Growth of *Tylochromis Bangwelensis* (Hump-Back Bream, Regan, 1920) in Bangweulu Lakes and Swamps Complex Fishery, Zambia

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ABSTRACT

Growth of *Tylochromis bangwelensis* (hump-back bream) in Bangweulu Lakes and Swamps Complex Fishery was investigated. The ultimate objective was to determine growth parameters of *T. bangwelensis* in Bangweulu Lakes and Swamps in the fishery. A sampling area (S 11^{o} 19' 24.6" and E 029^{o} 34' 16.9") that represented the main landing sites was selected. The fish samples were procured from the local fisher's catches for seven months from March 2019 to September 2019. Length measurements were taken from each fish specimen using a fish measuring board to the nearest one millimeter. Weight was measured using an electronic balance to the nearest one gramme. The reproductive biology were investigated by examining fish sex and maturity stages of the gonads. Length frequency histograms were also used to determine spawning seasonality. Mean lengths representing each peak from peaks of length frequency histograms plotted for all the specimens were collected. Growth parameters L_∞ and k of the species were determined using the Ford-Walford plot. The asymptotic length, L_∞ was estimated at 348mm and growth coefficient k was found to be 0.837.

Keywords: Reproductive biology, Asymptotic length, Ford-Walford plot, T. bangwelensis, Bangweulu Lakes and Swamps Complex Fishery

INTRODUCTION

Tylochromis bangwelensis (hump-back bream, Regan, 1920) is one of the most common fish species in Bangweulu lakes and swamps complex fishery. This fish species is found in the whole Luapula River, Lake Bangweulu, the Chambeshi (upper Congo River basin) in Democratic Republic of Congo, upper Lualaba and lakes Mweru and Upemba River and its swamps [6]. It is a hump-back bream freshwater fish species that occupies the benthopelagic regions. Nsangula is the local name for this species and belongs to the family cichlidae. Studies by [6] have shown that *T. bangwelensis* (hump-back bream) is mainly a zooplankton feeder. The species' predominant food is the lake-fly in its larval aquatic stages and also feeds on plants. *T. bangwelensis* is a maternal mouth brooder that does not pair-bond and has Maximum length of 27.5cm. The female *T. bangwelensis* (hump-back bream) is a mouth-brooder and the young are favorite prey for the tiger fish. For the purpose of offering parental care, *T. bangwelensis* keeps closer inshore among *Eleocharis* sp and other vegetation. Young fish still attached to the yolk sac can be found in the mouth of a parent which is at the verge of spawning again. At high water, the fish move from the lake to their breeding grounds in adjacent swamps to spawn [5]. This study therefore is aimed at finding out if *T. bangwelensis* (hump-back bream) stocks in the Bangweulu Lakes and Swamps Complex Fishery are over or under exploited using length-based fish stock assessment methods. This study is important because it will improve

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on the understanding of the present status of the Bangweulu lakes and swamps complex fishery and will recommend measures that can be used in management and conservation of fish species in the ecosystem. The fish stocks are considered over-exploited due to high fishing pressure which has resulted to the total fish catches decreasing in the area and therefore, the fisheries management plan should not aim at increasing the catch of the stock as it is already diminishing. The estimation of growth parameters of the stock of the species is important in the evaluation of the condition factor or general well-being of the animal in the ecosystem. They also form the basis of a knowledge of the growth, mortality, recruitment and other fundamental parameters of their population [5]. The Cichlid *T. bangwelensis* (hump-back bream) of the Bangweulu Lakes and Swamps Complex fishery is being targeted in this study because it is the most abundant in the fishery and targeted species as it is considered a spot fish and an important component of a large artisanal and recreational fishery in this region [6]. It is expected that the study will help to know the growth parameters of *T. bangwelensis* (hump-back bream) in the Bangweulu Lakes and Swamps Complex Fishery. It is also envisaged that the findings of this study may be of great value to policy makers in the Ministry of Fisheries and Livestock and other stakeholders as it will enlighten them on the growth and mortality rates of *T. bangwelensis* in Bangweulu Lakes and Swamps Complex Fishery.

MATERIALS AND METHODS

2.1. Study area

This research was conducted in the Bangweulu Lakes and Swamps Complex Fishery (figure 1), which had an area up to 2,000 km^2, and was located in Luapula Province of Zambia (10 15’ -12 30’S and 29 30’-30 30’E). It lied in the hollow depression in the centre of an ancient cratonic platform [3].

