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Research Article

Age and Growth of Commercially Exploited Fish Species, *Oreochromis niloticus* (Linnaeus, 1758) from the Tributary of the Ganga River, India

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ABSTRACT

Studies were undertaken during the period February 2019 to 2020 January from the lower stretch of the Tons River at Prayagraj, Uttar Pradesh, India. During the present work, 683 fish specimens of Nile Tilapia, *Oreochromis niloticus* (336 males and 347 females) were studied for estimation of age composition, age and growth increment. An over-all representation of age, growth increment and age composition of *O. niloticus* has been obtained by the study of its key scales. The age composition of *O. niloticus* varied from 0+ to 7+ age groups. The maximum growth increment was recorded during first year of life cycle and showing a gradual decrease in growth as the fish got older. The minimum growth increment was recorded during the seven year of the life cycle. On the basis of pooled sampled specimen in the length ranges from 83 to 463 mm showed that the fish attained the mean length 159 mm in 1+, 237 mm in 2+, 309 mm in 3+, 357 mm in 4+, 394 mm in 5+, 429 mm in 6+ and 455 mm in 7+ age groups. The growth increments in *O. niloticus* was observed as 159 mm, 78 mm, 72 mm, 48 mm, 37 mm, 35 mm and 26 mm for 1+ to 7+ age groups, respectively. The slow growth increment observed after first year may be attributed to the maturity attained within first year of life. It is well known that the growth potential is used for the gonad development. The growth percentage varied from age to age in the male, female and pooled samples.

Keywords: *Oreochromis niloticus*; Growth; Age composition; Tons River

INTRODUCTION

The age and growth studies of fishes within sexes (e.g. male and female) are consequently essential in assessing population characteristics that can impact the productivity of an ecosystem, food web structure of the water body and management of fisheries [1-3]. Accurate fish growth rates are important for growth analysis, age structure analysis and estimation of mortality rate [4-6]. The information of fish growth increment is also necessary to perceptive a species life history, reproductive biology, population dynamics, biomass and fisheries sustainability [7,8]. Growth is a complex mechanism, which represents the outcome of the interactions among several biotic and abiotic factors operating on behavioural and physiological processes [9-11]. The age and growth parameters of the fish in entirely different habitats would have different length distributions, age composition and growth rates [3,12-15].

In general, Nile tilapia, *Oreochromis niloticus* is eminent for their plasticity in survival (Example due to its ability to tolerate a wide range of environmental conditions and ability to feed at different trophic levels), feeding nature, fast growth, tolerance, high resistance to diseases, ease of breeding and size-at first maturity [16-20]. They have ability to invasion in any fresh water ecosystem and become powerfully established in non-native ecosystem or introduced ecosystem but also allow them an excellent aquaculture species with other indigenous carps, sport fishing and stock enhancement [10,21-25]. After introduction or invasion in any ecosystem, *O. niloticus* have a tendency to out-compete native species for habitat (example space), dissolved oxygen, food especially natural food and spawning grounds [26-29].

O. niloticus is a great economical importance species and significant role in the tropical and subtropical aquatic ecosystems [30-35]. These characteristics make possible it to be a pioneer species that can flourish in various ecosystems such as lakes, estuaries and rivers [22,36-39]. *O. niloticus* is a most common invader worldwide [40-42] and has become the dominant species (by catch or landing) in many rivers of the Ganga River system, India [35,43]. *O. niloticus*

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niche overlap to *Cirrhinus mrigala* and *C. carpio*, Nile tilapia tends to quickly gain the competitive advantage because of its hardy nature and feeding plasticity due to these features, it is dominated to other fishes from the Ganga River system. Thus, the present study has been conducted to unravel the age, growth and age composition of *O. niloticus* from the Tons River, which is entirely very new home for the fish. The study would help the fishery managers and planners in management of the riverine fisheries.

MATERIALS AND METHODS

The Tons River is essentially a hilly stream water body arising in the Kaimur hills of the Vindhyan range, India. It banks are lined by deep ravines and the bed is rocky. The Tons River lies between latitude 2400'-25016'54" North and longitude 80026'45"-82004'57" East. The sample was collected during February 2019 to 2020 January from Sirsa fish landing centre at Prayagraj, Uttar Pradesh, India. Fishes were collected using a variety of methods including gill nets, drag nets, cast nets and hook and lines. Samples of scales from 683 specimens in the length ranges between 82-463 mm were examined for determination of age composition, age and growth from the Tons River at Prayagraj, Uttar Pradesh, India.

Scales were used to estimate *O. niloticus* age. They were the easiest to prepare and the use of scales would provide greater accuracy. The total length of each fish (in mm, from the tip of snout and the end of longest caudal fin rays) was measured and recorded. The Key scales were collected from the region just below the dorsal fin (3-4 rows) above the lateral line and were thoroughly washed in tap water until all extra matter got completely removed and mounted intact in between two glass plates. The ring formation was determined according to the criterion suggested by [6,13,44,45]. Almost all the annuli, except the one, appeared as light relatively transparent bands, concentrically arranged around the whole of the anterior sculptured part of the scales. Annual ring formation was recorded in the present fish. Ring 1, 2 and 3..... were denoted to 1+, 2+ and 3+.... age of the fishes.

