Received: 13 November 2017 | Revised: 7 February 2019 | Accepted: 22 March 2019
DOI: 10.1111/lre.12271

ORIGINAL ARTICLE

Lakes & Reservoirs — Science, Policy and Management for Sustainable Use — WILEY

Some aspects of reproduction and feeding habits of Nile tilapia (*Oreochromis niloticus*) in three dams in Uasin Gishu County, Kenya

Nicholas N. Gichuru[1,2] | **Julius O. Manyala**[2] | **Philip O. Raburu**[2]

[1]Kenya Marine and Fisheries Research Institute, Kisumu, Kenya
[2]Department of Fisheries and Aquatic Sciences, University of Eldoret, Eldoret, Kenya

Correspondence
Nicholas N. Gichuru, Kenya Marine and Fisheries Research Institute, Pipeline area, near Kisumu International Airport, Kisumu, Kenya.
Email: nkunjag@yahoo.com

Abstract
Knowledge of the fisheries status of dams within Uasin Gishu County was needed prior to the government's plan to introduce fish and fisheries in the area. The dams were constructed in the 1950s and stocked with tilapia for local consumption, recreation and control of macrophytes. The Nile tilapia (*Oreochromis niloticus*) was selected for the present study due to its establishment success and popularity in the Kenyan market. Water samples were collected at subsurface levels for phytoplankton analysis and compared with the phytoplankton found in the stomachs of *O. niloticus*, revealing the food preference of the fish in a natural environment. Fish samples were collected with gillnets and beach seines. The results of the present study identified the most important food items for the fish were Chlorophyceae (green algae), Bacillariophyceae (diatoms) and Cyanophyceae (blue-green algae). The fish exhibited a relative condition factor of about 1.00, indicating their robustness or well-being in the dams. The LM_{50} was reached at 18–20 cm class interval, which coincides with the most critical breeding biomass needing some kind of protection for sustainable management of the fishery.

KEYWORDS
feeding habits, *Oreochromis niloticus*, reproduction, Uasin Gishu dams

1 | INTRODUCTION

The majority of riverine, dams and small lake fisheries are small scale in magnitude. A significant part of production is not commercialized, or else is marketed through informal channels, thereby not being reflected in national economic statistics. As a result, these fisheries are regarded as low-value economic activities (Allan et al., 2005). Nevertheless, FAO (2010) has underscored the importance of inland fisheries in regard to the livelihoods of people in both developed and developing countries, even though irresponsible fishing practices, habitat loss and degradation, water abstraction, drainage of wetlands, dam construction and pollution often act synergistically, compounding the individual effects. Riverine fishing is particularly important to poor households because it provides food not dependent on the rainfall pattern (LaFranchi, 1996). To this end, fish production statistics of reservoirs in Kenya is lacking or inadequate. The fish currently found in reservoirs either has accidentally escaped from culture conditions or was stocked in an effort to increase fish supply (FAO, 1998).

Stocking of fish in Uasin Gishu County was done during the colonial era (1950s). Most of the dams were stocked with tilapiine species (mainly *Oreochromis niloticus* (Linnaeus 1757) and *Coptodon zilli*) by the “White settlers”. There are no records indicating when this was done (Machuka, E. pers. comm.). Tilapia is a hardy fish species, being resistant to low dissolved oxygen concentrations in natural bodies and ponds (Balarin & Hatton, 1979; Witte et al., 1992). The fish also can withstand high carbon dioxide levels (Fish, 1956). Other gases tolerated by these fish include ammonia, methane and hydrogen sulphide produced by decaying organic matter. The fish is widely distributed from the near East (Israel, Palestine) to rivers and lakes in most parts of Africa. It has been introduced to other parts of the world because of its wide adaptability in tropical and subtropical regions, including Asia, the Caribbean and the Americas, through aquaculture development (FAO, 2006; Khallaf & Alne-na-ei, 1987; Popma & Lovshin, 1996). Cichlids/tilapiines are "small brood" spawners that produce batches of eggs at frequent intervals. They generally occupy a "territory" and often make nests where they spawn and guard their eggs (Lowe-McConnell, 1987).

Oreochromis niloticus was essentially stocked in Uasin Gishu for sport fishing and local consumption, while *C. zilli* was stocked to control aquatic weeds in the dams (Machuka, E. per comm.). The Kenyan government identified promotion of fish production as a key to economic development, fondly referred to as the "blue economy". Nevertheless, information on fish and fisheries in Uasin Gishu County is scanty or entirely lacking. Accordingly, the present study was conducted to generate information for preparing sound fisheries production and management plans for long-term exploitation. It is the intention that the results of the present study will also be useful in aquaculture development.

1.1 | Study area

Uasin Gishu County lies across the equator in one of Lake Victoria's North catchment areas at an altitude of 1,250–1,850 m above sea level. The rivers draining into it are tributaries of the Yala River, which drains into Lake Victoria via the Yala Swamp. The area receives an annual rainfall of 900 to 1,100 mm, and the general climate of the area is characterized by two seasons, including a wet season (April–September) and dry season (October–February; Onyango, 1999).

