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Population structure of exotic fish tilapia (*Oreochromis mossambicus* P. 1852) in Vallabhsagar reservoir - a large aquatic ecosystem on western ghats of India

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ABSTRACT

The present study was conducted to find out the population structure of the studied fish tilapia which provides the information on the exploitation pattern, existing growth and sustainability of the fish in the surrounding aquatic environment. The random fish scale samples (505 numbers) were collected at monthly basis during the month of November 2021 to April 2022 from different commercial fish collection center at Vallabhsagar reservoir, Gujarat for the proposed study of exotic fish tilapia (*Oreochromis mossambicus*). The findings of the study shows that fishes varied from 1+ to 5+ age classes and in which 4+ (29%) age group was dominated which followed by 2+ (26%), 3+ (25%), 1+ (12%) and 5+ (9%) of the total population. Moreover, bell shaped age pyramid of tilapia was observed by the balanced population growth due to static aquatic environment in Vallabhsagar reservoir, Gujarat. The increasing length and weight indicated that aquatic environment was favorable for *Oreochromis mossambicus* in study area may be due to abundance of energy rich food. This rare study in this particular area have been found very useful to evaluate the status of populations, scientific management of fisheries and stock assessment.

Key words: *Population structure, Oreochromis mossambicus, Vallabhsagar, Tilapia, Pyramid, Stock assessment.*

Introduction

The tilapia (*Oreochromis mossambicus*) is a teleost fish of the family Cichlidae which is known also as mozambique mouth brooder or mud bream. It originated from Africa and after introduction it became the second most common aquaculture species and have been spread outall over the world except Antarctica (Fitzsimmons, 2006). The exotic species including tilapia was used for fisheries and aquaculture diversification and practiced for rising demand of food and nutritional security through development of aquaculture worldwide. The tilapia (*O. mossambicus*) inhabits of in slow flowing rivers and streams and still waters such as lakes and lagoons and in both fresh brackish and marine waters. Tilapia is now dominated and represent the maximum portion of fish biomass in the different water bodies and most native fish species are invasive (Ujjania *et al*., 2021). The increase and higher survival rate of tilapia is attributed to the overfishing of endemic fishes, reducing competition and diverse diet of tilapia which includes insects, algae, fish, molluscs and detritus ((Ujjania and Sharma, 2023), whereas, the dominance of tilapia over other fishes in the aquatic ecosystem is attributed to several factors including

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high fecundity, prolific breeding and fast growth rates (Ujjania *et al*., 2013). The fish also survive a wide range of pH and low dissolved oxygen concentrations (Balirwa, 1998). Tilapia can mature at the small size under more extreme conditions or in stressful environmental condition of the water bodies which help to increase the population.This increased population of tilapia is not only invasive impacts on indigenous fish fauna (Ujjania *et al*., 2020) but also the population structure and growth trend and production of tilapia in the aquatic ecosystem is also affected. The number of fishes available in unit area of the water body is considered as population density which considered as the one of the important factor to influence the growth, production, sex ratio and fecundity (Ronald *et al*., 2014). Population density in poly culture system also effect the growth and production of exotic carp (Muhammad, 2013). The population structure of fish in the water body represents the ratio of differentage classes at given time similarly it was explicated by Kajungiro *et al*., 2019 and Gopesh *et al*., (2021). The population structure of the fish in water bodies is useful to provide the information about fertility, mortality, migration and population dynamics which are impacted by the aquatic environment (Markert *et al*., 2010), age of existence of the fish species in the water body etc. (Dwivedi *et al*., 2017). The present study was aimed to examine the population structure of tilapia (*O. mossambicus*) in different large and perennial water bodies of western ghat of India. The findings would be beneficial to find the current population structure of the fish which help to develop the strategies for the conservation of indigenous fauna and sustainable aquaculture production in these aquatic ecosystems.

Materials and methods

Vallabhsagar reservoir is constructed across the Tapi River (Gujarat) for multipurpose uses including agriculture, hydroelectricity, industry, domestic consumption and for fish farming (Fig. 1). It has 80.772 m height, 4972 m length, 7414.29 Mm^3water storage capacities and catchment area is 62,255 Km^2.

The fish scale samples (5-6) were randomly collected from 505 fish specimens during the post-monsoon season (November 2021 to April 2022) from the important commercial fish collection centers. These scale samples were collected from above the lateral line and below dorsal fish of each fish specimen in

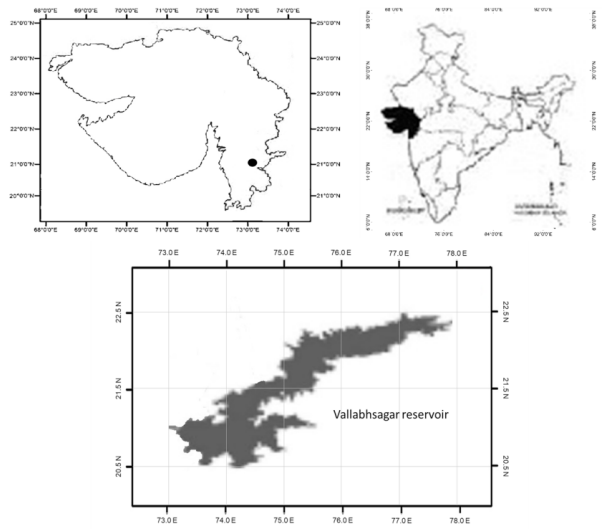

Fig. 1. Map of the study area (Vallabhsagar reservoir)

paper envelop with keynote informations including total length (cm), standard length (cm), weight (g), date of scale collection, name of fish species, name of lending center, name of sample collector etc. These scale samples were treated with 1% KOH solution and wash with tape water prior to rubbing with fingertip to increase the transparency. These scales were analyzed under the 4P scale reader to follow the method (Ujjania *et al.*, 2014) at the Research Laboratory, Department of Aquatic Biology (VNSGU, Surat).