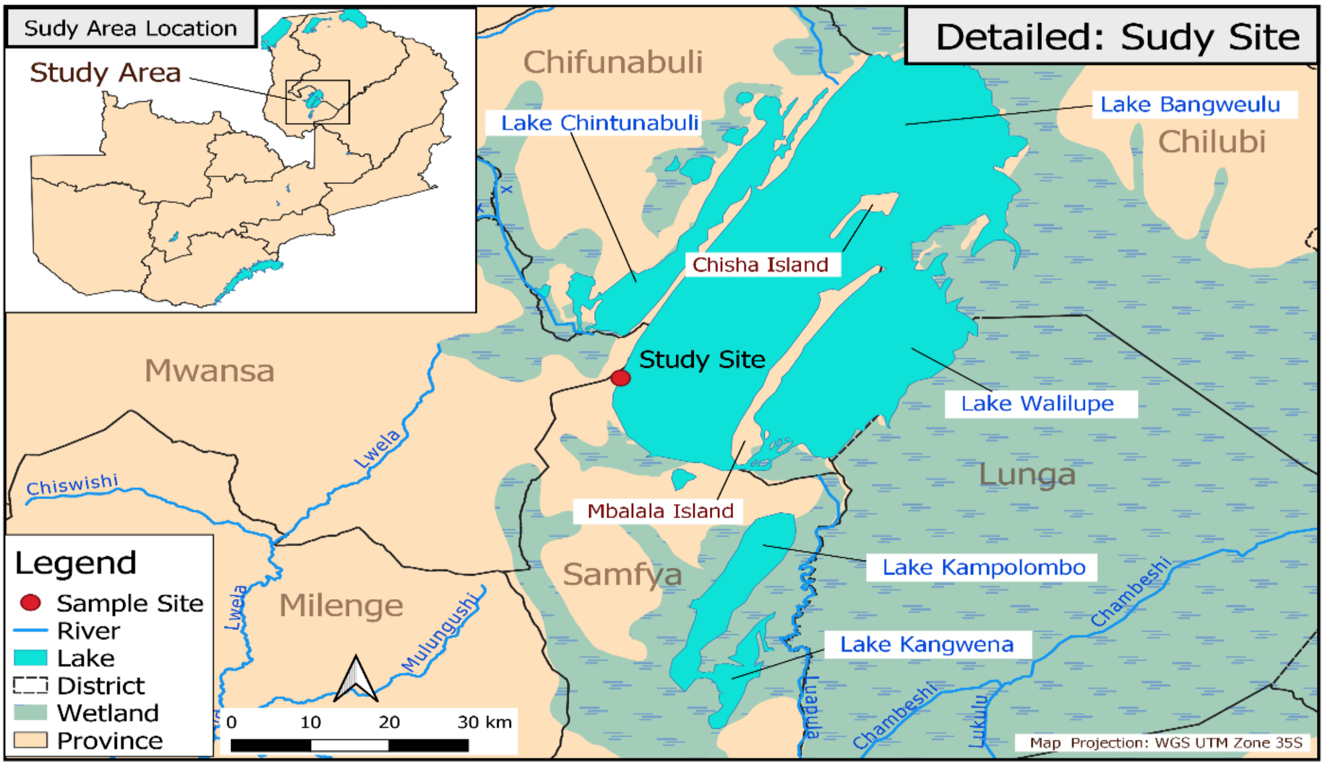

Figure 1: A map of the Bangweulu lakes and swamps complex fishery showing sampling area (Adopted from [3]).

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Sampling design

One sampling area was selected from the Bangweulu Lakes and Swamps Complex (S 11^{o} 19’ 24.6” and E 029^{o} 34’ 16.9”), where samples were collected since the stock was the same. Sampling was conducted in three consecutive days in each month from March, 2019 to September, 2019. Sampling during this period coincided with observed periods of rapid growth and reproductive activities [2]. All the specimens used in this study were procured from local fishers.

Sample size

The sample size for this study constituted 1,852 individuals of *T. bangwelensis* collected from March 2019 to September, 2019 which was picked on the basis of the researcher’s convenience and accessibility.

Data Collection

Data for this research was collected from both the field and in the laboratory. Field techniques were used to collect fish species from fisher’s catches while laboratory techniques were used to collect length (mm), weight (g) and examination of the gonads on each fish species. The variables that were collected from each fish specimen were used to estimate growth parameters of *T. bangwelensis*. The fish samples of *T. bangwelensis* were obtained from the local fishermen’s catches. The fish obtained were identified using standard keys [11] for the species being studied and verification by pictures and detailed published description. Then, the specimens were transported to Samfya District Research Station for measurements in the laboratory. Total length of each fish sample was measured to an accuracy of one millimetre (1.0 mm) using measuring board. The Total length (TL) of each fish was measured from the tip of the anterior part of the mouth to the posterior end of the caudal fin. The weight of individual *T. bangwelensis* fish species was measured to the nearest one gram (1.0 g) with an electronic balance, after removing moisture and debris from the body surface using blotting papers. Weight and length measurements were used to determine growth parameters of *T. bangwelensis*. Each *T. bangwelensis* fish species was dissected, their internal parts exposed and their gonad maturity status determined by examination of the gonads. The information collected was recorded in the fishery data field recording sheets.The gonad maturity status was identified based on the [9] classification of the fish gonad maturity stages. The gonad maturity stage data collected were converted to percentages of gonad maturity stages. Then length frequency histograms were constructed and mean lengths were collected and used to determine the growth parameters from Ford-Walford plot.

