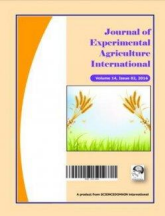

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Study on the Evaluation of a High Speed Tagging Device for Nile Tilapia Stock Assessment in the Vunania Dam in Kassena-Nankana District, Upper East Region

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Authors' contributions

Both authors designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The study on the evaluation of a high speed tagging device for *Oreochromis niloticus* (Nile tilapia) stock assessment was conducted in the Vunania dam in the Kasena-Nankana District of the Upper East Region of Ghana for two months(April- May 2014). A total of 49 Nile tilapia fishes were obtained during the period of study. Out of this number 28 were males and 21 were females representing 57.1% and 42.9% respectively. In the research the females *Oreochromis niloticus* had a range of 11 cm to 20 cm total length with a standard deviation of 2.0998 and a weight range of 25 g to 140 g with a standard deviation of 28.7697. Males had a range of 11.30 cm to 16.8 cm with a standard deviation 1.4409 and a total weight range of 27 g to 110 g with a standard deviation of 18.4637. In totality the sampled *Oreochromis niloticus* had a minimum weight of 25 g and maximum of 140 g and a mean of 82.5, minimum length of 11 cm and a maximum of 20 cm and a mean of 15.5. MS222 at a dose of 0.3 g/l [23] was used for the sedation with a minimum sedation time of 12 sec and maximum time of 238 sec and a mean of 125, minimum recovery time of 27 sec and a maximum of 311 sec and a mean of 169, a minimum tagging time of 4sec and a maximum of 122 sec and mean of 63.

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Keywords: High speed tagging device, Nile tilapia, stock assessment

1. INTRODUCTION

Tilapia has served as food for a long time [1]. Their cultivation though comparatively recent [2] is being carried out in many countries of the world [3, 4, 5]. In Ghana no serious attention has been paid to the cultivation of Tilapia though a number of species occur in the inland waters [6,7].

Tilapia in general reproduces with great rapidity [8] which makes the fish suitable for commercial production. To meet the increasing demand for fish food, aquaculture production should increase by 50 million metric tons by 2050 [9].

Aquaculture is currently the fastest growing segment of food production in the world. In 2002 it contributed approximately 30% by weight of fish and shellfish consumed worldwide. A greater proportion of global fish supply comes from captured fisheries but with several fisheries now on the verge of collapse, global fish supply may not be able to keep up with the demand and rising prices may drive fish out of the reach of the poor particularly in developing countries including Ghana. One way to achieve this is to restock overfished water bodies with hatchery bred fingerlings.

The basic idea behind stock assessment is to determine growth and mortality rates of fish which can provide the basis for long-term potential yield prediction under steady-state assumptions with regard to the biological processes. All stock assessment models are based on rates and the measure of the rates is time, which is why the age of the fish caught is needed. Direct extraction of age information from fish in tropical environment is difficult, so stock assessment models for tropical fisheries especially those in developing countries are usually implemented in terms of length in which case growth or the relation between length (size) and time (age) is needed. While length is not a desirable variable from a mathematical or statistical modeling perspective due to its non-linear relationship with time, it is an attractive measurement from sampling point of view because it is easily taken in the field. Although requiring a substantial amount of data [10, 11] a length based stock assessment is therefore a convenient method to study fish stocks within a narrow temporal scale assuming a constant parameter system to make the approach valid [12].

Tags are used to help fisheries managers to study fish populations. The application of tagging as a stock assessment tool is unknown in Ghana. In developed countries however this is a common practice. Tagging enables fisheries managers to determine growth rates, migration or dispersion and reproduction of target fish populations [13].

Tags serve as markers. A mark is any factor that makes a fish identifiable either as an individual or as a member of a batch. Markers can be artificial eg. mutilation of fins or addition of tags. The objectives of marking fish are to enable their numbers to be established indirectly or to follow the fate of the labeled fish. The main uses are for the studies on population parameters such as mortality rate, rates of exploitation, rates of recruitment, movement and migration, growth and age determination as well as behavior work and other studies where the recognition of individuals is involved. The ideal marker of individually tagged fish should make it permanently and unmistakably recognizable to anyone examining it. It should be inexpensive, easy way to apply in the field conditions and have no effect on the fish growth, mortality, behavior, liability to capture by predators or fishing gear.