2 | MATERIALS AND METHODS

Three (3) dams were selected for the present study on the basis of their size (i.e. large [>100 acres in size]; medium [between 20 and 100 acres]; small [<20 acres]) and anthropogenic activities (level of human disturbance). Other secondary factors were the ownership status. Kesses Dam and Kerita Dam are communally owned, while Chebigut Dam is a privately owned waterbody (Figure 1). Kesses Dam covers an area of about 500 acres, being located around 0°17′0.263″ North, and 35°19′0.852″ East, at an altitude of about 2,192 m (GPS readings, etrex Garmin model). Kerita Dam is a

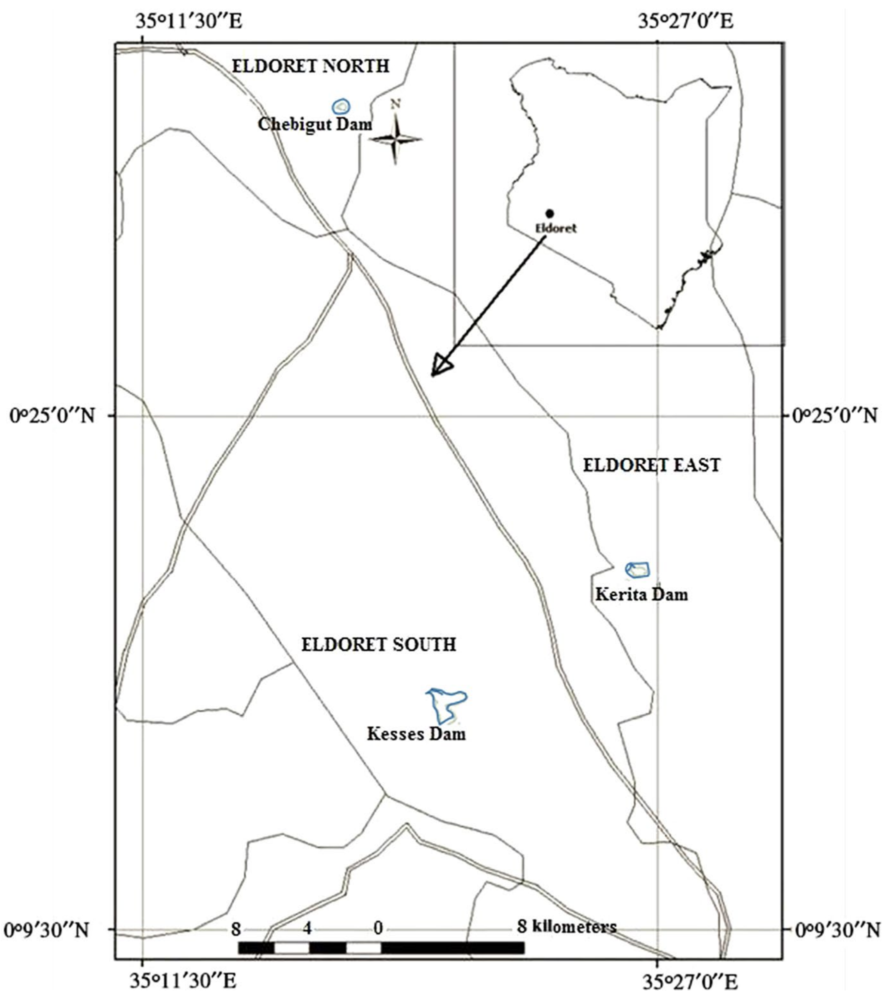

FIGURE 1 Location of the three study dams in Uasin Gichu County, Kenya

medium-sized dam covering an area of about 35 acres and located around 0°19′0.294″ North and 35°24′0.329″ East, at an altitude of about 2,240 m. Chebigut Dam is a small reservoir, covering an area of about 10 acres. It is located around 0°33′0.984″ North and 35°22′0.394″ East, at an altitude of about 2,185 m. The distance from Kesses Dam to Kerita Dam is about 20 km by road, while Chebigut Dam is about 42 km from Kerita Dam by road (Figure 1).