RESULTS AND DISCUSSION

In the present study, scales were used for age determination and by using the readings of its annual growth rings and it were found that the longevity of *O. niloticus* attained 7+years from the Tons River at Prayagraj, Uttar Pradesh, India. The age composition of *O. niloticus* varied from 0+ to 7+age group in case of male fishes while 0+ to 6+age group was recorded in female fishes. The maximum growth increment was recorded during first year of life and showing a gradual decrease in growth as the fish got older (Tables 1-3).

Pooled samples

On the basis of pooled sampled specimen in the length ranges from 83-463 mm showed that the fish attained the mean length 159 mm in 1+, 237 mm in 2+, 309 mm in 3+, 357 mm in 4+, 394 mm in 5+, 429 mm in 6+ and 455 mm in 7+ age groups. The growth increments in *O. niloticus* was observed as 159 mm, 78 mm, 72 mm, 48 mm, 37 mm, 35 mm and 26 mm for 1+ to 7+ age groups, respectively. The slow growth increment observed after first year may be attributed to the maturity attained within first year of life. It is well known that the growth potential is used for the gonad development. The growth percentage varied from age to age in the pooled samples (Table 1). The growth increment percentage varied from age to age in the pooled samples (Figure 1).

Male and female samples

Total length of males ranged from 82-463 cm and females from 34-66 cm. The maximum increase in length was noted during the first year of life and showing a gradual decrease in growth as the fish got older. Male growth was recorded slower compared to female in first year of the life cycle of *O. niloticus* (Tables 2 and 3). The minimum growth increment was recorded during the seven year of the life cycle in case of male while in case of female during the six year of the life cycle. In case of male fishes, the growth increments of *O. niloticus* was observed as 154 mm, 87 mm, 72 mm, 46 mm, 38 mm, 37 mm and 21 mm for 1+ to 7+ age groups, respectively while in case of female fishes, the growth increments in *O. niloticus* was reported as 168 mm, 67 mm, 66 mm, 48 mm, 37 mm and 32 mm for 1+ to 6+ age groups, respectively (Tables 2 and 3). Female *O. niloticus* was not appeared to live longer than 6 years. The present observations also indicated that the aquatic environment of the Tons River at Prayagraj was most favorable for *O. niloticus* due to fast growth increment. The growth percentage varied from age to age in the male and female both samples. The maximum growth percentage was recorded in 1+ age group with 33.85% in case of male while growth percentage was increased in 1+ age group upto 40.19% in case of female (Figure 2). The mean length of all males and females was significantly different.

Table 1: Age and growth of Nile tilapia, *Oreochromis niloticus* from the Tons River at Prayagraj, Uttar Pradesh (Male samples).

S. N.	Age classes	Size ranges (mm)	Mean length (mm)	Growth increment (mm)	Growth percentage
1	0+	82-131	112		
2	1+	127-209	154	154	33.85
3	2+	194-273	241	87	19.12
4	3+	261-343	313	72	15.82
5	4+	339-381	359	46	10.11
6	5+	359-432	397	38	8.35
7	6+	413-449	434	37	8.13
8	7+	447-463	455	21	4.61

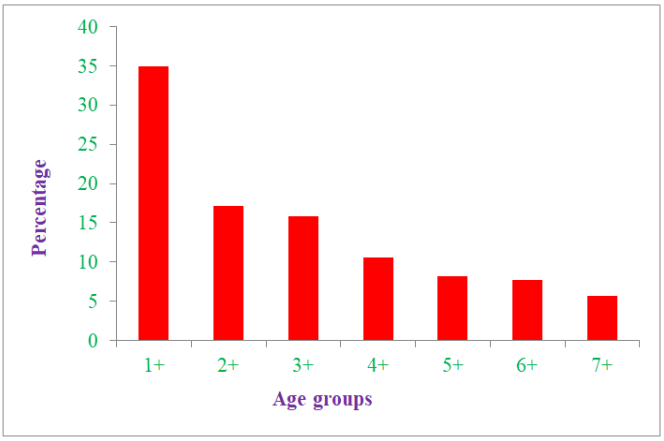

Figure 1: Growth increment % of pooled samples of *Oreochromis niloticus* from the Tons River at Prayagraj, Uttar Pradesh, India.

Table 2: Age and growth of Nile tilapia, *Oreochromis niloticus* from the Tons River at Prayagraj, Uttar Pradesh (Female samples).

S. N.	Age classes	Size ranges (mm)	Mean length (mm)	Growth increment (mm)	Growth percentage
1	0+	86-141	125		
2	1+	134-219	168	168	40.19
3	2+	253-338	235	67	16.03
4	3+	251-329	301	66	15.79
5	4+	327-369	349	48	11.48
6	5+	357-417	386	37	8.85
7	6+	407-443	418	32	7.65

Table 3: Age and growth of Nile tilapia, *Oreochromis niloticus* from the Tons River at Prayagraj, Uttar Pradesh (Pooled samples).

