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LENGTH-WEIGHT AND LENGTH-LENGTH RELATIONSHIP OF INVASIVE ALIEN SPECIES, *OREOCHROMIS NILOTICUS* FROM LENTIC HABITATS OF PALAKKAD DISTRICT, KERALA

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Abstract: Nilotic tilapia, one of the important invasive alien species (IAS) of inland waters of Kerala, a south-western state in India attracted attention due to many factors including beneficial as well as detrimental factors like its aquaculture potential and its invasive and/or destructive nature respectively. Nile tilapia is reared extensively due to its both, table and ornamental value especially in Palakkad district of Kerala state in which, one of the biodiversity hotspots in world, the Western Ghats and the Nilgiri Biosphere Reserve are partially located. The bioreserve is an abode of many indigenous and rare species of ichthiyofauna, which are under threat due to invasive nature of hardy Nile tilapia along natural lentic habitats. The growth and its population were assessed through length weight relationship from a natural pond habitat in Palakkad district. 28 specimens were collected and assessed for its gender wise length weight relationship employing linear regression analysis. Results revealed that male (b = 2.636), female (b = 2.463) and total population (b = 2.618) shows allometric growth with out much difference between sex (P > 0.05). A good growth pattern and strong population in lentic habitat has been established by the Nile tilapia.

Key words: *Oreochromis niloticus*, Morphometry, Length-weight relationship, invasive species, Ichthyofauna, Exotics

INTRODUCTION

Introduction of exotic species has caused numerous negative effects to biodiversity, natural environments, economics, and even human health. Exotic species become predators or competitors of native species (Hill and Lodge, 1999), spread parasites or pathogens (Torchin *et al*., 2003; Torchin and Mitchell, 2004), cause unexpected hybridization (Gaskin and Schaal, 2002; Mallet, 2007), and may ultimately cause a decrease in local biodiversity by eliminating local species (Chapin *et al*., 2000; Dick and Platvoet, 2000). Freshwater ecosystems are especially vulnerable to invasions because there are so many potential routes of introduction (Sala *et al*., 2000). Efforts to limit the introduction of invasive species or to manage established exotic populations are often hindered by insufficient understanding of the natural history of problematic species (Simberloff *et al*., 2005).

Tilapia, a native of Africa have proved to be a highly successful colonizing species in many countries mainly due to a wide range of parameters like rapid growth rate, highly efficient reproductive strategy, wide physiological tolerance and habitat preferences and their ability to feed on different components of the aquatic food chains so that they can exploit unutilized food resources in many systems.

Length-weight and other morphometric relationships are of great importance in fisheries research because they provide information on population parameters as well as growth pattern of the species (Krause *et al.,* 1998; Ovredal and Totland, 2002; Ecoutin *et al*., 2005). The rate of change in length-weight relationships are done mainly to assess the age of fishes, to estimate the mortality rate and to assess the sustaining power of the fishery stock. However, the size attained by the indi

vidual fish may also vary due to variations in food supply. The condition of the stock is also evident from the length weight relationship, which can be regarded as a sustainability indicator for the species in the habitat. The growth pattern of *Oreochromis niloticus* from Palakkad district of Kerala was assessed through length weight relationship, which help in determining the growth of exotics species when compared to that of local indigenous varieties.

MATERIALS AND METHOD

The length weight relationship of *Oreochromis niloticus* (Linnaeus, 1758) (Perciformes: Cichlidae) was assessed from individuals collected from Nooram pond in Palakkad district of Kerala. A total of 28 specimens were collected with special precautions for non-damage of specimens using cast nets during August to December 2011. The fishes were euthanized by keeping in freezers and transported. Different length parameters like total length, standard length, head length and fork length (caudal fin length) of fishes were taken using a measuring board to the nearest centimetre. Body weight was taken to the nearest gram using an electronic balance after blot-drying excess water from the body. After recording the morphometric data, the specimen was cut open to examine its sex correctly. Length weight relationship was established for male, female and total population of the species following Cube law reported by Le Cren (1951), which is calculated employing linear regression analysis (Snedecor, 1956) on natural log transformed data. Regression method was also used to establish relationship between total length and other length parameters without sex difference. Condition factor of the species also determined using standard formula (Pauly, 1983). Different lengths and other variables were compared between sexes using Student's t test. For all statistical evaluations, a two-tailed probability value of < 0.05 was considered significant.