Sampling was done monthly from December 2011 to April 2012 except for January 2012 because of logistic problems. As sampling was done in the dry season when the dam's environmental conditions were relatively stable, the failure to sample in January did not significantly affect the results within and between the months. The dams were divided into three distinct sampling areas, including the inlet, mid-water and outlet sectors of the dams. One-litre plastic bottles were used to collect water at the subsurface water column in duplicates. Samples were collected in the littoral and open water regions of the dams. The samples were immediately preserved in Lugol's iodine solution and left to settle for 48 hr to allow particulate matter to settle. The lower water layer (40–100 ml) containing the settled algae was decanted into glass vials and stored in a cool, dark room for subsequent analysis. The known volume of the concentrated sample was used to identify and count the phytoplankton, using a compound microscope (model ULTRA SWIFT LITE-M3200). The phytoplankton in the water column was compared to the phytoplankton in the fish stomachs, with the data used to determine the fish food preferences. The fish were caught using gillnets ranging from 2 to 4 inch stretched mesh size. The fish sampling method borrowed heavily from the sampling methods recommended by Sparre and Venema (1992), with nets being set during the day in duplicates at the inlet, mid-water and outlet regions and left for two to three hours before removal. The term “day” in the present study means any time from 08:00 to 16:00 hours, when the tilapia was expected to be actively feeding. As Kesses and Kerita dams are close to one another, they were sampled on the same days. The time for setting nets in Kesses Dam was at 08:00 to 11:00 hours, and the nets were set from 13:00 to 16:00 hours on the same day. Chebigut Dam was sampled the following day from 08:00 to 11:00 hours. The fish catch from each gear was sorted separately, and each individual's total length determined with a 1 m fish measuring board to the nearest cm. A beach seine net of 1 inch stretched mesh size, 100 m in length, was used to collect data for diet analysis, improving the size range of fish caught in the dams. A beach seine net reduces regurgitation and catches a wider range of fish. The specimen weights were determined with a 5 kg digital weighing scale (Vibra Model no. 000321) to the nearest gram. The fish were then gutted, sexed and the maturity stages of the gonads noted using the Witte and Densen (1995) classification. The stomachs were carefully removed with a dissecting kit and immediately preserved in 40% alcohol (ethanol) for later laboratory analysis. The stomachs were subsequently opened in the laboratory, and the gut contents put into a Petri dish. Distilled water was added to the contents at a ratio of 1:10, being thoroughly stirred until an evenly distributed mixture was attained. One millilitre of the mixture was examined under a compound microscope. A counter (Sedgewick-Rafter cell 550) with one hundred (100) counting cells was used to count individuals of each food item. Food items were first classified into families and then into their respective genera. Minute food items were counted in 10–20 randomly picked counting cells, with their mean values calculated and multiplied by 100, and the result then being multiplied by the dilution factor. For medium to large food items, 20–40 randomly picked cells were counted, their mean value obtained, and then multiplied by 100, and subsequently multiplied by the dilution factor. For very large food items, the entire cells (100) were counted and then multiplied by the dilution factor. For extra large food items (i.e., those that could be seen by a naked eye), the items were visually identified, except for those not clearly visible to the eye, for which a dissecting microscope was used to aid identification. Consumed detritus were estimated as percentages they could occupy in the fish stomach.

Principal component analysis (PCA) was used to perform multivariate analysis to identify variables responsible for major variations in the dams. The “Past” programme/package was used to draw the graph highlighting the variations in relation to correlated variables, making it possible to compare water quality between the three dams and the major variables responsible for variations in the dams. The fish natural food selectivity was calculated using Ivlev's electivity/selectivity index (Ivlev, 1961), defined as:

$$E_i = (r_i - P_i) / (r_i + P_i) \tag{1}$$

where r_i = relative abundance of a prey in a predator's diet; P_i is prey's relative abundance in the ecosystem; E_i ranges from −1 to +1 (where −1 represents total avoidance of a given prey; 0 represents non-selective feeding; and +1 represents exclusive feeding on a given prey).

The sex ratio of males:females was calculated using the pooled data for the entire sampling period.

The relative condition factor (K_n) was estimated using LeCren's equation (1951):

$$K_n = W / aL^b \tag{2}$$

where K_n = Observed weight/expected weight; W, weight of fish (g); TL, total length (cm); a = intercept; and b = slope (using maturity stages III–VI).

The length–weight relationship was calculated using LeCren's (1951) formula, as follows:

$$W = aL^b \tag{3}$$

where W, weight (g); a, constant (Y-intercept); L, TL length (cm); and b, exponent describing regression line slope.

This can be logarithmically transformed to log W = log a + b log L, as suggested by LeCren (1951).

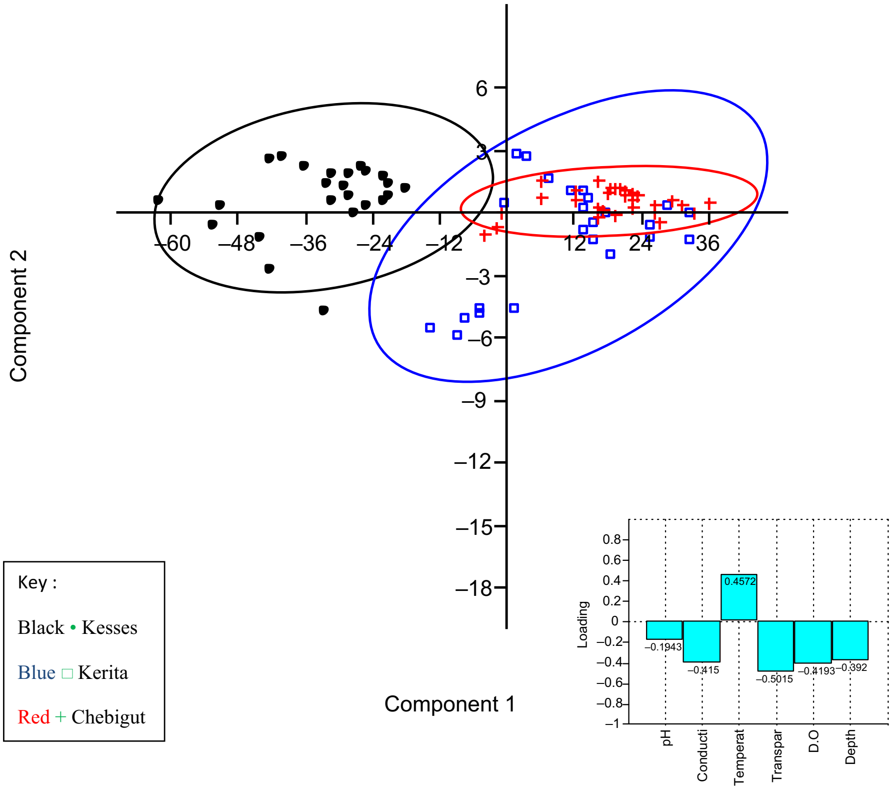

FIGURE 2 PCA diagram of water quality in three study dams in Uasin Gichu County, Kenya