The population structure was denoted by age pyramid and it was prepared following the method of Odum (1971).

Results

The scale based age and growth analysis of tilapia in Vallabhsagar reservoir is revealed that fish population containing 1+ to 5+ year classes and contributing 12%, 26%, 25%, 29% and 9% for age class respectively (Table 1). In the catch, 8.80 cm/17.690 gm, 14.758 cm/76.171 gm, 21.612 cm/223.369 gm, 26.170 cm/386.865 gm and 28.846 cm/506.744 of length and weight were observed respectively (Table 1 and Fig. 2). The population structure or age class distribution denoted by the age pyramids which represents the percentage of the various age classes in a population at a given time. In the present study, the bell-shaped age pyramid (Fig. 3) of tilapia in Vallabhsagar reservoir was observed. Similarly, results were depicted that in compare to early and

later age class (1+ and 5+ age classes) of fish middle age classes (2+ to 4+ age classes) were more exploited which contributed 80% (Table 1).

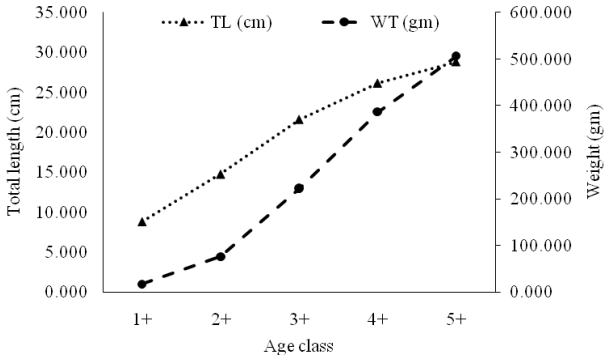

Fig. 2. Growth trend (length and weight) of tilapia in Vallabhsagar

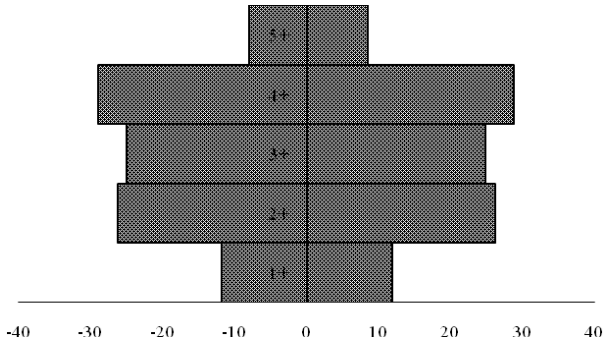

Fig. 3. Population structure of tilapia in Vallabhsagar reservoir

Discussion

The length and weight of the tilapia showing normal increasing trends with age which interpreted that exotic fish tilapia was surviving in better manner in the aquatic environment of Vallabhsagar that could be justified by satisfactory growth and wellbeing of fish. The similar trends of the age and satisfactory growth of tilapia were reported in Jaisamand Lake Rajasthan (Ujjania *et al.*, 2004) in Ana Sagar Lake (Ajmer) Rajasthan (Rose *et al*., 2018) and in *Labeo calbasu* from the Yamuna river, India (Sheeba *et al*., 2019). The more exploitation of middle age of the fishes were reported in Himalayan mahseer (Bhatt *et al*., 2000) in *Aorichthys seenghala* (Seth and Katiha, 2001) and in *Bariliusbendelisis* (Nautial and Negi, 2004) from different water bodies. In evidence of the current findings, bell shaped age pyramid reported which revealed the abundance of 3+ age group of *L. calbasu* in the river (Sheeba *et al*., 2019). The finding on the growth and population structure of the studied fish tilapia characterized by the stable population growth that indicates equal population of the small sized fish and large sized age group less exploited which revealed that aquatic environment of Vallabhsagar reservoir is much favorable for survival and existence. These findings were also depicted that growth of studied the fish in reservoir was more satisfactory which may be attributed by abundance of energy-rich food and more stable aquatic environment of the reservoir (Ishikawa, 2013).

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Table 1. Population structure of tilapia in large water body (Vallabhsagar)

Age group	N	%	Length (cm)	Weight (gm)
1+	60	12	5.99-11.41 (8.80)	5.75-35.74 (17.69)
2+	132	26	10.69-18.29 (14.76)	29.71-136.41 (76.17)
3+	125	25	18.46-26.27 (21.61)	139.89-380.66 (223.37)
4+	145	29	22.01-31.67 (26.17)	230.56-647.01 (386.87)
5+	43	9	25.67-33.03 (28.85)	356.59-728.69 (506.74)
Total	505	100	15.00-33.70 (23.60)	77.00-662.00 (309.95)

the research and help to provide the fish specimens for the scale and data collection.

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

The first author (NCU) was involved as research guide and helped in manuscript reviewing and editing while second author (NPS) helped in sample analysis and manuscript writing whereas third author (DJP) is involved in fish samples collection.

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