JASEM ISSN 1119-8362

Full-text Available Online at
http:// www.bioline.org.br/ja

J. Appl. Sci. Environ. Mgt. 2005
Vol. 9 (1) 93 - 97

Fish Distribution in a small Domestic Water Supply Reservoir: A Case Study of Kangimi Reservoir, Kaduna, Nigeria

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ABSTRACT: A study of the composition and distribution of fish populations in the inshore, surface and bottom water habitats of Kangimi Reservoir showed that the most abundant family was the Cichlidae followed in order of abundance by the families Cyprinidae, Schilbeidae, Mormyridae, Mochokidae, Characidae, Centropomidae and Bagridae. Though the overall composition of families caught in the three habitats did not vary significantly ($P > 0.05$) only family Cichlidae showed habitat preference: there was a preponderance of Cichlidae in the inshore water habitat ($P < 0.05$). The families Bagridae and Centropomidae were caught only in the inshore and bottom water habitats while the other families were caught from all habitats and showed no habitat preference. The dominance of primary and secondary consumers indicates high fish production potential under adequate management. @JASEM

In Nigeria, studies of fish biodiversity, distribution, abundance and yield of most of the inland lacustrine water bodies have been limited to large sized water bodies (>1,000 ha) which include mainly Kainji, Jebba, Shiroro, Tiga, Bakolori, Goronyo among others. Studies on small-medium sized reservoirs (>2 - <1,000 ha) have been limited to a few examples which include International Institute for Tropical Agriculture (IITA) Reservoir, Oguta Lake (Ita and Balogun, 1982). Bernacsek (1986) estimated the fish production from small water bodies in Africa as one million tones annually and argued that it could be considerably more if production enhancement fishing systems are applied, an approach to which small water bodies are particularly well suited. In order to establish the fisheries potentials of the small sized reservoirs there is need to conduct ichthyofauna surveys of the water bodies. The primary objectives of this study are to conduct fish stock assessment and fish distribution in Lake Kangimi and to utilize the information in predicting fisheries production potential of the reservoir.

MATERIALS AND METHODS

Kangimi Reservoir lies in the Savannah region, between latitude 10° 46' and longitude 7° 25' E. The reservoir, formed after the impoundment of a tributary of River Kaduna in 1972, is located 12.8km southeast of Maraba (Kaduna-Jos Trunk Road Junction) (Fig. 1). It is about 3.75 km in length and has a maximum depth of 12.92m, covering an area of 567 ha with storage capacity of 59,098 million litres and inflow of 45.5 million litres of water per day (Abba 1987) to Kaduna State Water Board for treatment. The reservoir was impounded primarily to provide 45.44 million litres of water to Kaduna State Water Board. It was also expected to provide water for irrigation of 1619 ha of land on the north bank of River Kaduna upstream of the town.

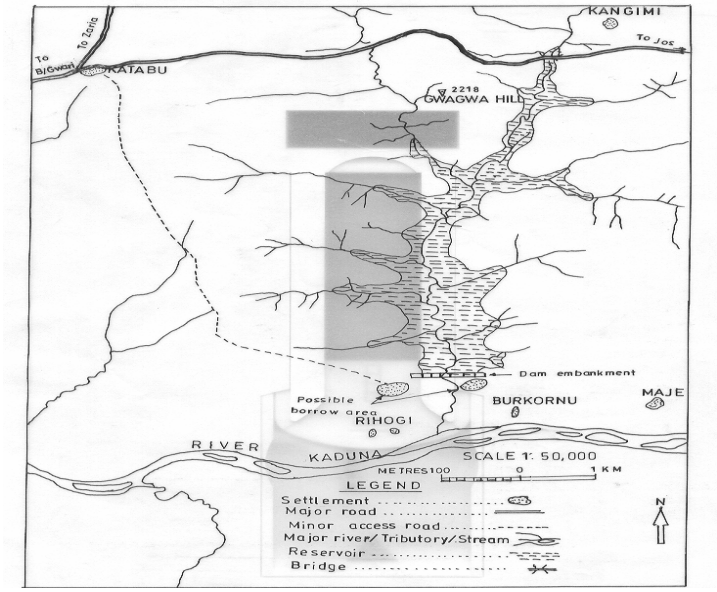

Fig 1. Map of Kangimi Reservouir

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Fish Sampling: A fleet of gill nets consisting of nine multifilament nets of 25.4, 38.1, 50.8, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8 mm stretched meshes was used to sample shore, surface and bottom waters at the dam site. Each net measured 30m long and 3m deep, with 210/3 twine used for the first eight meshes and 210/6 for the 177.8 mm mesh.