2.1 | Catch per unit effort (CPUE)

The CPUE is an indirect measure of the abundance of target species. CPUE changes signify changes in the true abundance of target species. A decreased CPUE signifies overexploitation, while an unchanged CPUE signifies sustainable exploitation. This method has several advantages over other measures of abundance, noting it does not interfere with routine harvesting, and the data are easily collected and analysed, even by a non-specialist. The CPUE was expressed as mean weight in kg person^{-1} hr^{-1} (mean of four-month sampling).

3 | RESULTS

Kesses was the only dam where commercial and sport fishing was evident. The remaining dams were relatively unexploited, except for occasional fishing for domestic consumption.

3.1 | PCA for water quality in the dams

Kesses Dam was distinctly different from the other dams (Figure 2). The capability of PCA to account for as much variation as possible using principal components (PC) in a descending order of important was used to analyse the data, being a good approach for using limnological variables to explain variations in fish condition in the different sites/dams. Most of the variations in the dams are explained by PC 1, which explains 50.72% of the variations, and PC 2 which explained 6.64% of the variations. The PCA loadings identified water transparency, temperature and electrical conductivity as the variables most responsible for the variations (Figure 2).

3.2 | The diet of *O. niloticus* in the dams

The main food items consumed by *O. niloticus* in all three study dams were Chlorophyceae (green algae), Bacillariophyceae (diatoms), Cyanophyceae (blue-green algae) and detritus (Figure 3). Euglenophyceae (flagellates) and Desmideaceae (desmids) were less important. On examining the fish diet at genus level, the most important food items consumed were *Botryococcus* (chlorophyceae), *Navicula*, *Diatoma* (bacillariophyceae) and *Phormidium* (cyanophyceae). *Gonatozygon* (a flagellate). *Phacus* (a desmid) were consumed selectively when available (Appendices S1, S2 and S3).

For Kesses Dam, the fish exhibited total to near-total avoidance of Desmideaceae (Figure 4), feeding non-selectively on Bacillariophyceae and Chlorophyceae, except in February when it exhibited some strong avoidance of Chlorophyceae. There was a general avoidance of Cyanophyceae at the start of the sampling period, followed by a gradual acceptance of this food as the dry season progressed.

For Kerita Dam, the fish exhibited a positive selection of Cyanophyceae and Euglenophyceae, except in February when it appeared to avoid Euglenophyceae (Figure 5). The fish fed almost non-selectively on Chlorophyceae, although exhibiting a strong avoidance of Bacillariophyceae at the start of the sampling period, followed by gradual acceptance of the food as the dry season progressed.

For Chebigut Dam, the fish exhibited a positive selection of Chlorophyceae at the start of the sampling period, subsequently

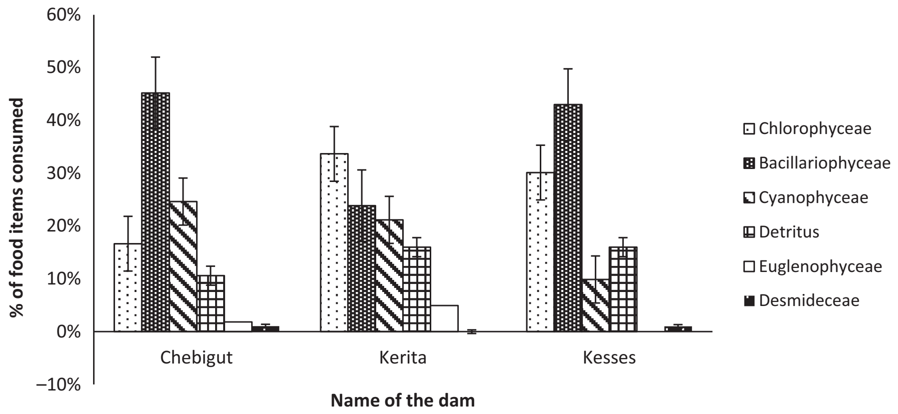

FIGURE 3 Diet of *O. niloticus* in the three study dams (S.E bars)