The great advantage of tags over the other forms of identification is that they are serially numbered thus enabling individual fish to be identified. A wide variety of tags have been used by fishery workers. [14,15] have carried out extensive research into tags. There are various types including internal tags made of metals or plastics plates [16], external tags [17], external tags with an internal anchor [18] and many more.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in a dam at Vunania a few kilometers from Navrongo campus of the University for Development Studies (UDS). The reservoir has a maximum surface area of approximately 3.28ha at the peak of the rainy season. It dries to about half of its maximum size in the dry season. The dam has a pH of 7.48.

2.2 Data Collection Techniques

Simple random sampling was used to take *Oreochromis niloticus* for the study which was conducted within a period of two months (April to May because that is the dam's peak within the raining season). Cast net and Seine net and

dragging net were used to catch the fish in the water.

2.3 Identification of Species

Oreochromis niloticus was identified by following the identification guide of [19] and [20].

2.4 Sexing

Oreochromis niloticus were sorted into males and females by observing the shape and opening of the genital papilla and the coloration of the caudal fin. Matured males possess pink to red caudal fins and the females had light to dark grey caudal fins.

2.5 Body Measurement

The sampled *Oreochromis niloticus* were measured on a measuring board to determine their total length. The total length was measured from the tip of the snout to the end of the caudal fin. Each fish was weighed separately to determine its total weight (g/) using a spring balance.

2.6 Sedation and Tagging

Oreochromis niloticus sample were sedated using tricaine methane sulfonate (MS-222) at the dose of 0.3 g/l. The time taken for the fish to be sedated was noted using a stop watch. The fish was then tagged using an external tag with an internal anchor by means of a magazine loading applicator. The tag was shot (implanted) into the dorsal muscle. The number of tags was recorded and the recovery time was also noted. The tag fish were released into a hapa installed in the middle of the pond and was held there until the end of the tagging operation for the day.

The reservoir was divided into zones (A to E) and the tagged fish were released from the hapa into zone E which was in the middle.

2.7 Statistical Analysis

The data analysis was done using SPSS statistical tool [21] and the method used was both graphical and non-graphical exploratory data analysis in the form of summary table, histogram and scatter plots.

3. RESULTS

A total of 49 Nile tilapia (*O niloticus*) specimens were obtained for tagging during the study. Out of this number 28 were males and 21 females representing 57.1% and 42.9% respectively (Fig. 1). This represent sex ratio of 1:1.3 (F:M), which does not deviate from the expected sex ratio in the dam (1:1). The weight of the fish ranged from 25-140 g (average of 68 g), length ranged from 11-20 cm (average of 15 cm). The sedation time ranged from 12-238 sec (average 41.8 sec). Tagging time ranged from 4-144 sec (average of 26.3 sec) and recovery time ranged from 27-311 sec (average of 151.6 sec). The average time for tagging was 26.3 sec.

The relationship between tagging time against weight (Fig. 2 -correlation of –0.009), tagging time against length (Fig. 3- correlation of –0.009), sedation time against weight (Fig. 4- correlation of –114), sedation time against length (Fig. 5- correlation of 0.060), recovery time against weight (Fig. 6 - correlation of 0.186) and recovery time against length (Fig. 7 correlation of 0.159) are all scatted diagrams with no specific patterns.

3.1 Post Tagging Mortalities

A total number of six fish died (four males and two females) with the following tag numbers 24852, 24858, 24851, 23781, 24898, and 24893. The length range of males that died was 15.1-15.9; weight range of 53-75 and of females was length of 15.5-16.9, weight of 75-80. The cause of death was due to the high temperature in the hapa.