Nets were set approximately 2 hours before sunset and lifted 2 hours after sunrise. The fish caught in each net were removed and transferred into large labeled plastic bowls. There was a separate bowl for each net. Each fish was weighed and measured for standard and total length. The forage to carnivore (F/C) ratios was estimated. The duration of survey lasted for four months i.e September, October 1997, January and July 1998.

RESULTS

The percentage composition of fish species/families by number and the relative distribution in the shore, surface and bottom waters are shown in Tables I and II. The most abundant fish family was the Cichlidae, followed in order of abundance by the families Cyprinidae, Schilbeidae, Mormyridae, Mochokidae, Characidae, Centropomidae and Bagridae. Along the shore the cichlids dominated while Cyprinidae dominated the surface followed closely by the Schilbeidae. In the bottom the Cyprinidae also dominated. The Forage to Carnivore (F/C) Ratios were 1.17 and 2.28 in terms of number and weight respectively. The analysis of variance showing the variabilities of catches of various fish families among the major habitats (shore, surface and bottom waters) is shown in Table III. There was no significant difference in the overall catch composition among the major habitats. However the mean catches for the fish family Cichlidae were significantly different among the major habitats. A post hoc test was used for the mean separation test (Duncan Multiple Range Test) which revealed that the Cichlidae were highly concentrated in the shore waters. The fish families Bagridae and Centropomidae were caught only in the shore and bottom waters. The other families namely Mormyridae, Cyprinidae, Mochokidae, Characidae and Schilbeidae were caught from all habitats and showed no habitat preference.

Table II. Percentage composition (by number) of fish families in the shore, surface and bottom samples from Kangimi Reservoir for 1997-1998

Family	Shore	Surface	Bottom	No.
Cichlidae	79.2	5.24	11.52	191
Cyprinidae	25.4	38.1	36.51	63
Schilbeidae	48.98	36.73	14.29	49
Mormyridae	23.53	20.59	55.88	34
Mochokidae	41.38	20.69	37.93	29
Characidae	72.22	5.56	22.22	18
Centropomidae	75.00	_	25.00	08
Bagridae	_	_	100.00	01

Table I. Percentage composition of fish by number in Kangimi Reservoir gillnet catches for the period 1997-1998 and the relative distribution in the shore, surface and bottom samples.

		Distribution (%)		
Family/species	**No.(%)**	**Shore**	**Surface**	**Bottom**
Cichlidae				
Hemichromis fasciatus	113(28.32)	81.42	5.31	13.27
H. bimaculatus	61 (15.29)	86.89	6.56	6.56
Oreochromis niloticus	01 (0.25)	_	_	100
Tilapia zilli	15 (3.76)	86.67	_	13.33
Sarotherodon galilaeus	01 (0.25)	100	_	_
Sub total	191(47.87)			
Cyprinidae				
Barilius spp.	55(13.78)	29.09	34.55	36.36
Labeo parvus	03(0.75)	_	_	100
Barbus spp.	05(1.25)	_	100	_
Sub total	63 (15.79)			
Mormyridae				
Marcusenius psittacus	23(5.76)	26.09	26.09	47.83
Gnathonemus senegalensis	02(0.56)	_	_	100.00
Mormyrus rume	07(1.75)	28.57	14.29	57.14
Marcusenius branchistius	02(0.50)	_	_	100.00
Sub total	34 (8.52)			
Mochokidae				
Synodontis schall				
S. parvus				
Sub total	25(6.27)	32.00	24.00	44.00
	04(1.00)	100	_	_
Schilbeidae	29(7.27)			
Schilbe mystus				
Characidae	49(12.28)	48.98	36.73	14.29
Alestes macrolepidotus				
A. nurse				
Sub total	06(1.50)	83.33	16.67	_
	12 (3.01)	66.67	_	33.33
Centropomidae	18 (4.51)			
Lates niloticus				
Bagridae	08(2.01)	75.00	_	25.00
Bagrus docma				
			_	
TOTAL	01(0.25)			100.00
	399			

Table III. The analysis of variance showing the variability of catches among the major habitats (shore, surface and bottom) sampled (d.f. among and within = 2 and 30 respectively : F =0.05,