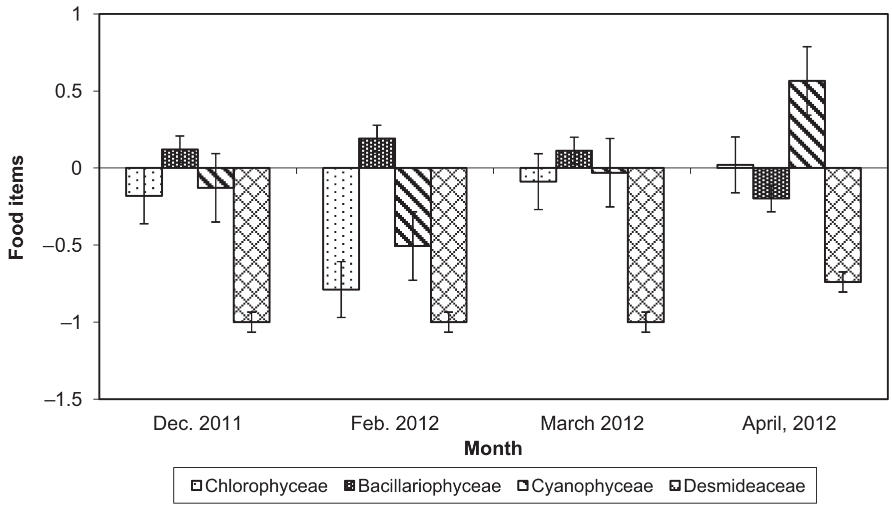

FIGURE 4 *Oreochromis niloticus* generally avoided desmideaceae and fed non-selectively on bacillariophyceae and cyanophyceae in Kesses dam

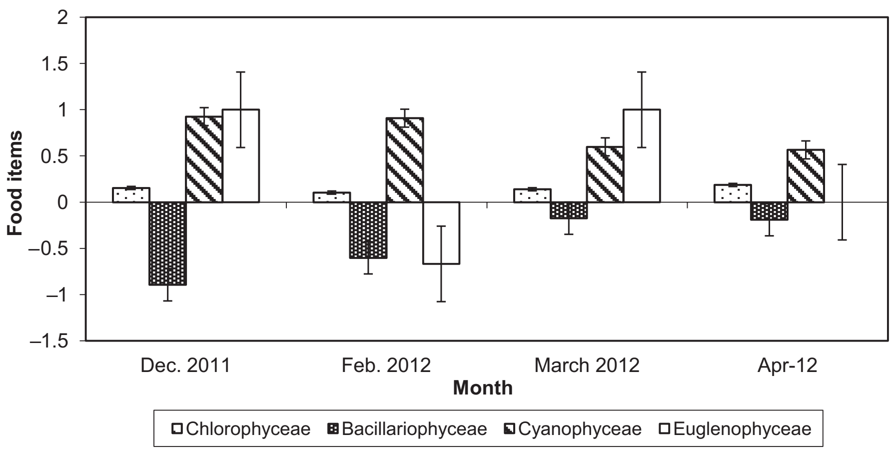

FIGURE 5 Diagram illustrating *O. niloticus* fed selectively on Cyanophyceae and non-selectively on chlorophyceae in Kerita Dam during the start of the dry season

showing a slight avoidance of the diet as the dry season progressed (Figure 6). It exhibited a positive selection of Cyanophyceae throughout the sampling period, with the acceptance improving as the dry season progressed. The fish also exhibited a high degree of avoidance of Bacillariophyceae at first, later accepting the food as the dry season progressed. It fed almost non-selectively on this diet from February onwards. The fish also fed on non-selectively were Euglenophyceae and Desmideaceae during the sampling period. Chebigut was the only dam containing some fish found to be piscivorous, which fed on their own fry/juveniles, *Gambusia sp.* and fish eggs (Figure 6).

3.3 | Sex and maturity stage (LM_{50})

A total of 64 specimens from Kesses Dam were examined, comprising 33 females ranging from 13.3 to 28.0 cm TL and 31 males ranging from 13.8 to 28.5 cm TL. The sex ratio was about 1:1 (males: females). The

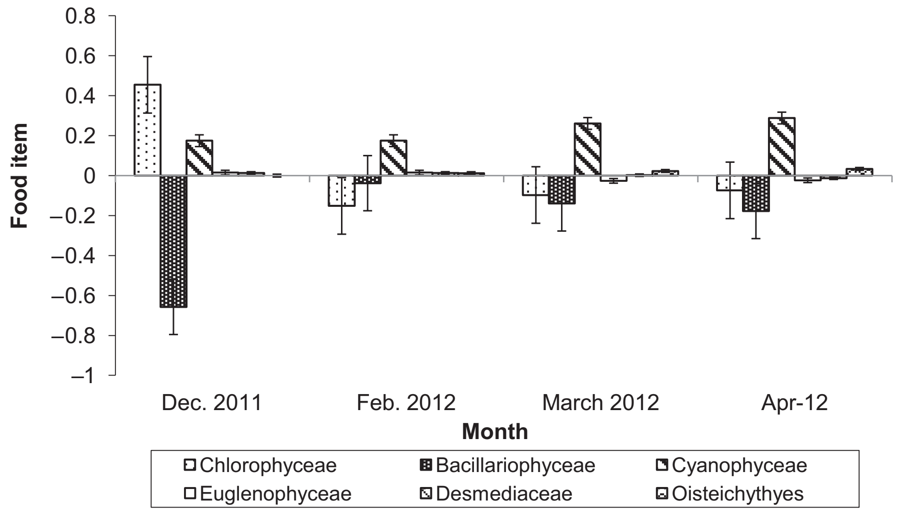

FIGURE 6 Diagram illustrating *O. niloticus* food preference in Chebigut Dam was generally similar to that of Kerita Dam