RESULTS

Length weight and other length relationships of invasive Nile tilapia were assessed to determine its growth pattern from lentic habitats of Palakkad district of Kerala State. Gender wise average length and weight along with other morphometric parameters of Nile tilapia and its condition factor (k) is given in table 1. The mean total and standard length registered in present study is 24.48 $\pm$ 4.15 cm and 19.42 $\pm$ 3.40 cm respectively and there were no significant difference between sexes with respect to these lengths, even though males registered little bit more length than females. Body weight of males (316.65 gm) was found to be significantly ($P < 0.05$) high values than female population. Other length parameters like head length and fork length also showed no significant sex difference in Nile tilapia population. Condition factor registered almost similar values for both sexes without significant difference as well as for total population. All morphometric parameters registered low value for female population than the total population where as males recorded little high value than of average total population values. Similarly condition factor (k) of the males (1.89) were higher than that of females (1.81) without significant difference, but slightly higher than from total population mean (1.86).

Length weight relationship of Nile tilapia from Palakkad district registered a significant linear relationship for male, female and for total population (Table 2). An allometric pattern for length weight relationship with regression coefficient 2.636 was obtained for male population where as female and total population registered regression coefficients as 2.463 and 2.618 respectively with good growth characteristics (Figs. 1 to 3). Table 2 also provides comparison of length weight relationship of Nile tilapia reported from different countries/locations. Regression coefficient was little bit higher for male population rather than female Nile tilapia.

Another important relationship in morphometrics is length–length relationship, in which total length was associated with standard length, head length and fork length of the total population. Total length of Nile tilapia registered a positive relationship with 'b' values 1.0499, 1.0841 and 0.8373 for standard length, head length and fork length respectively (Figs. 4, 5 and 6).

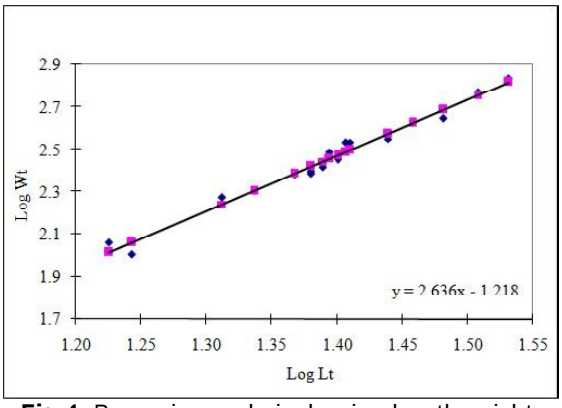

Fig. 1. Regression analysis showing length weight relationship of *O. nilotica* male population

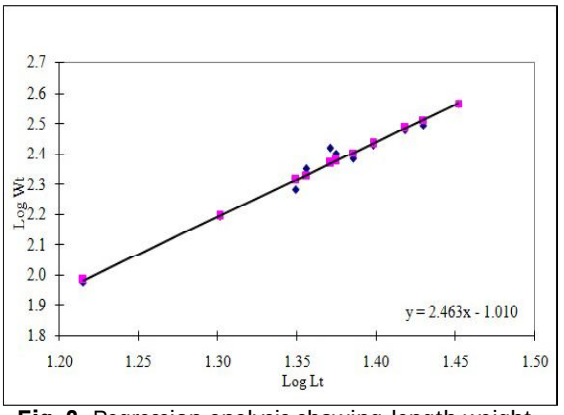

Fig. 2. Regression analysis showing length weight relationship of *O. nilotica* female population

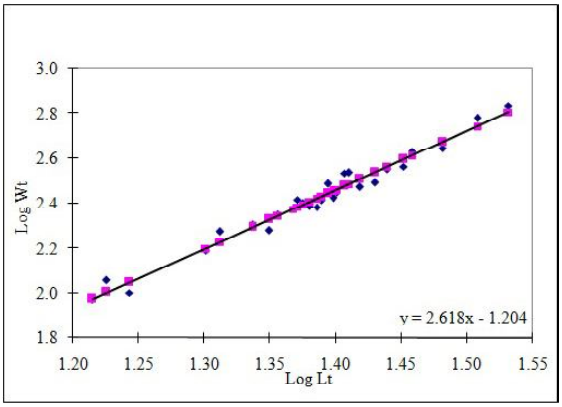

Fig. 3. Regression analysis showing length weight relationship of *O. nilotica* total population

