to commercial extinction due to over exploitation. It is feared that the same fate may befall on some of the freshwater fisheries of India especially ornamental fishes. It is therefore imperative that a fishery should be properly managed to sustain its benefits to the future generations.

Studies on fish stock assessment involve estimation of information on age, rate of growth, mortality and other factors which cause variations in fish stocks. The estimation of mortality rates is a basic requirement in fish stock assessment studies. The rate at which the numbers of a population is decreasing is the mortality. Usually in an exploited stock there are two sources of mortality – the natural mortality M and the instantaneous rate of fishing mortality F. The former covers events such as predation, diseases and deaths due to old age. Thus we have Z = F + M, where Z is the instantaneous rate of total mortality or the mortality coefficient or simply the total mortality rate, F is the fishing mortality coefficient and M is the natural mortality coefficient. An essential characteristic of a stock is that its population parameters remain constant throughout its area of distribution. The easiest way to describe the change in a fish stock is often to follow the fate of a cohort (Sparre *et al.*, 1989). This means that all fish of a cohort are assumed to have the same age at a given time so that they all attain the recruitment age, tr at the same time. Due to mortality there is a continuous decrease in the number of survivors. In the context of mortality rates the number of survivors from a cohort is estimated as a function of time.

Stock assessment of tropical fish resources has gained momentum in the last one and a half decade mainly through the works of Pauly (1983). The introduction of special software for fish stock assessment in particular those based on length frequency data such as LFSA (Sparre, 1987), COMPLEAT ELEFAN (Gayanilo *et al.*, 1988) and FEAT (Gayanilo *et al.*, 1995) has also contributed to the rapid development of stock assessment studies on tropical fish stocks. There have been several studies on the population dynamics of marine fin fishes from Indian waters but very limited towards freshwater. Alagaraja (1984, 1989) have given accounts on stock assessment models and estimation of parameters suited for assessing tropical fish stocks. Mortlity rate of *H.bimaculatus* in the aquarium condition observed during the study period. The *H.bimaculatus* were collected, strored and handled by adequate trained individual and transported under suitable condition, the estimated level of fish mortality was low as a few percent. No steps are taken by the agents or local dealers to prevent the mortality. Population dynamics is the branch of life sciences that studies short-term and long-term changes in the size and age composition of populations, and the biological and environmental processes influencing those changes. These are all the changes in population size in time and/or space, can be understood with reference to simple mathematical models. The major role of the population dynamic study is regulating populations of fish is essential to a general understanding of the ecology including population grows and shrinks over time, as controlled by birth, death, emigration or immigration and to determine sustainable yields. However, in the present study was conducted *H.bimaculatus* mortality rate under to evaluate the population dynamic of the species.

2.MATERIALS AND METHODS

Specimen collection

A total of 200 individuals of the Jewel fish *Hemichromis bimaculatus* were collected monthly from November, 2010 to May, 2012 using a hand dip net of mesh size 1mm from the Crystal Aquarium, Chennai and transported to the research lab, Annamalai University, Annamalainagar in well oxygenated plastic bags. The specimens were preserved in 10% formalin until examination.

Length-weight relationship

Methods to estimate the length-weight relationship of fishes are described by Pauly (1983). The length-weight relationship (LWR) was estimated by using the equation:

$$W = aL\ b$$

where W = weight in grams, L = total length in centimeters, a is a scaling constant and b the allometric growth parameter.

Mortality

Total mortality (Z) was estimated from length converted catch curves and natural mortality (M) which caused by all other factors except fishing, was estimated from the empirical relationship of Pauly (1980), as following:

$\log 10M=-0.065-0.287\cdot\log 10L\infty+0.604\cdot\log 10K+0.513\cdot\log T$ using a mean annual environmental temperature of 25°C. The estimate of F was obtained by subtracting M from Z. then exploitation ratio was obtained as:

$$E=F/Z.$$

The length at first capture Lc was estimated by Pauly (1984a, b). Relative yield per recruit (Y/R) ′and relative biomass per recruit (B/R)_ were estimated using Beverton and Holt's (1966) model as follows:

(Y/R) ′=E U M/K [1 –(3U/1 + m) +(3U2/1 +2M) -(U3/1 +3m).(B/R)_ = (Y/R) ′/F

Due to mortality (fishing or natural) there is a continuous decrease in the number of survivors. At birth a cohort has age zero and from this age to Tr (the minimum size at recruitment) it **is** in the pre-recruitment phase.