smallest mature female caught was 13.6 cm long, while the smallest mature male caught was 16.5 cm TL. The males were generally bigger than females, with the mean length for females being 16.59 ± 3.55 cm (*SD*) TL, while the mean length for males was 20.13 ± 3.72 cm. A total of 135 specimens were examined from Kerita Dam, comprising 76 females ranging from 12.9 to 24.2 cm TL and 59 males ranging from 15.2 to 24.2 cm TL. The smallest mature female caught was 16.1 cm long, while the smallest mature male caught was 19.0 cm TL. The mean length for females was 18.5 ± 2.60 cm, while the mean length for males was 18.8 ± 3.32 cm. The sex ratio was 1.0:1.3 (males: females). A total of 209 specimens were examined from Chebigut Dam, comprising 131 females ranging from 15.2 to 23.4 cm TL, and 78 males ranging from 15.5 to 23.0 cm TL. The smallest mature female was 15.6 cm long, while the smallest mature male was 17.1 cm TL. The mean length for females was 18.6 ± 1.49 cm, while that for males was 18.3 ± 1.63 cm long. The male:female sex ratio was 1.0:1.7. The LM_{50} for females in Kesses Dam was 17.0 cm and that for males was 18.0 cm TL. The LM_{50} for females in Kerita Dm was 20.0 cm and that for males was 19.0 cm. The LM_{50} for females in Chebigut Dam was 18.0 cm while that for males was 19.0 cm.

3.4 | K_n values for fish in the dams

There were no significant differences in the relative condition factor for males and females ($p > 0.05$) in the three dams. The relative condition factors for *O. niloticus* in the dams were around 1, with the condition being better in Kesses (females 1.04 *SD* ± 0.22; males 1.02 ± 0.12) than in the other dams (Kerita—females 0.99 ± 0.17, males 1.01 ± 0.01; Chebigut—females 1.01 ± 0.12, males 1.01 ± 0.13). The females were generally in better condition than the males in all the dams, except Kerita.

3.5 | Relative condition factor by size for males and females in the dams

The fish exhibited two peak health conditions (Figure 7). In terms of reproduction, it appears the fish have at least two peak reproductive periods. The most notable observation was that the fish were found to exhibit a decreased body condition at a length of 18–20 cm in all the dams, an indication of recent spawning. This class interval appears to be the critical breeding biomass (see LM_{50} above), needing some kind of protection in order to sustain the fishery.

3.6 | Length–weight relationship for *O. niloticus* in the dams

A *t* test was used to determine whether or not the observed b values were significantly different from the expected value of 3. The p values were significantly different from 3 (*p* value <0.05) for all the dams. The males in Kesses Dam registered a *p* value of 0.022, while the females had a p value of 0.032, indicating *O. niloticus* exhibited a positive allometric growth in this dam ($b > 3$). For Kerita Dam, the p value for females was 0.0241, while the males exhibited a *p* value of 0.0037, indicating the fish exhibited a negative allometric growth ($b < 3$). For Chebigut Dam, the females exhibited a *p* value of 0.0013, while the males had a *p* value of 0.0159, with both sexes exhibiting a positive allometric growth ($b > 3$) Table 1. Thus, Kerita Dam was the only one exhibiting a negative allometric growth, suggesting the environmental conditions in Kerita Dam did not favour robust state of health or well-being for *O. niloticus*. The length–weight relationship values for regression for intercept (*a*) and regression slope (*b*) parameters for males and females in the three dams are summarized in Table 1.

3.7 | Catch per unit effort (CPUE)

The CPUE was significantly different between the three study dams ($p = 0.0002$). Chebigut Dam exhibited the highest CPUE of ~0.5 kg $person^{-1}$ hr^{-1}, while Kesses Dam was last with a CPUE of 0.17 kg $person^{-1}$ hr^{-1} (Table 2). Kesses dam fish production was different from that of the other two dams in that it was composed of fewer, but bigger, fish (production by weight). The remaining dams exhibited smaller, but numerous, fish (production by numbers).