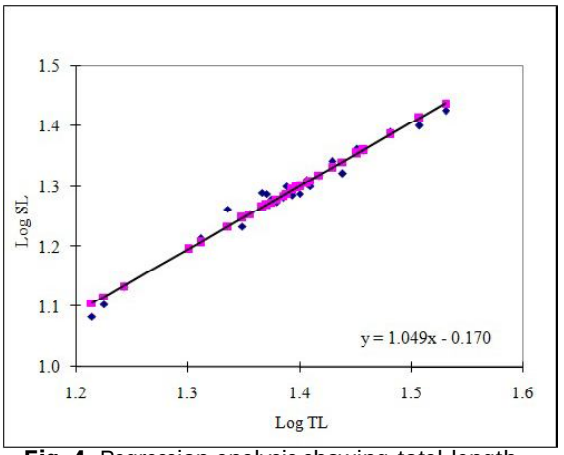

Fig. 4. Regression analysis showing total length - standard length relationship of *O. nilotica* total population

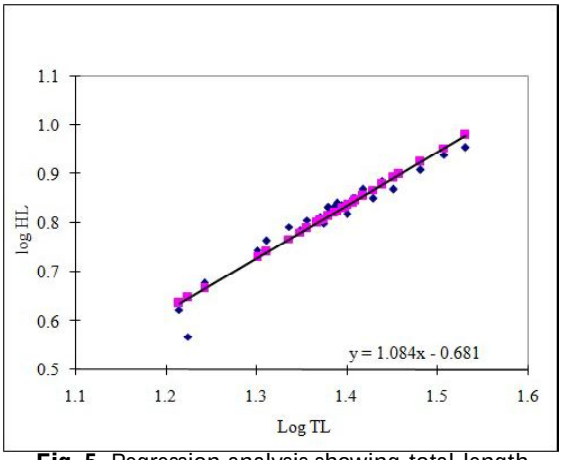

Fig. 5. Regression analysis showing total length - head length relationship of *O. nilotica* total population

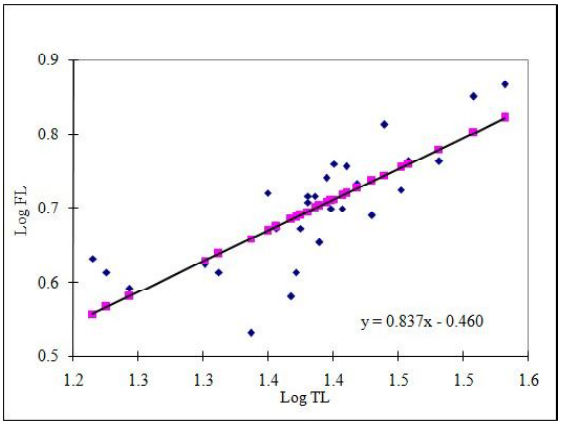

Fig. 6. Regression analysis showing total length - fork length relationship of *O. nilotica* total population

Table 1. Weight and length parameters and their comparison between sexes of *O. niloticus*

Parameters	Total Population		Male		Female		t value
	Mean	± SD	Mean	± SD	Mean	± SD	
Total Length (cm)	24.48	4.15	25.07	4.62	23.58	3.31	1.333
Standard Length (cm)	19.42	3.40	19.86	3.65	18.76	3.02	1.196
Weight (gm)	287.30	132.93	316.65	154.71	241.95	75.41	2.139*
Head Length (cm)	6.68	1.18	6.86	1.32	6.41	0.92	1.394
Fork Length (cm)	5.05	0.95	5.21	1.15	4.82	0.46	1.065
Condition Factor (k)	1.86	0.19	1.89	0.21	1.81	0.17	1.206

* $P < 0.05$

Table 2. Length-weight relationship of Nile tilapia from different countries/locations