RESULTS

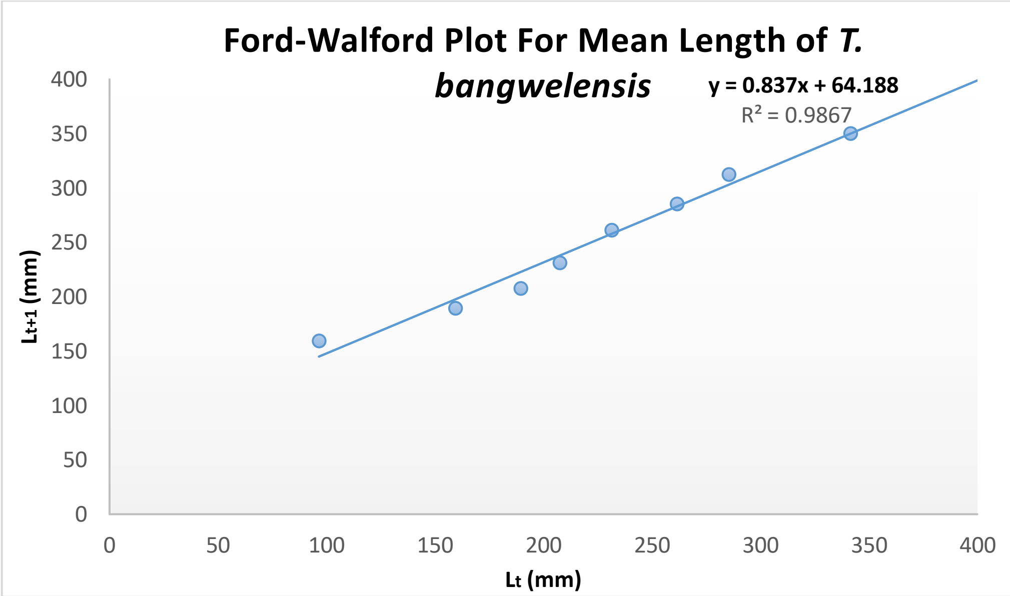
3.1 Growth parameters of *T. bangwelensis*

Table 1: Summery of L_t and L_{t+1} derived from the mean length of *T. bangwelensis* of Bangweulu Lakes and Swamps Complex Fishery.

L_t (mm)	96.5	159.5	189.5	207.5	231.5	261.5	285.5	341.5
L_{t+1} (mm)	159.5	189.5	207.5	231.5	261.5	285.5	341.5	401.5

The mean lengths were calculated from each peak or cohort of the length frequency histogram graphs that were plotted for all the specimens of *T. bangwelensis* collected from which growth parameters L_∞ and k were determined using the mean lengths on Ford- Walford plot. The asymptotic length L_∞ and the growth coefficient k of the species estimated from the mean length ML of the length classes using the Ford-Walford plot were as shown in figure 22 below.

Figure 2: Ford-Walford plot: estimation of L_∞ and k of *T. bangwelensis*



The estimates of growth parameters L_∞ and k obtained were 348mm and 0.837 respectively (see figure, 9) using Ford-Walford plot above.

Table 2: Summary of growth parameters L_∞ and k for of *T. bangwelensis* of Bangweulu Lakes and Swamps Complex Fishery.

Parameter	Mean value of the Ford-Walford Values.
k	0.837
L_∞	348mm

FWP= Ford- Walford plot, L_∞ = asymptotic length (mm) and k = growth coefficient

CONCLUSION

4.1 Growth parameters of *T. bangwelensis*

The growth coefficient (k) and the asymptotic length L_∞ of the species were taken into consideration from the parameters estimated from the Ford-Walford plot. It was noted that the asymptotic coefficient L_∞ of *T. bangwelensis* was estimated at 348mm and the growth coefficient k at 0.837. This high asymptotic length obtained in the present study implies that *T. bangwelensis* in the Bangweulu Lakes and Swamps Complex Fishery has a lot of food that promote attainment of high growth in terms of length. This could be attributed to climatic conditions such as temperature that can affect the rate of growth of fish in any water body. In agreement with this, [7] elucidated that wet season flooding in the Bangweulu Swamps stimulates greater primary and secondary production thereby promoting growth among fish in this fishery. The fast growth of aquatic flora in the Bangweulu Swamps in the rainy season creates good habitats for fish in the Bangweulu Lakes and Swamps Complex fishery. Reference [7] further added that, increase in rainfall during the rainy season promotes the growth of algae, phytoplankton, zooplanktons and diatoms that provide food resources to the fish of the Bangweulu Lakes and Swamps Complex fishery. The results of this study on the growth parameters of *T. bangwelensis* relative to other cichlids are inconsistent with international studies in major African lakes of East and West Africa such as [1] who obtained asymptotic length L_∞ of 278.3mm in a cichlid *Tilapia zilli*. This indicates that asymptotic length L_∞ and growth coefficient k are different for different species of fish and water systems. In other literature, [4] in their study found that the asymptotic length L_∞ was 415mm in *O. niloticus* which was larger than that noted in the current study for *T. angwelensis*. The growth coefficient and asymptotic length of cichlid *T. bangwelensis* that were found in this research were slightly lower than those that were revealed by [10], owing to the different species of fish in which the study was concentrated. The results of [10] obtained asymptotic length L_∞350mm, 400mm and 480mm in *Oreochromis andersonii*, *Oreochromis macrochir* and *Oreochromis niloticus* respectively. Further, [12] in their study revealed that the asymptotic length L_∞ was 345.2mm in *T. zilli* and 438.2mm in *O. niloticus*. The values of the maximum length for *O. niloticus* were noted in other literature as 500mm by and 390mm in natural waters [8].

ACKNOWLEDGEMENTS

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COPYRIGHT DECLARATION

I, Kabundula Kahilu, hereby declare that this Journal article represents my own work and that it has not previously been submitted for publication to this or another Journal.

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APPENDICES

Appendix A.