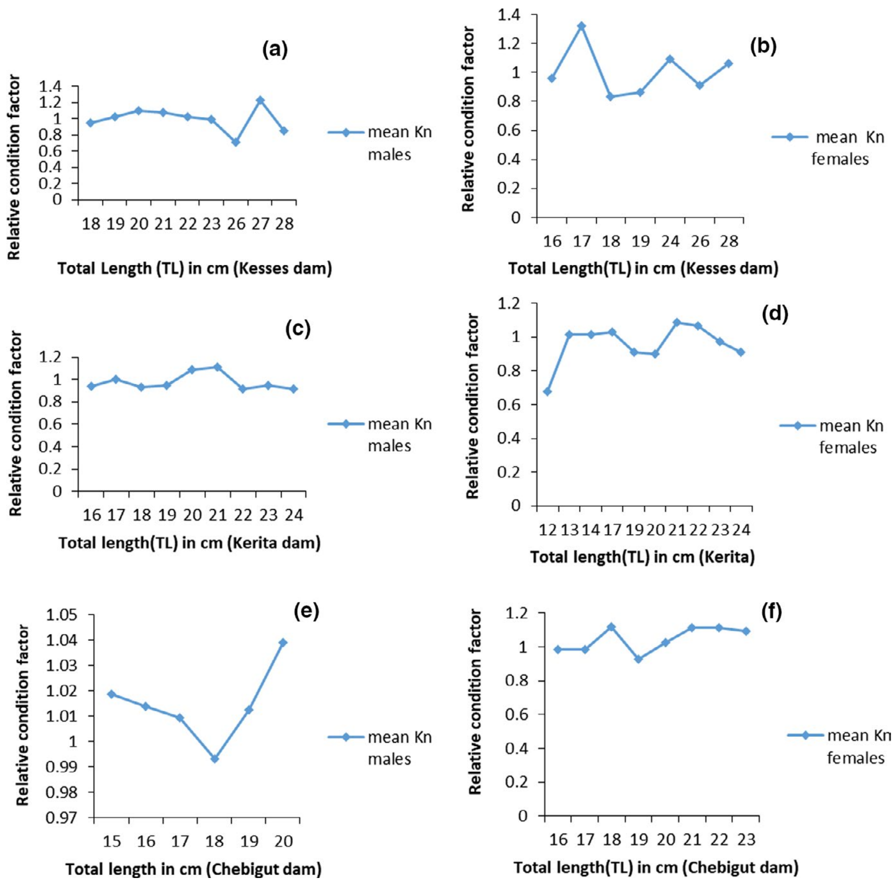

FIGURE 7 Diagram illustrating the males (a, c, e) and females (b, d, f) had two peak conditions (low and high), and that the relative condition factor indicates *O. niloticus* was in relatively good condition in all three study dams. S.D., standard deviation; ♂, males; ♀, females

4 | DISCUSSION

The status of the fisheries in Uasin Gishu was unknown when the government thought of introducing "blue economy" to a predominantly agricultural area. The health and well-being of the fish was good in the present study, where the Kn value was about 1 for all the sampled dams, indicating the robustness of *O. niloticus* in the dams. The LM_{50} is defined as the mean length at which gonadal development has advanced to at least stage IV in 50% of the individuals. The results of the present study suggest, except for Kerita Dam, that females probably matured at a smaller size compared to males, making the Kerita Dam an interesting subject for future studies. Fish production in Kesses Dam was lower in Kerita and Chebigut dams, one reason likely being that Kesses Dam was being commercially exploited. Further, Kesses Dam has been re-stocked with tilapia more than once, most recently in 2011, suggesting tilapia has not established itself well in the dam, or else the fishery is being over-exploited. The low CPUE, comprised of fewer, but bigger-sized, fish suggests a possible recruitment failure. Relative condition is a measure of a fish well-being, including ecological and biological factors (e.g., degree of fitness; gonad development; environmental suitability with regard to feeding condition; Mac Gregoer 1959). The condition factor can be affected by stress, sex, season, food availability and water quality (Khallaf, Galal, & Athuman, 2003). The class interval 18–20 cm (TL) appears to be the most crucial class (size) for the breeding biomass (mature females), meaning an effective management strategy is necessary to protect this class in order to sustain the fishery. An appropriate fishing gear(s) that allows this group of fish to escape is essential. Alternatively, a closed season during the peak breeding period(s) could serve the same purpose. Imam, Bala, Balarabe, and Oyeyi (2010) reported a negative allometric growth of four species of fish, including *O. niloticus*, in Wasai Reservoir in Kano (Nigeria). The poor condition of the fish was attributed to domestic and industrial wastewater effluents from the Jakara and Getsi rivers. The K factor for *O. niloticus* in Wasai Reservoir was highest in the wet season and lowest in the dry season. There is a possibility that tilapia fisheries in Uasin Gishu dams could be affected by seasons, although seasonality was not considered in the present study. The sampling period was not a truly dry season, with intermittent rainfall being observed during the sampling period. The optimum temperature for tilapia growth ranges from 29 to 31°C, with its growth declining with decreasing temperature. At a temperature of 20–22°C, growth is about 30% of the optimum (Teichert-Coddington and Lovshin, 1997). Bagenal and Tesch (1978) indicated a range of

TABLE 1 Length-weight relationships of *O. niloticus* in the three dams

	Males		Females	
	a	*b*	*a*	*b*
Kesses	0.0238	2.8896	0.0013	3.8545
Kerita	0.0120	3.1171	0.0319	2.7796
Chebigut	0.0064	3.3795	0.0151	3.0687

a: Regression intercept; *b*: Regression slope.

TABLE 2 Comparison of CPUE in the three dams

Name of the dam	Kerita	Kesses	Chebigut
CPUE (kg/person/hr)	0.321	0.171	0.483

Catch per Unit Effort (p = 0.0002) was significantly different between the dams.

2.9–4.8 as the ideal range of K factor for normal growth and utilization of nutrients by a normal freshwater fish. Water temperature in the County ranged from 23 to 24°C, which likely means the potential for the tilapia fishery in Uasin Gishu County is much higher than suggested by the current fish landings, suggesting it can be achieved by increasing the temperature in an aquaculture setup. Nehemia, Maganira, and Rumisha (2012) succeeded in rearing tilapia (*Coptodon zilli* and *Oreochromis urolepis urolepis*) in full strength seawater (FSSW), concluding that tilapia farming can be feasible in FSSW if the water quality parameters are properly monitored. Overall, the results of this study suggest the hardy tilapia are a good candidate for beginners and poor households interested in fish farming, as a means of improving their income and food security.