S. N.	Age classes	Size ranges (mm)	Mean length (mm)	Growth increment (mm)	Growth percentage
1	0+	82-136	116		
2	1+	129-210	159	159	34.95
3	2+	196-273	237	78	17.14
4	3+	258-341	309	72	15.82
5	4+	335-376	357	48	10.55
6	5+	353-428	394	37	8.13
7	6+	409-452	429	35	7.69
8	7+	447-463	455	26	5.71

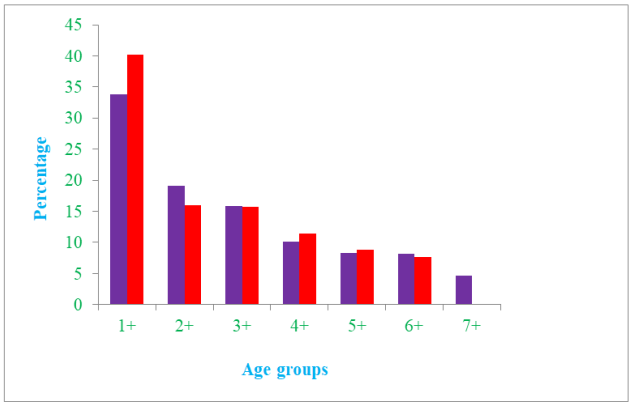

Figure 2: Growth increment % of male and female samples of *Oreochromis niloticus* from the Tons River at Prayagraj, Uttar Pradesh, India.
Note:(■) Male% (■) Female%

The study of age and growth is highly required to get a status of stock population, recruitment pattern and status of fish health (example maximum length and weight, maximum age) in the ecosystem. Age composition or longevity of *O. niloticus* varies at different regions and different ecosystems year to year [45-47]. These significant variations are due to the changes in the fishing technique, mesh size of nets and efforts, and exploitation rate and natural mortality of the fishery resources, as well as, over fishing throughout the past and present times [47-49]. Gomez-Marquez et al., observed age of *O. niloticus* from lake Nabugado ranged from 0 to 8 years in males and 0 to 7 years in females while lake Wamala ranged from 1.5 to 5 years for males and 1.5 to 6.5 years for females [46]. It was found that; *O. niloticus* from El-Bahr El-Faraouny Canal has a relatively lower longevity, as they attained 6 years old only [50]. Bwanika et al., reported higher mean length of 16.96 cm in 1+, 24.33 cm in 2+, 31.12 cm in 3+, 36.44 cm in 4+, 40.54 cm in 5+ and 43.50 cm in 6+ age group from the Yamuna River at Allahabad (now Prayagraj) [45].

Current growth of the combined *O. niloticus* (Tons River) populations was more or less similar reported by Bwanika et al., from the Yamuna River at Allahabad (now Prayagraj) [45]. El-Kasheif et al. observed slow growth increment 10.61 cm in 1+, 12.43 cm in 2+ and 13.46 cm in 2.5+ age groups compared to present findings from tropical shallow lakes in Mexico [47]. Growth of the combined *O. niloticus* (Tons River) populations was greater than from the shallow lakes in Mexico observed by [47]. Growth rate may be strongly temperature-dependant and, by inference, latitudinally dependent, although carp growth may also be depressed by increasing salinity [3,51-53]. Dwivedi AC and Nautiyal P reported only 4+ year old (ranged in size from 41.3-400.0 mm total length) *O. niloticus* in coastal Mississippi, USA [7]. The maximum age estimated for *O. niloticus* in Lake Tana, Ethiopia was 14.3 years [54]. The variation in the findings between the present study and the previous may be due to many reasons as like: water temperature, function of ecosystem, densities of fishes, localities and food supply. The growth of fishes is affected by environmental quality, changes in food availability, seasonality and breeding season [55,56]. The fishing pressures also affect the growth of fish [57-61].

CONCLUSION

In the present study, scales were used for age determination and by using the readings of its annual growth rings and it were found that the longevity of *O. niloticus* attained 7+years from the Tons River at Prayagraj, Uttar Pradesh, India. The maximum growth increment was recorded during first year of life cycle and showing a gradual decrease in growth as the fish got older. The minimum growth increment was recorded during the seven year of the life cycle. On the basis of pooled sampled specimen in the length ranges from 83 to 463 mm showed that the fish attained the mean length 159 mm in 1+, 237 mm in 2+, 309 mm in 3+, 357 mm in 4+, 394 mm in 5+, 429 mm in 6+ and 455 mm in 7+ age groups. The growth increments in *O. niloticus* was observed as 159 mm, 78 mm, 72 mm, 48 mm, 37 mm, 35 mm and 26 mm for 1+ to 7+ age groups, respectively. The slow growth increment observed after first year may be attributed to the maturity attained within first year of life. It is well known that the growth potential is used for the gonad development. The growth percentage varied from age to age in the male, female and pooled samples.

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