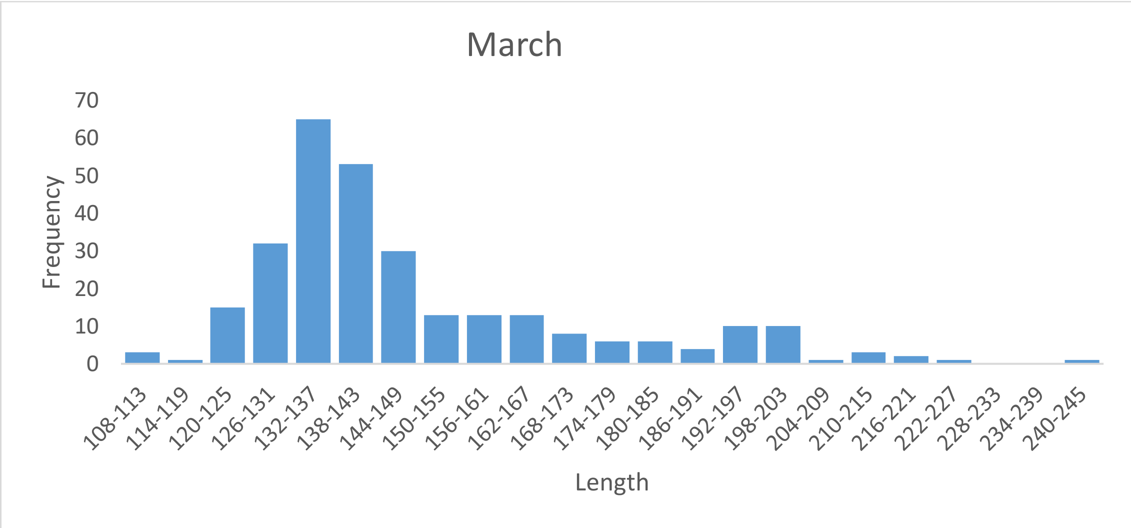

Figure 8: Length frequency histogram showing breeding seasonality of *T. bangwelensis* in March.

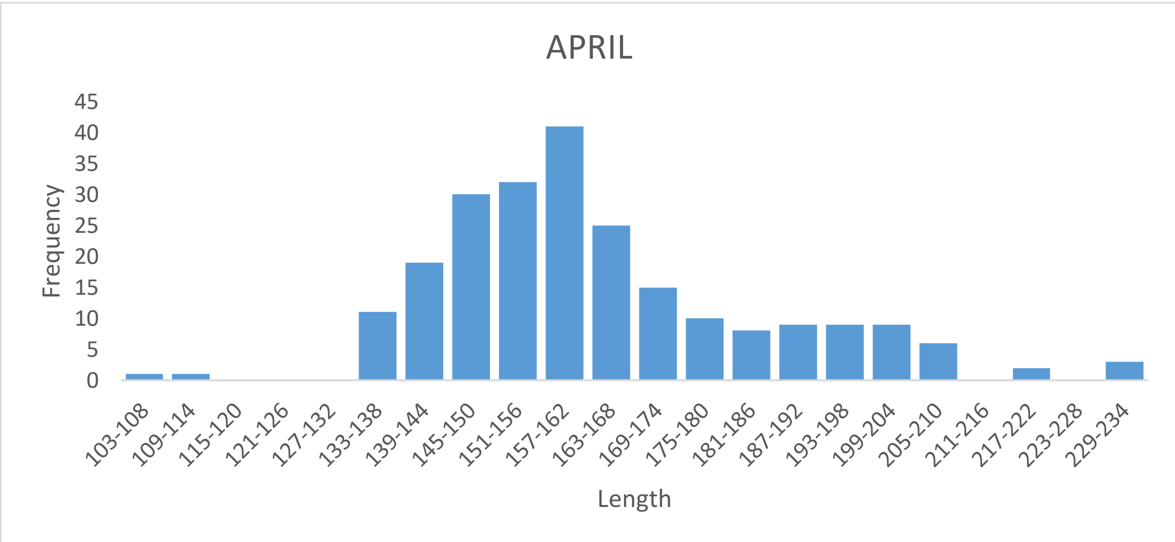

Figure 9: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in April.

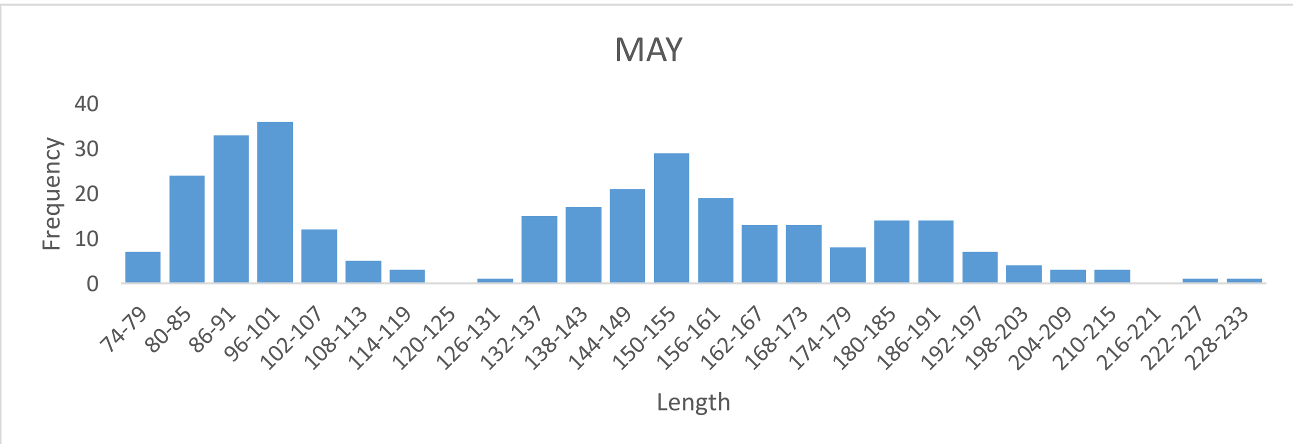

Figure 10: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in May.