5 | CONCLUSIONS

Oreochromis niloticus in all the study dams, except for the females in Kerita Dam, exhibited a relative condition factor >1, indicating a good robustness/well-being of the fish in the dams. The critical breeding biomass of *O. niloticus* in the dams is around the 18–20 cm class length. A management strategy must be implemented to protect this group. The most important food items for fish in the dams were Bacillariophyceae (diatoms), Cyanophyceae (blue-green algae) and Chlorophyceae (green algae).

ACKNOWLEDGEMENTS

The authors wish to thank the fishermen of Kesses Dam for volunteering to assist in fishing efforts in the dams. Moi University was very helpful with the logistics for data collection. Special thanks are due to Lubanga Lunaligo for assisting in phytoplankton identification in the laboratory.

ORCID

Nicholas N. Gichuru https://orcid.org/0000-0002-8039-5369

REFERENCES

Allan, J. D., Abell, R., Hogan, Z., Revenga, C., Taylor, B. W., Welcomme, R. L., & Winemiller, K. (2005). Overfishing of inland waters. *BioScience*, *55*, 1041–1051.

Bagenal, T. B., & Tesch, F. W. (1978). *Methods for assessment of fish production in freshwaters* (pp. 350). Oxford, UK: Blackwell Scientific Publication.

Balarin, J. D., & Hatton, D. (1979). *Tilapia A guide to their biology and culture in Africa*. Scotland, UK: Aquatic Patho-biology Unit, University of Stirling.

FAO. (1998). *Fishery country profile: The republic of Kenya in Fisheries*. Rome, Italy: FAO.

FAO. (2006). *Cultured aquatic species information programme*. Rome, Italy: FAO Fisheries and Aquaculture Department.

FAO. (2010). *The state of world fisheries and aquaculture*. Rome, Italy: FAO Fisheries and Aquaculture Department.

Fish, G. R. (1956). Some aspects of respiration of six species of fish from Uganda. *Journal of Experimental Biology*, *33*, 186–196.

Imam, T. S., Bala, U., Balarabe, M. L., & Oyeyi, T. I. (2010). Length-weight relationship and condition factor of four fish species from Wasai Reservoir in Kano, Nigeria. *African Journal of General Agriculture*, *6*(3), 1–6.

Ivlev, V. S. (1961). *Experimental ecology of the feeding of fishes*. New Haven, CT: Yale University Press.

Khallaf, E. A., & Alne-na-ei, A. A. (1987). Feeding ecology of *Oreochromis niloticus* (Linnaeus) & Tilapia zilli (Gervias) in a Nile Canal. *Hydrobiologia*, *147*, 57–62.

Khallaf, E., Galal, M., & Athuman, M. (2003). The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology*, *12*, 405–416.

LaFranchi, C. (1996). *Small-scale fisheries and subsistence use of natural resources in Namibian communal areas* (pp. 81). The World Wildlife Fund (USA). Living in a Finite Environment ("LIFE") Programme.

LeCren, C. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition of perch (*Perca fluviatilis*). *Journal of Animal Ecology*, *20*, 179–219.

Lowe-McConnell, R. H. (1987). Ecological studies in tropical fish communities Mac Gregoer, J. S. (1959). Relation between fish condition and population size in the sardine (*Sardinops cacrulea*). *U.S. Fish and Wildlife Service, Fish Bulletin.*, *60*, 215–230.

Nehemia, A., Maganira, J. D., & Rumisha, C. (2012). Length-weight relationship and condition factor of tilapia species grown in marine and freshwater ponds. *Agriculture and Biology Journal of North America.*, *3*, 117–124. https://doi.org/10.5251/abjna.2012.3.3.117.124

Onyango, O. S. (1999). The diet of pond raised *O. niloticus* (L.) and its influence on the condition of the fish. A MSc. thesis submitted to Moi University, Kenya

Popma, T. J., & Lovshin, L. L. (1996). *Worldwide prospects for commercial production of tilapia*. Research and Development Series No., 41, pp. 26 Alabama: International Centre for aquaculture and aquatic environments, Auburn University.

Sparre, P., & Venema, V. C. (1992). *Introduction to tropical fish stock assessment*, FAO Technical Paper No. 306/1.

Teichert-Coddington, P., & D. R., & Lovshin, L. L., (1997). Attributes of tropical pond-cultured fish. In H. S. Egna, & C. E. Boyd (Eds.), *Dynamics of pond aquaculture* (pp. 183–198). Boca Raton, FL: CRC Press.

Witte, F., Goldschmidt, T., Goundswaard, P. C., Ligtvoet, W., van Oijen, M. J. P., & Wanink, J. H. (1992). Species extinction and Concomitant ecological changes in lake Victoria. *Netherlands Journal of Zoology*, *42*, 214–232.

Witte, F., & Van Densen, W. L. T. (1995). *Fish Stock and Fisheries of Lake Victoria*. Samara House, Cardigan: A Handbook for Field Observation, Samara Publishing House.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Gichuru NN, Manyala JO, Raburu PO. Some aspects of reproduction and feeding habits of Nile tilapia (*Oreochromis niloticus)* in three dams in Uasin Gishu County, Kenya. *Lakes & Reserv*. 2019;24:181–189. https://doi.org/10.1111/lre.12271