Country	Equation (log BW = b log TL ± a)	Gender (if any)	Reference
Thailand	Log BW = 3.026 Log TL - 1.839	Total Population	Kosai *et al.*, 2014
Bangladesh	Log BW = 2.693 Log TL - 4.089	Total Population	Shahriar Nazrul *et al.*, 2011
Egypt	Log BW = 2.748 Log TL - 1.154	Total Population	Bakhoum and Aabdallah, 2002
Egypt	Log BW = 2.963 Log TL – 1.654	Male	Midhat *et al.*, 2015
(Al-Minufiya)	Log BW = 2.951 Log TL – 1.628	Female	
	Log BW = 2.801 Log TL – 1.437	Total Population	
Italy	Log BW = 2.506 Log TL - 3.568	Total Population	Scordella *et al.*, 2003
Kenya	Log BW = 3.320 Log TL - 2.170	Male	Njiru *et al.*, 2006
	Log BW = 3.190 Log TL - 1.970	Female	
Kenya(Naivasha)	Log BW = 2.312 Log TL - 0.640	Total Population	Otieno, *et al.*, 2014
Nigeria	Log BW = 3.140 Log TL - 2.030	Male	Olurin and Aderibigbe, 2006
	Log BW = 2.900 Log TL - 1.960	Female	
	Log BW = 3.100 Log TL - 2.000	Total Population	
Pakistan	Log BW = 4.550 Log TL - 4.070	Total Population	Laghari *et al.*, 2011
USA	Log BW = 2.992 Log TL - 4.668	Total Population	Grammer *et al.*, 2012
Saudi Arabia	Log BW = 3.160 Log TL – 2.670	Male	Mortuza and Al-Misned, 2013
	Log BW = 2.980 Log TL – 2.080	Female	
	Log BW = 3.080 Log TL – 2.480	Total Population	
India(TamilNadu)	Log BW = 2.313 Log TL – 3.417	Total Population	Karal Marx *et al.*, 2014
India(Kerala)	**Log BW = 2.636 Log TL – 1.218**	**Male**	**Present Study**
	Log BW = 2.463 Log TL – 1.011	**Female**	
	Log BW = 2.618 Log TL – 1.205	**Total Population**	

* Original table from Kosai *et al.*, 2014.

DISCUSSION

Morphometric relationship of Nile tilapia was explored to determine its growth pattern from lentic habitats of Palakkad district of Kerala State as Nile tilapia is spreading along Kerala state as an invasive alien species due to its adaptability, hardy nature, breeding behaviour etc and in addition, they are used for various purposes as table fish and ornamental fish. The threat really arises when it intrude into natural habitats especially along Western Ghats biodiversity hotspot. It not only forms a competitor for food and breeding ground with other species (Hill and Lodge, 1999), but also brings parasite and/or diseases to native fauna (Torchin and Mitchell, 2004). The hardy nature of the Nile tilapia makes it suitable to live in any condition compared to other native inmates making them a superior hierarchy in the habitat. Hence baseline observations on the biology and geographical spreading/distribution of Nile tila

pia across peninsular India warrants utmost attention and information on morphometrics and other body measurements like condition factor and length weight relationship can express the growth performance of species in natural inland habitats.

The significance, applications and different methodology including a detailed meta-analysis of length – weight relationship studies in Ichthyology was reported by Froese (2006). Length weight relationship of Nile Tilapia was reported from different parts of the world by different authors so far including the present study is given in table 2. All most all the study results revealed that Nile Tilapia follows an allometric growth with 'b' values almost near to isometric growth (3). From table 2, it can be noticed that the slope (b) value ranges between 2.3 to 3.3, except in the study (b=4.455) from Pakistan (Laghari *et al.*, 2011) which shows allometric growth near to isometric growth of *niloticus* species throughout the world including the current study. Present study results registered a little bit low 'b' values like 2.64, 2.46 and 2.62 for male, female and total populations respectively and corroborates with reports from all over. This is indicative of well defined growth pattern for the species throughout the world without much environmental or food influence, which thereby designate the adaptability of the species to various environmental conditions and to different food spectrum so that the species can thrive to its optimum growth performance. Another notable point is that male *nilotica* shows more isometric growth or higher 'b' values than female populations or from mean total population from all studies reported including the present study.

Length-length relationships were also resulted in positive association which act as a function of the shape and growth aspect of the species. Positive relationship suggests that the growth performance in their habitats are optimum or strong enough to overrule the species diversity occupying the same niche. The present study results are supportive of earlier reports (Karal Marx *et al.*, 2014; Kosai Piya *et al.*, 2014; Midhat *et al.*, 2015) from different part of the world which shows that the species is hard enough to acclimatize and thrive to any climatic conditions throughout the world. Condition factor of the species is suggestive of the total thriving condition of the species along with their well being (LeCren, 1951). Since the condition factors are on comparatively high values Nile tilapia from Palakkad district of Kerala state should be identified as good adaptive and acclimatizing species in tropical situations, which have positive and negative significance as food fish and alien invasive species respectively.

REFERENCES

Bakhoum, S. A. and Aabdallah, M. 2002. Study to detect impacts of pollution on fishery biology of Tilapias in Lake Manzalah, Egypt. *J. King Abdulaziz Univ. Marine Sci.*, 13: 147-160.