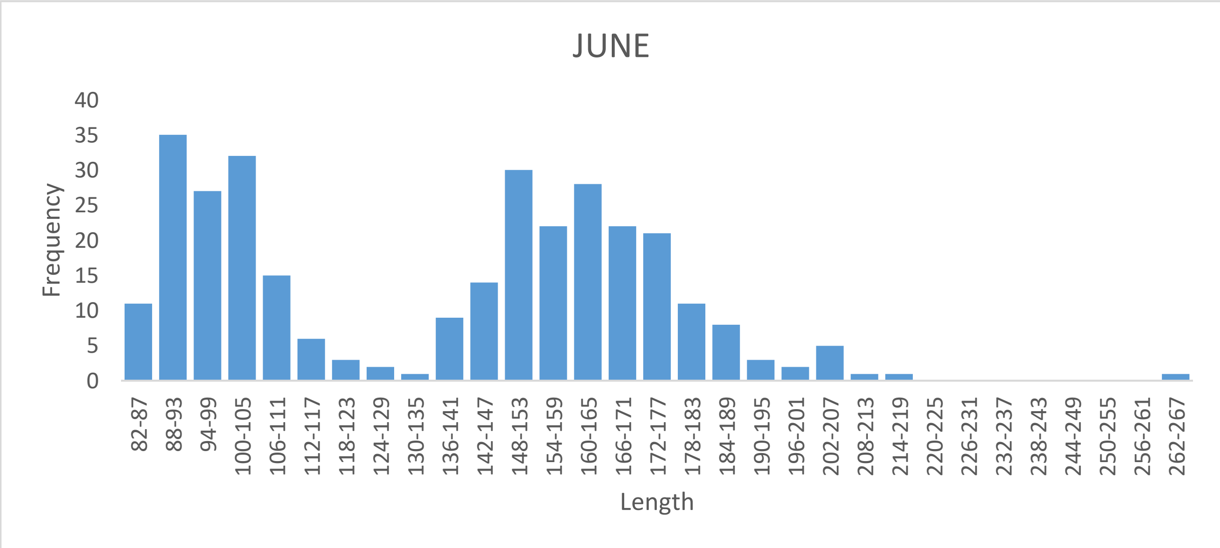

Figure 11: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in June.

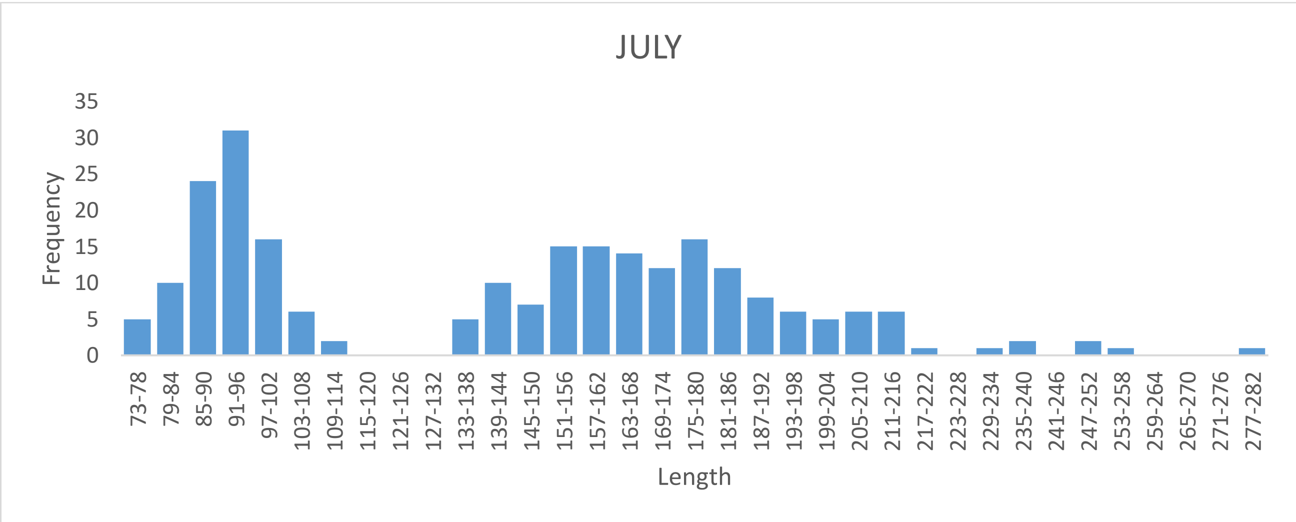

Figure 12: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in July.