4. DISCUSSION

In this study, a magazine-loaded applicator was used to implant floy tags into *Oreochromis niloticus* obtained from the Vunania dam near the UDS campus in Navrongo. The study was done to evaluate the speed of this tagging technique, which was intended for monitoring fish populations in the Vunania dam to enhance the local fish industry. A total of 49 Nile tilapia specimens were tagged. Out of this number 28 were males and 21 were females. The tag which was made from 0.25 to 2.5 mm diameter plastic tubing with a printed message was shot into the muscle under the dorsal fin.

Bonneau et al. [22] using a similar applicator (a hand-held multishot injector) tagged fish at 400 per hour. In the present study, the tagging speed was estimated at 26.28 sec per fish which included time to determine the length, weight and time of sedation and recovery of fish. Therefore it will take one person 8 working hours to tag 1,095 fishes.

Table 1. Summary of results of tagging operations in the field

Parameters	Number	Range fish size	Minimum	Maximum	Average	Standard deviatin
Weight of fish(g)	49	25-140	25.00	140.00	82.5	23.2207
M	28	27-110	27.00	110.00	68.5	18.4637
F	21	25-140	25.00	140.00	82.5	28.7697
Total length of fish in cm	49	11-20	11.00	20.00	15.5	1.74739
M	28	11.3-16.8	11.3	16.8	14.04	1.4409
F	21	11-20	11	20	15.5	2.0998
Sedation time(sec)	49	12-238	12.00	238	125	35.0080
M	28	12-98	12	98	55	22.0426
F	21	24-238	24	238	131	47.4387
Tagging time(sec)	49	4-122	4	122	63	23.23880
M	28	7-82	7	82	44.5	20.2710
F	21	4-122	4	122	63	26.8172
Recovery time(sec)	49	27-311	27.00	311.00	169	64.59451
M	28	69-303	69.00	303.00	186	60.2430
F	21	27-311	27	311	169	71.4735
Post tagging death	6	13.90-16.90	13.90	16.90	15.4	1.8768
M	4	13.90-15.90	13.90	15.90	14.9	0.8869
F	2	15.5.-16.90	15.50	16.90	16.2	0.9899