The unit of Z is per year or in general per time unit. If Z remains constant throughout the life of acohort, the earlier equation is mathematically equivalent to

$$N(t) = N(tr) * \exp [-Z * (t-Tr)]$$

which is called the exponential decay model. The fraction surviving after one year is called survival rate (Ricker, 1975):

$$N(tr + 1) \exp(-Z) = N(tr)$$

ESTIMATION OF FISHING MORTALITY COEFFICIENT 'F'

As the total mortality rate ***Z*** is the sum total of natural mortality rate M and

fishing mortality rate F *Q* = M + F), F is computed by the subtraction of M from ***2.***

3.RESULTS AND DISCUSSION

Length-weight relationship

The length-weight data of *H.bimaculatus* was segregated sex-wise and the stage of the maturity of the gonad (Table-1). The standard lengths of males and females varied between 55mm to 125mm and 45mm to 90mm respectively. The body weight ranged from 2.53g to 15.73g for males and 1.25g to 11.5g for females. Males were significantly longer than females at the later stage of maturity. But during the initial stage of maturity, females were larger than males ($p < 0.001$), in both weight and length during pre-breeding, breeding and post-breeding months. The increase in the weight of the fish was an exponential function of its length. During the breeding period, the total length of matured males ranged from 65 - 120mm and mature females from 55 - 90mm. Their body weight ranged from 2. 65g - 145g for males and 1.75g - 12.0 g for females.

Mortality

The monthly record of mortality on various maturity stages in *H.bimaculatus* is shown in Table- 2. The monthly record of pond mortality and lab mortality in *H.bimaculatus* is given in **Table- 3.** It was observed that mortality was less than 5% in all the months. The mortality rate was more in males. The value of Z (Instantaneous mortality) for all the 24 months is given in Table -4. The monthly mortality values estimated for *H.bimaculatus* are shown in Table-4 **.** It was observed from the data that the estimate of Z was 1.246 - 1.434 for the males and 1.00 - 1.583 for the females for different months of the study period. Similarly the fishing mortality (F) was 0.258 - 0.586 for the males and 0.035 - 0.349 for the females. The natural mortality (M) was 0.997 - 0.923 for the males and 0.913 - 1.258 for the females.

Total instantaneous mortality of the males was 1.326/year and that of the females was 1.208/year. The Fishing mortality coefficient was 0.406/year for males and 0.158/year for females. The estimated value of M for males was 0.956/year for males and 1.05/year for females. The estimate of M was calculated using Pauly's (1980) multiple regression equation with VBGF parameters L_∞ = 66mm, K = 0.52/ year for males and L_∞ = 59mm, K = 0.75/year for females at the mean annual temperature (T) of 29.5°C. The attributes such as age, standard length, live fish weight, liver weight, gonad weight, condition factor, hepatosomatic index and gonadosomatic index were considered. The reproductive studies showed similar results in the aquarium conditions. Some slight variation was observed in the number of eggs and the number of oil droplets in the egg of *H.bimaculatus* during the study period.

Table. 1. *H. bimaculatus:* Relationship of the fish length with weight of the gonad and gonadosomatic index of male and female.

	FEMALE		MALE	
STANDARD LENGTH (mm)	Wt .of ovary (g)	GSI (%)	Wt .of testis (g)	GSI (%)
50 ± 5	0.015±0.004	0.532±0.02	0.007	0.125±0.02
55 ± 5	0.025±0.002	0.845±0.03	0.007	0.235±0.05
60 ± 5	0.037±0.001	1.235±0.05	0.009	0.457±0.03
65 ± 5	0.095±0.002	1.456±0.03	0.100	0.732±0.05
70 ± 5	0.150±0.003	1.975±0.05	0.120	0.937±0.02
75 ± 5	0.175±0.004	2.234±0.03	0.120	1.132±0.03
80 ± 5	0.210±0.001	2.572±0.05	0.130	1.535±0.05
85 ± 5	0.250±0.002	2.752±0.02	0.135	1.759±0.02
90 ± 5	0.275±0.004	3.257±0.03	0.145	1.953±0.03
95 ± 5	0.300±0.002	3.725±0.05	0.145	2.115±0.05
100 ± 5	0.350±0.004	4.235±0.02	0.150	2.232±0.02

Each value ± SE of 2400 observations

Table. 2. *Hemichromis bimaculatus*: Monthly mortality record on various maturity stages.