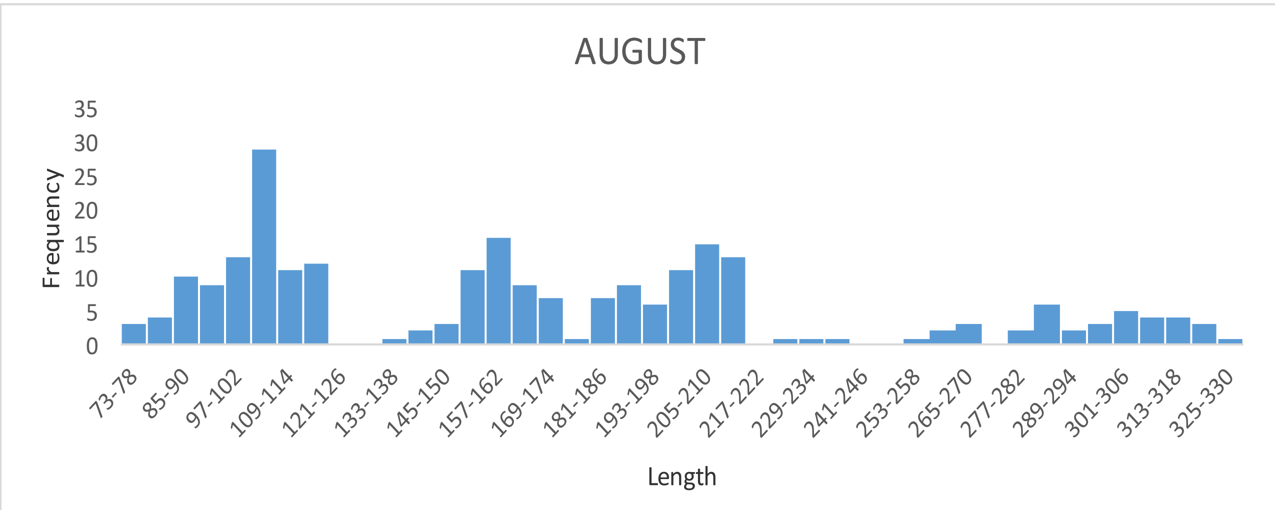

Figure 13: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in August.

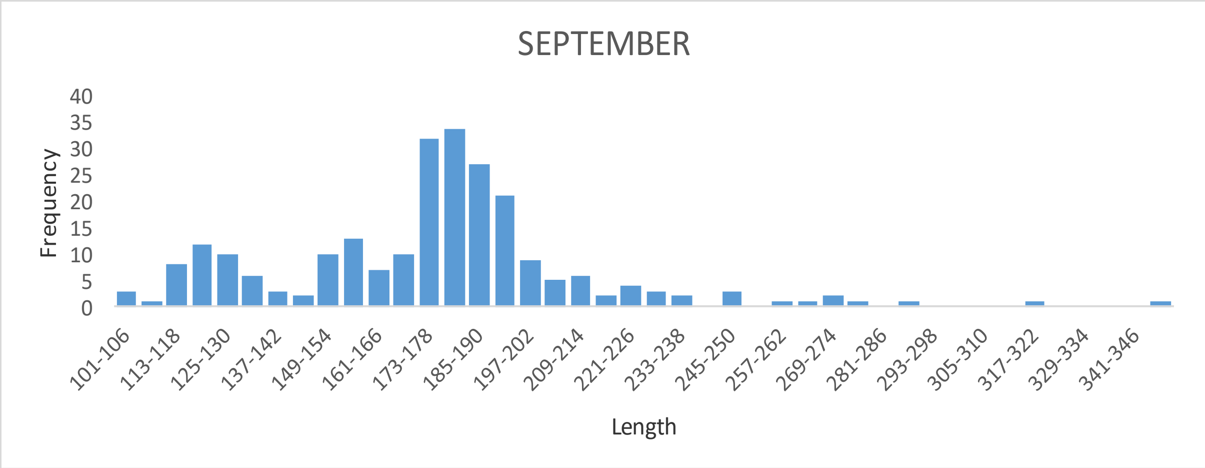

Figure 14: Length frequency histograms showing breeding seasonality of *T. bangwelensis* in September