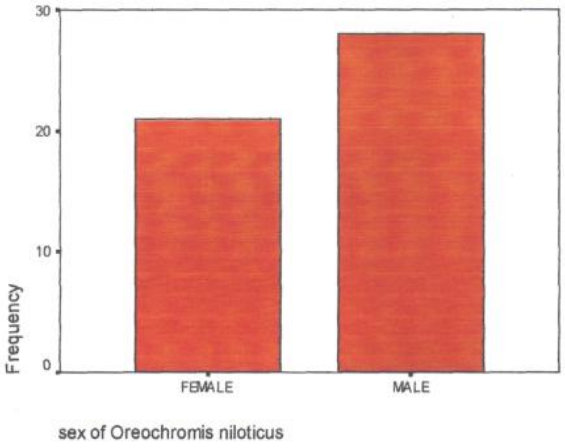

Fig. 1. Sex of *Oreochromis niloticus* sampled from Vunania dam for tagging

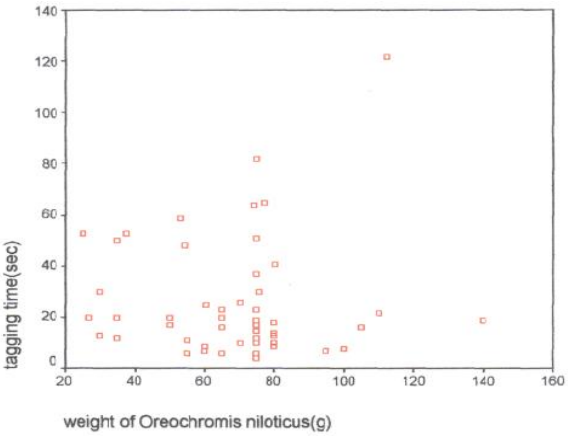

Fig. 2. Relationship between weight of fish in grams and the tagging time in sec

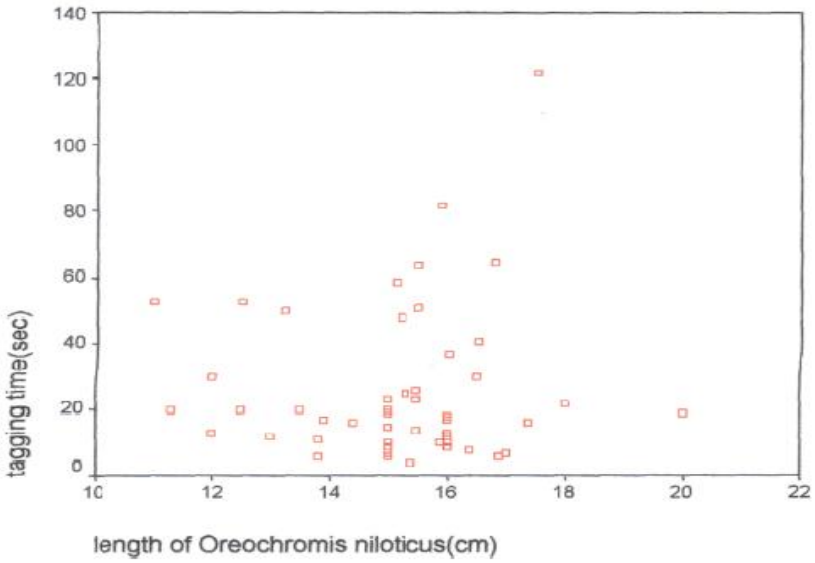

Fig. 3. Relationship between length of fish and tagging time

The female Nile tilapia ranged from 11 cm to 20 cm in total length and the males were 11.30-18 cm. The dorsal muscle provided a firm convenient site to lodge the anchor part of the tag. However, tags may be attached to various parts on the body of the fish, depending on the type of tag and fish species [23,24].

To facilitate handling and minimizing stress, the fish were tranquilized in tricaine methane sulfonate (MS-222), which is a common anesthetic for fish, at a dose of 0.3 g/l. Sedation time ranged from 12-238 sec with a mean of 125 sec while recovery from sedation took 27-311 sec with a mean of 169 sec to complete. In effect the tagging speed during the operation was equivalent to approximately 140 fish per hour. The lower rate of tagging in this study compared to the speed of was apparently due to the time taken to measure length and weight of fish.

In this study tagged fish were not released directly into the dam but were held in a 1 m² mosquito net hapa suspended in water until the tagging operation was completed. The tagging was done on a hot day. Six out of the forty-nine tagged fish died in hapa (size of 120 m2).

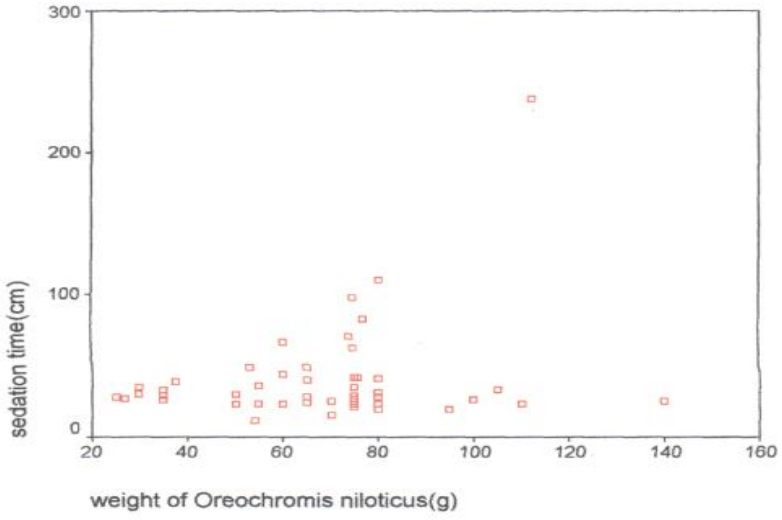

Fig. 4. Relationship between sedation time in seconds and weight of fish in grams