Month	Total No. Fish	Male	Female	Maturing		Mature		Spent	
				M	F	M	F	M	F
Nov -2010	8	2	6	1	2	1	2		2
Dec -2010	5	2	3	1	2	1	1	0	0
Jan -2011	5	2	3	0	1	1	1	1	1
Feb -2011	3	2	1	2	1	0	0	0	0
Mar -2011	2	1	1	1	1	0	0	0	0
Apr -2011	7	4	3	2	2	2	1	0	0
May -2011	5	3	2	3	0	0	2	0	0
Jun -2011	8	3	5	2	3	1	2	0	0
Jul -2011	10	7	3	2	2	4	1	1	0
Aug -2011	8	6	2	3	1	3	0	0	1
Sep -2011	2	1	1	0	1	1	0	0	0
Oct -2011	5	3	2	2	1	1	1	0	0
Nov -2011	7	2	5	1	2	1	3	0	0
Dec -2011	5	2	3	1	1	1	1	0	1
Jan -2012	6	3	3	2	1	1	2	0	0
Feb -2012	3	3	0	0	0	2	0	1	0
Mar -2012	2	2	0	1	1	1	1	0	0
Apl - 2012	3	2	1	1	1	1	0	0	0

M – Male F - Female

Table. 3. *Hemichromis bimaculatus* : Monthly record of fishing and lab mortality.

Month	Total no. of Fish	Male	Female	Fishing Mortality		Lab Mortality	
				Male	Female	Male	Female
Nov -2010	8	2	6	1	4	1	2
Dec -2010	5	2	3	1	2	1	1
Jan -2011	5	2	3	1	2	1	1
Feb -2011	3	2	1	1	0	1	1
Mar -2011	2	1	1	1	0	0	1
Apr -2011	7	4	3	3	2	1	1
May -2011	5	3	2	1	2	2	1
Jun -2011	8	3	5	1	3	2	2
Jul -2011	10	7	3	5	2	2	1
Aug -2011	8	6	2	3	0	3	2
Sep -2011	2	1	1	0	1	0	1
Oct -2011	5	3	2	1	2	2	0
Nov -2011	7	2	5	1	3	1	2
Dec -2011	5	2	3	2	1	0	2
Jan -2012	6	3	3	1	2	2	1
Feb -2012	3	3	0	2	0	1	0
Mar -2012	2	2	0	1	0	1	0
Apr -2012	3	2	1	1	1	1	0

M – Male F - Female

Table 4. *Hemichromis bimaculatus*: Monthly record of various mortalities.

Period	Total Instantaneous Mortality (Z)		Fishing Mortality (F)		Natural Mortality (M)	
	Male	Female	Male	Female	Male	Female
Nov -2010	1.408	1.407	0.450	0.149	0.958	1.258
Dec -2010	1.433	1.583	0.478	0.349	0.955	1.234
Jan -2011	1.396	1.426	0.442	0.172	0.954	1.254
Feb -2011	1.434	1.188	0.437	0.035	0.997	1.153
Mar -2011	1.409	1.191	0.486	0.204	0.923	0.987
Apr -2011	1.422	1.186	0.468	0.229	0.954	0.957
May -2011	1.365	1.220	0.380	0.055	0.985	1.165
Jun -2011	1.365	1.205	0.433	0.070	0.932	1.135
Jul -2011	1.433	1.212	0.488	0.089	0.945	1.123
Aug -2011	1.423	1.236	0.488	0.094	0.935	1.142
Sep -2011	1.433	1.207	0.479	0.054	0.954	1.153
Oct -2011	1.387	1.194	0.422	0.079	0.965	1.115
Nov -2011	1.387	1.192	0.463	0.205	0.924	0.987
Dec -2011	1.374	1.183	0.389	0.227	0.985	0.956
Jan -2012	1.361	1.175	0.365	0.200	0.996	0.975
Feb -2012	1.349	1.167	0.396	0.221	0.953	0.946
Mar -2012	1.336	1.158	0.412	0.183	0.924	0.975
Apr -2012	1.323	1.150	0.358	0.227	0.965	0.923

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5.REFERENCES

Alagaraja, K. 1989. A brief account on stock assessment models and estimation of parameters suited to tropical fish stocks.J. mar: biol. Ass. India, 31 (1 & 2): 167-171.