Froese, R. 2006. Cube low, condition factor and weight-length relationships; history, meta-analysis and recommendations. Journal of Applied ichthyology, 22: 241-253.

Grammer, G. L., Slack, W. T. Peterson, M. S. and Dugo, M. A. 2012. Nile tilapia *Oreochromis niloticus* (Linnaeus, 1758) establishment in temperate Mississippi, USA: multi-year survival confirmed by otolish ages. *Aquat. Invasion*, **7:** 367-376.

Karal Marx, K., Vaitheeswaran, T., Chidambaram, P., Sankar ram, S. and Karthiga, P. 2014. Length weight relationship of Nile Tilapia of *Oreochromis niloticus niloticus* (Linnaeus, 1758) (Family: Cichlidae), *Ind. J. Vet. & Anim. Sci. Res*., 43(1): 33-39.

Kosai Piya, Piyadon Sathavorasmith, Kanitta Jiraungkoorskul and Wannee Jiraungkoorskul, 2014. Morphometric characters of Nile Tilapia (*Oreochromis niloticus*) in Thailand. *Walailak J. Sci. & Tech*., 11(10): 857-863.

Laghari, M. A., Dars, B. A. and Narejo, N. T. 2011. Length-weight relationship of *Tilapia niloticus* in concrete pond of Habib ADM, Hub, Balochistan. *Sindh. Univ. Res. J.,* 43: 29-32.

LeCren, E. D. 1951. The length weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Acol*., 20: 201-219.

Linnaeus, C. 1758. Systema Naturae per Regna Tria Naturae Secundum Classes, Ordines,

Genera, species, cum Characteribus, Differentiis, Synonymis, Locis. 1st Edn., Editio Decima,Reformata, Holmiae, Salvius, pp: 1-4.

Midhat A El-Kasheif, Mohammad M.N Authman, Fawzyah A. Al-Ghamdi, Seham A. Ibrahim and Alaa M. El-Far, 2015. Biological Aspects and Fisheries Management of Tilapia Fish *Oreochromis niloticus* (Linnaeus, 1758) in El-Bahr El-Faraouny Canal, Al-Minufiya Province, Egypt. *Journal of Fisheries and Aquatic Science,* 10 (6): 405-444.

Migiro, K. E., Ogello, E. O. and Munguti, J. M. 2014. The length-weight relationship and condition factor of Nile Tilapia (*Oreochromis niloticus* L.) broodstock at Kegati Aquaculture Research Station, Kisii, Kenya. *International Journal of Advanced Research*, 2(5); 777-782.

Mortuza, G. M. and FA Al-Misned, 2013. Length-Weight Relationships, Condition Factor and Sex-Ratio of Nile Tilapia, *Oreochromis niloticus* in Wadi Hanifah, Riyadh, Saudi Arabia. *World Journal of Zoology*, 8(1): 106-109.

Njiru, M., Ojuok, J. E., Okeyo-Owuor,J. B., Muchiri, M., Ntiba, M. J. and Cowx, I. G. 2006. Some biological aspects and life history strategies of nile tilapia *Oreochromis niloticus* (L.) in Lake Victoria, Kenya. *Afr. J. Ecol.,* 44: 30-37.

Olurin, K. B. and Aderibigbe, O. A. 2006. Length-weight relationship and condition factor of pond reared juvenile *Oreochromis niloticus. World J. Zool.,* 11: 82-85.

Otieno, O. N., Kitaka, N. Njiru, J. M. 2014. Length-weight relationship, condition factor, length at first maturity and sex ratio of Nile tilapia, *Oreochromis niloticus* in Lake Naivasha, Kenya. *International Journal of Fisheries and Aquatic Studies,* 2(2): 67-72.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Technical Paper, (234), FAO, Rome, Italy

Scordella, G., Lumare, F., Conides, A. and Papaconstantinou, C. 2003. First occurrence of the tilapia, *Oreochromis niloticus niloticus* (Linnaeus, 1758) in Lesina lagoon (Eastern Italian coast). *Mediterr. Marine Sci.*, 4: 41-47.

Shahriar Nazrul, K. M., Mamun, A. A., Sarker, B. S. and Tonny, U. S. 2011. Morphological variability of the 11th generation strain of Nile tilapia, (*Oreochromis niloticus*) and traditional genetically improved farmed tilapia. *J. Bangladesh Agri. Univ.*, 9: 345-349.

Snedecor, G. W. 1956. Statistical Methods. The Iowa College Press, Ames, Iowa, U.S.A., 534p.