Fish family Variations	Sources of (in log ratios)		Sums of squares	F ratio
Cichlidae Within habits	Among habitats	3.81	4.40*	
3.82				
Cyprinidae Within habitats	Among habitats	3.29	1.02	
3.93	N.S.			
Schilbeidae Within habitats	Among habitats	3.40	2.29	
3.70	N.S.			
Mormyridae Within habitats	Among habitats	3.18	1.36	
3.70	N.S.			
Mochokidae Within habitats	Among habitats	2.34	0.06	
4.22	N. S.			
Characidae Within habitats	Among habitats	3.68	3.53	
3.79	N. S.			
Centropomidae Within habitats	Among habitats	3.46	1.50	
3.94	N.S.			
Bagridae Within habitats	Among habitats	3.22	1.00	
3.88	N.S.			
Total	Among habitats3.84		3.04	

DISCUSSION

The dominance of the fish family Cichlidae in Kangimi Reservoir compares favourably with other African lakes/reservoirs such as Kainji, Tiga, Bakolori where cichlids are known to dominate (Pike and Gay, 1965; Petr, 1966; Reynolds, 1973; Ita, 1978; Ita and Balogun, 1982 and Balogun, 1986).

The significant concentration of the cichlids along the inshore also indicates that the shoreline has been stabilized and is capable of providing enough food, shelter and breeding sites for the littorally-inhabiting fish species. Unlike the dominance of *Sarotherodon galilaeus* and *Oreochromis niloticus* in Lakes Kainji, Tiga and Bakolori, *Hemichromis fasciatus* dominated the cichlids in Kangimi. This could be attributed to differences in the feeding habits, behaviour and population. While *O. niloticus* and *S. galilaeus* are phytoplankton feeders, *H. fasciatus* are zooplankton feeders (Akintunde, 1976). The difference in feeding habit, behaviour and population affects rates of catches when different fishing gears are used (Ita, 1982). Other littoral inhabiting fish families include the Centropomidae and the Bagridae which were caught only in the shore and bottom water habitats. While the Centropomdae were caught more in the shore than in the bottom the Bagridae were evenly caught in the shore and bottom waters. The dominance of the surface by the Cyprinidae followed closely by the Schilbeidae was similar to situation in Kainji Lake.

Kangimi Reservoir fisheries differs from other African Reservoirs in the dominance of fish in the bottom habitat. In Kainji Reservoir the bottom water was dominated by the Mochokidae (Balogun, 1986) unlike the dominance of the Cyprinidae in the bottom waters of Kangimi Reservoir. The difference could be attributed to differences in the mean depth, flush rates and fishing rates in the reservoirs (Ita and Balogun, 1982). Though there was no significant difference in the total catch composition of all fish species among the major habitats the probability (0.06) was not well in excess of 0.05. The near significance level was reflected in the catch of individual fish family where the catch of fish family Cichlidae, the most dominant fish family showed significant difference ($P < 0.05$) among the major habitats with highest concentration in the inshore water. This result shows that the littoral zone is stabilized and conducive for the littoral inhabiting species.

The stabilization of the shoreline with the dominance of Cichlidae in the inshore, the dominance of the surface by the Cyprinidae followed closely by the Schilbeidae, the abundance of the Centropomidae and Bagridae and the Forage to Carnivore (F/C) Ratios of 1.17 and 2.28 in terms of number and weight respectively in the lake show that the dominant fish species are either primary or secondary consumers, thus indicating high potential to fish production under adequate management (Ita and Balogun, 1982). For more efficient fisheries conservation and management, appropriate monitoring, control and surveillance (MCS) systems are required (FAO, 1995). Emphasis on MCS systems for inland water bodies are focused on registration of fishermen and their equipment, enactment of minimum mesh regulation and community based scheme (FAO, 1995). The absence of systematic approach towards the management and development of this reservoir is therefore advocated for fisheries sustainable yield.

Conclusion

This study reveals that Kangimi Reservoir is behaving like other African reservoirs/lakes where the cichlids dominate the overall catch composition. The study also reveals that the littoral zone is stabilized giving rise to the dominancy of littoral-inhabiting cichlids. However, the study shows that the common phytoplankton cichlid feeders which are dominant in other African water bodies are less prominent in Kangimi Reservoir where *Hemichromis spp*., zooplankton feeders dominates. The dominancy of primary and secondary consumers in the lake points to the high potential fish production of the reservoir under adequate management.

Acknowledgements: The fieldwork in this work was financed by a research grant from the National Agricultural Research Project (NARP) coordinated by National Institute for Freshwater Fisheries Research (NIFFR). The author is grateful to Mr. John A. Obemeata for the statistical analysis of the data.

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