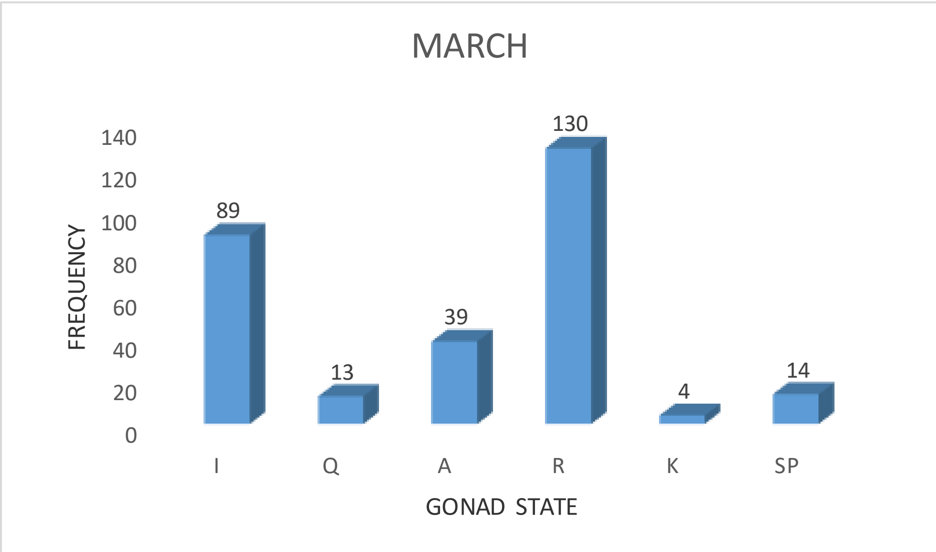

Figure 15: Frequency of gonad maturity status of *T. bangwelensis* in March

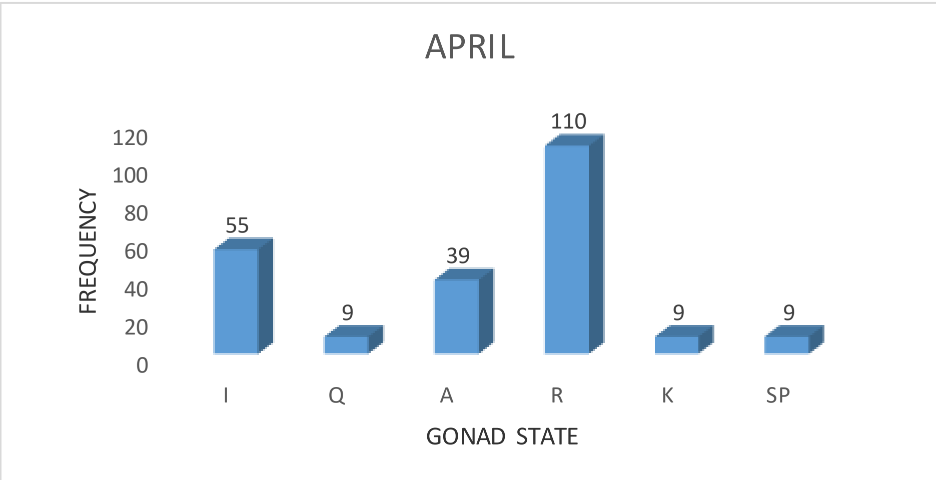

Figure 16: Frequency of gonad maturity status of *T. bangwelensis* in April

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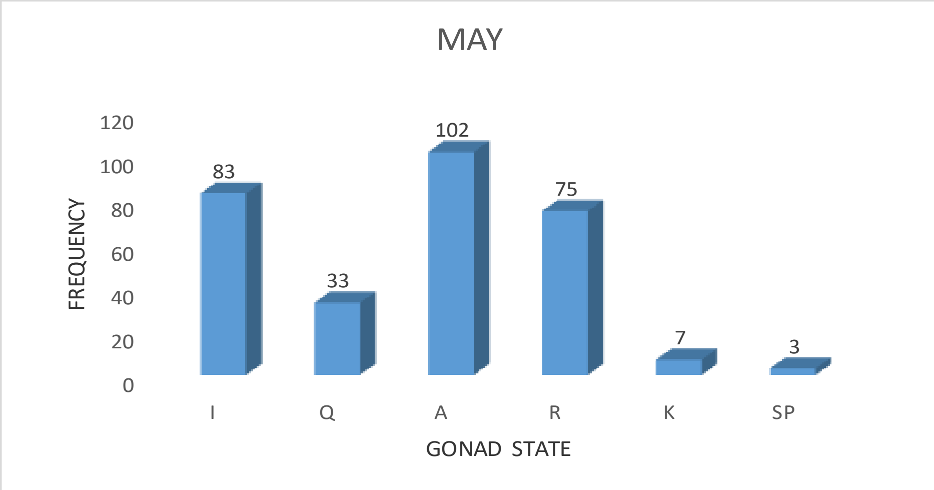

Figure 17: Frequency of gonad maturity status of *T. bangwelensis* in May.