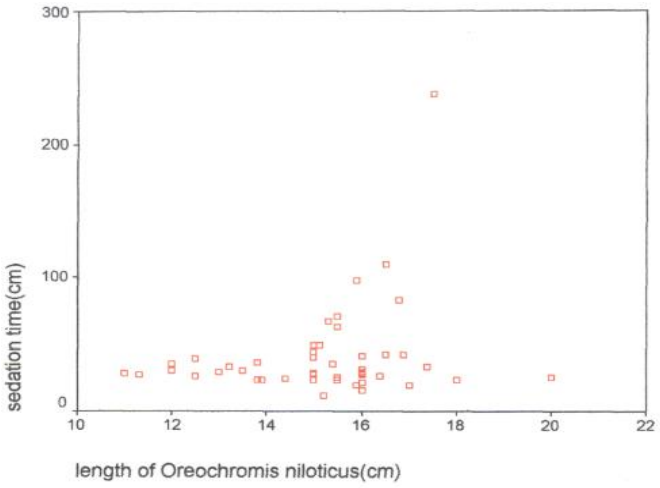

Fig. 5. Relationship between sedation time and length of fish in cm

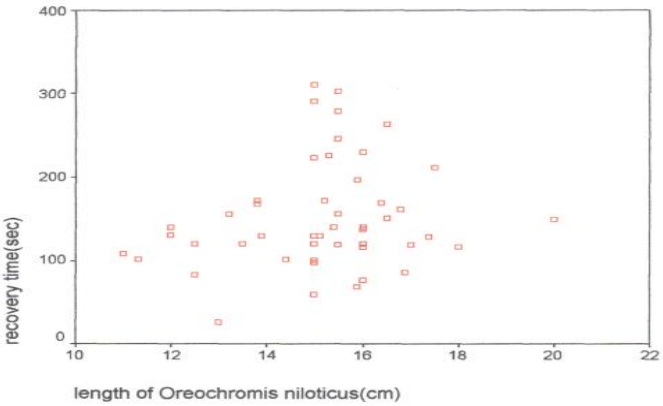

Fig. 6. Relationship between recovery time and length of fish in cm

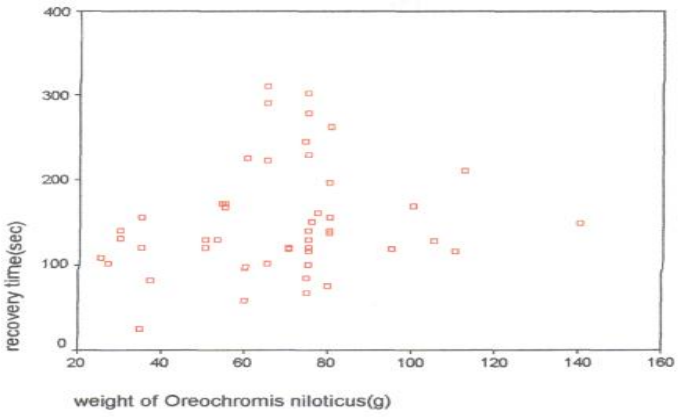

Fig. 7. Relationship between recovery time and weight of fish

High temperature and crowding was suspected to be the cause of the death. Post tagging mortality is common phenomenon. The small number of fish tagged (49) in this study was limited by the number of tags available. Floy tags are expensive and very scarce in the country.

5. CONCLUSION AND RECOMMENDATION

The research revealed that tagging when done right has no negative effect on the fish. The result indicates that there is no correlation between tagging time and the length or weight of fish. Normally such work should be done in the morning or late in the evening to avoid mortality due to high temperature in the day time.

This study should be followed immediately to assess;

1. The growth rate of tagged fish
2. Migration/dispersion of tagged fish from point of release
3. Rate of recapture of tagged fish
4. Rate of sexual maturation of tagged fish

The follow-up study should involve local fishermen who have been briefed already about the significance of the tagging operation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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