Alagaraja, K., 1984. Simple methods for estimation of parameter for assessing exploited fish stocks. *Indian J. Fish*.,31(2): 177-195.

Gayanilo Jr., F.C., M. Soriano and D. Pauly, 1988. A draft guide to the COMPLEAT ELEFAN. ICLARM Software Project 2.: 65 p. and diskettes

Gayanilo Jr., F.C., M. Soriano and D. Pauly, 1988. A draft guide to the COMPLEAT ELEFAN. ICLARM Software Project 2.: 65 p. and diskettes

Gayanilo, F.C. Jr., P. Sparre and D.Pauly, 1995. FAO – ICLARM Stock Assessment Tools (FiSAT) User's manual. FAOComp. Info. Ser. (Fisheries), 8:126 pp

Ghosh, A, B. K. Mahapatra and N.C. Datta 2003, Ornaniental Fish Farming - Successful Small Scale Aqua business in India. *Aquaculture Asia* **8(3):** 14- 16.

Guerrero-Estevez, S., and N. Moreno-Mendoza, 2012. Gonadal morphogenesis and sex differentiation in the viviparous fish *Chapalichthys encaustus* (Teleostei, Cyprinodontiformes, Goodeidae). J Fish Biol., 2012 Mar; 80(3):572-94. doi: 10.1111/j.1095-8649.2011.03196.x. Epub 2012 Jan 17.

Mahapatra, B.K., Dutta, A., Basu, **A..** Dey, U.K., and Sengupta, K.K., 1999. Observation on the spawning and rearing ofAngel fish, *Pterophjllunl scaluw* Lichenstein). In: *M.* Sinha. Dhirendra Kumar and P. K. Kathia (eds.), Ecofriendly Management of Resources for Doubling Fish Produclion Strategies for 2 1 st century. Inland Fish. Soc, of India, Barrackpore, p. 102- 106.

Pauly, D., 1980. On the interrelationships between natural mortality, growth parameters and mean environmental temperature in 175 Fish stocks. J. Cons. Int. Explor. Mer., 39: 175-192.

Pauly, D., 1983. Some simple methods for the assessment of tropical fish stocks. FAO. Fish. Tech. Pap., 234: 52-52.

Rahman AKA, 2005. Freshwater Fishes of Bangladesh (2nd edition). The Zoological Society of Bangladesh, Dhaka. 394pp.

Rema Devi K. and T.J. Indra, 2010. check list of the native freshwater fishes of india**.** Marine Biology Regional Centre. Southern Regional Centre.Zoological Survey of India, 130, Santhome High Road,Chennai-600 028.

Silas, E.G., Gopalakrishnan, A., Ramachandran, A., Anna Mercy, T.V., Kripan Sarkar, Pushpangadan, K.R., Anil Kumar, P., Ram Mohan, M.K. & Anikuttan, K.K. (2011). Guidelines for Green Certification of Freshwater Ornamental Fish. The Marine Products Export Development Authority, Kochi, India. xii + 106 p.

Sparre, P. 1987. Computer programming for fish stock assessment.Length based fish stock assessment (LFSA) for Applecomputers. *FAO Fisheries Technical Paper*, 101 (Suppl 2):217 pp.

Sparre, P. and S.C. Venema, 1989. Introduction to tropical fish stock assessment-part 1: Manual. FAO Fisheries Technical Paper No. 306/1, FAO, Rome, Italy, pp: 337.

The Marine Products Development Authority (MPEDA), 2013. In India, Available at http://www.mpeda.com

Wootton, R. J., 1998. Feeding. *In*: Ecology of Teleost Fishes. 2nd ed. Chapman and Hall, London, U. K. pp. 27-62.

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