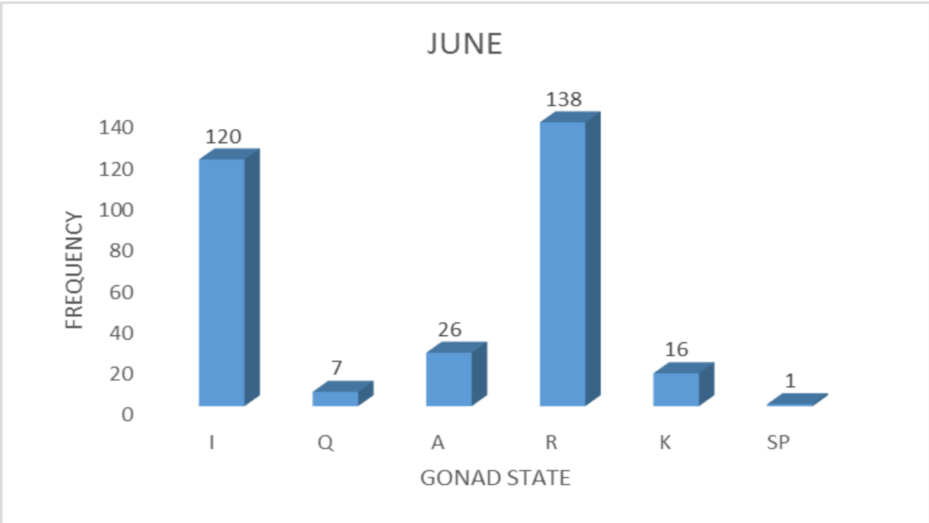

Figure 18: Frequency of gonad maturity status of *T. bangwelensis* in June

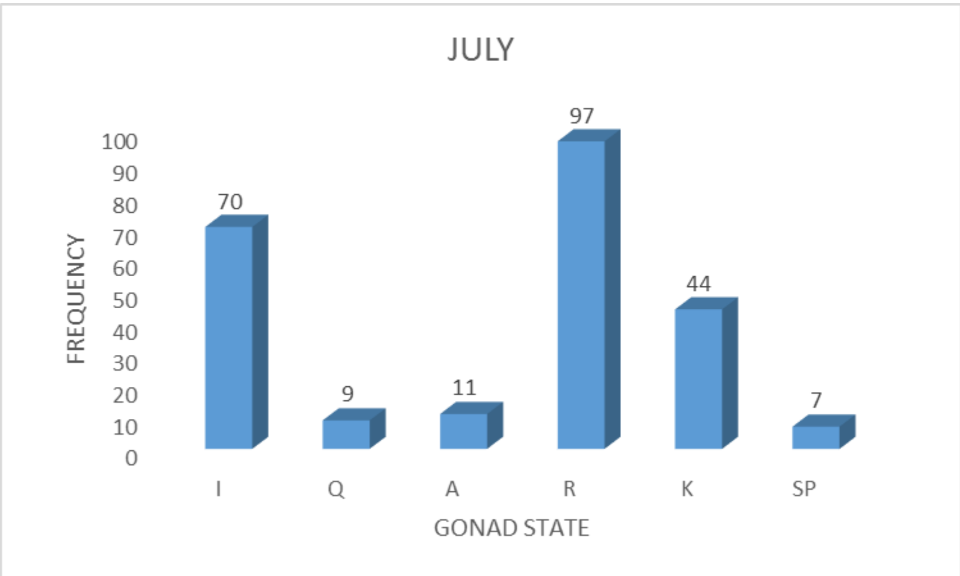

Figure 19: Frequency of gonad maturity states of *T. bangwelensis* in July

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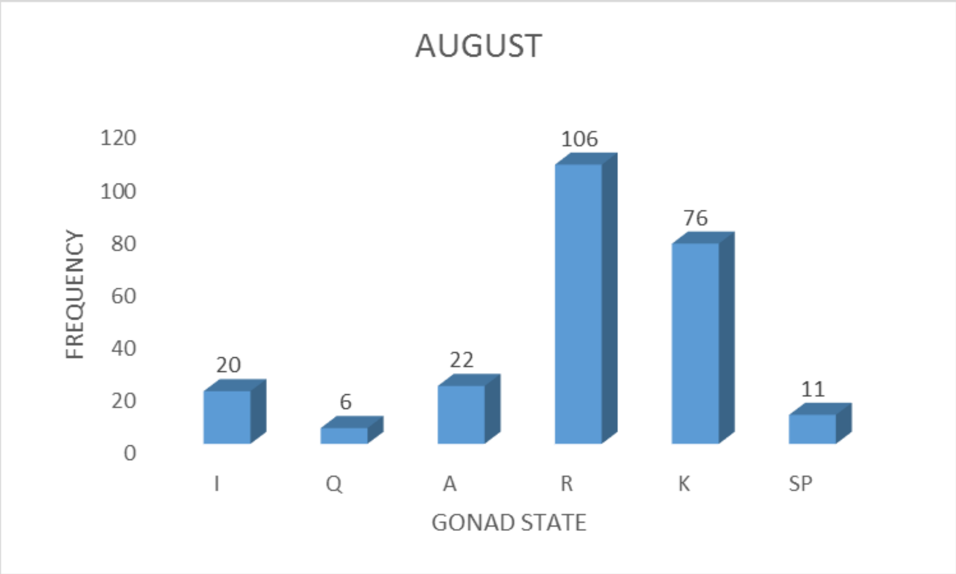

Figure 20: Frequency of gonad maturity status of *T. bangwelensis* in August

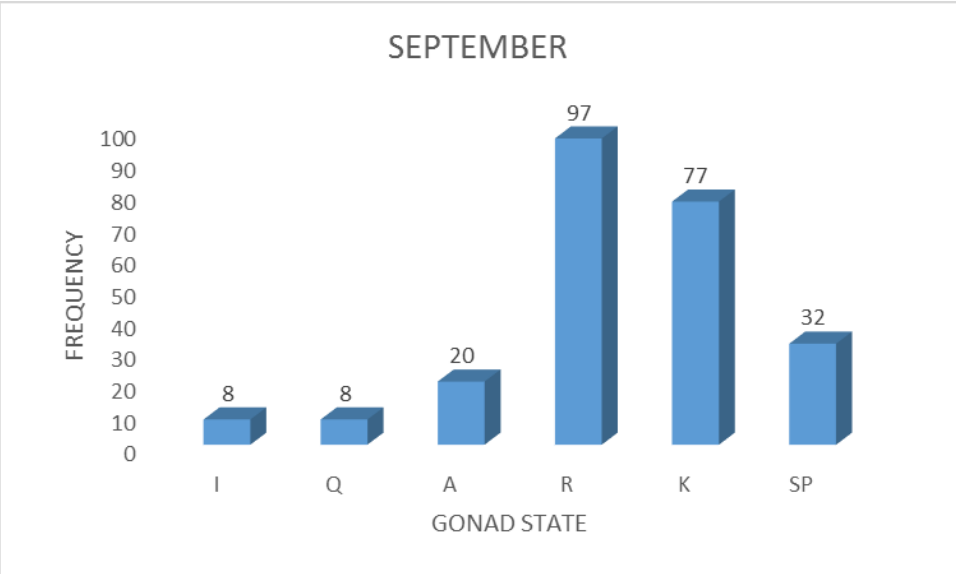

Figure 21: Frequency of gonad maturity status of *T. bangwelensis* in September.