Journal of Fisheries International 6 (1): 13-17, 2011
ISSN: 1817-3381

Freshwater Fish Abundance and Distribution in the Orange River, South Africa

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Abstract: Fish species abundance and distribution in the middle and lower Orange river basin were investigated in November 2010. Fish specimens were collected by means of an electric shocker and seine nets. Sixteen fish species comprising of a total number of 13,762 individuals belonging to five families were collected. The number of individuals caught showed that 64.7% were represented by the family Cyprinidae, 34.1% Cichlidae, 0.25% Claridae, 0.67% Austroglanidae and 0.36% Poecilidae. Aliens *Cyprinus carpio, Gambusia affinis* and translocated *Oreochromis mossambicus* were also recorded during the study. *Labeo capensis, Labeobarbus aeneus* and *Pseudocrilabrus philander* were the most abundant in the middle section of the river while *Mesobola brevianalis* and *Barbus hospes* were more abundant in the lower section of the river. During this study, a new distribution of *Gambusa affinis* was recorded at all sites except at site one and seven. High abundance of *Austroglanis sclateri* was only recorded at site three.

Key words: Freshwater fish, diversity, abundance, indigenous, distribution, alien, endemic, South Africa

INTRODUCTION

The Orange river is the largest and longest perennial river in South Africa. It emanates from the Maluti mountains in Lesotho and meanders West through the semi arid and arid Southern free state and the Northern Cape provinces and flows into Atlantic ocean at Alexander bay. It is shared amongst four countries namely; Botswana, Lesotho, Namibia and South Africa. It is highly regulated through several weirs and major dams such as the Gariep and Vanderklo of dams in an attempt to provide enough water for human consumption, mining and agriculture which supports the economy of South Africa (Tooth and McCarthy, 2004).

The indigenous freshwater fish species in the system are exposed to hostile environmental changes, climatic fluctuations, water abstractions, hydrological regime and agricultural activities. The changes in environmental factors such as water quality and depth, water current, food availability and substratum along the river influence the occurrence, abundance and distribution of the fish fauna (Bisht *et al*., 2009; Soyinka *et al*., 2010). Flooding is also one of the most important factors, affecting the stability of communities due to its rapid and disruptive effects on different groups of organisms (Medeiros and Maltchik, 2001).

According to Benade (1993), anthropogenic changes in the Orange river system have already resulted in a threat to the survival of certain fish species, like Rock catfish (*Austroglanis sclateri),* Largemouth yellowfish (*Labeobarbus kimberleyensis*) and Moggel (*Labeo umbratus*). Despite the river's large size, it houses a relatively low diversity of fish. The fish species are relatively dominated by cyprinids (minnows, mudfishes and yellowfishes).

The critically endangered Maloti minnow (*Pseudobarbus quathalambe*) and alien rainbow trout (*Oncorhyncus mykiss*) occurs in the head waters in Lesotho. Seven species are endemic to the system namely; Rock catfish (*Austroglanis sclateri*), Maloti minnow (*Pseudobarbus quathalambe*), Namaqua barb (*Barbus hospes*), River sardine (*Mesobola brevianalis*), Smallmouth yellowfish (*Labeobarbus aeneus*), Largemouth yellowfish (*Labeobarbus kimberlyensis*) and Mudfish (*Labeo capensis*).

The area below Augrabies falls is regarded as a hotspot for both species, diversity and endemic freshwater species, richness supporting high populations of Namaqua barb (*Barbus hospes*) and River sardine (*Mesobola brevianalis*) (Benade, 1993; Skelton and Cambray, 1981; Jubb, 1967). The Orange river system is very important for freshwater fish conservation and certain areas should be demarcated as fish sanctuaries. In this study, it was aimed to determine abundance and distribution of fish species in the middle and lower Orange river.

MATERIALS AND METHODS

Sampling sites description: The study was conducted in the middle and lower reaches of the Orange river within the borders of the Northern Cape province, South Africa.

The river is mainly characterized by indigenous non-woody vegetation such as reeds (*Phragmites australis*), sedges (*Cyperus marginatus*) and bulrushes (*Typha capensis*). Woody vegetation along the river banks includes variety of indigenous shrubs such as a River star (*Gomphostigma virgatum*), Cape silver willow (*Salix mucronata mucronata*) and an alien mesquite (*Prosopis* sp.). The rocky areas have patches of fine silts with emergent vegetation. The sites sampled varied though with regard to compositional relations of e.g., reeds to trees, silts to rocks.

Sampling methods: Fish surveys were conducted during November 2010 and seven sites were sampled. The sites were divided into three biotopes for fish sampling, these were shallow fast flowing turbulent waters (rapids), pools and marginal vegetation. The primary methods used in the sampling of fish were seine nets and electro-fishing (Smith-Root LR-24 electric shocker) because of its effectiveness in sampling the variety of habitats present: runs, riffles, rapids and shallow pools.

Sampling was from downstream to upstream and when the fish were shocked, they drifted downstream and were collected by means of a net. All fish were held in water-filled buckets. A fish guide (Skelton, 2001) was used in identification of fish species. Standard length, fork length and total length were taken and thereafter released back into the river. Unknown samples were preserved in 70% alcohol for further identification.

Data analysis: Data collected was analyzed using Shannon-Weiner index (H). The index is determined by both the number of species and the even distribution of individuals among those species (relative dominance). It was calculated using the following equation:

$$H = -\sum P_i(\ln P_i)$$

Where:

P_i = (Relative abundance) = ni/N
ni = Number of individuals in species
N = Total number of individuals in all species

The relative abundance gave comparisons of diversity at all the sampled sites.

RESULTS

A total of 13,762 individuals, representing sixteen species and five families were captured during November 2010 in the Orange river system (Table 1). The most abundant families during the sampling period were Cyprinidae (64.7%), Cichlidae (34.1%), Austroglanidae (0.67%), Poecilidae (0.36%) and Claridae (0.25%), respectively (Fig. 1). Of the sixteen species caught, one is introduced (*Oreochromis mossambicus*) and two are exotic species (*Gambusia affinis* and *Cyprinus carpio*). *Labeo capensis* was the most dominant species, representing 22.1% of the fishes caught. The Shannon-Weiner analysis showed that overall fish-species diversity was consistent throughout the sampling sites and a similar pattern was followed from the middle reaches to the lower reaches of the river.

DISCUSSION

The overall diversity of fish (sixteen species) found in the present study was fairly high in comparison with the number of species reported in previous studies, conducted by Benade (1993), Cambray (1984), Ecosun (2005), Jubb and Farquharson (1965), Jubb (1967, 1972), Skelton and Cambray (1981), Naesje *et al*. (2007) and Skelton (1993, 2001). These researchers concurred that the low diversity is related to the hydrological flow manipulations and environmental factors, their studies were performed on a much broader scale. The number of individuals caught showed that 64.7% were represented by the family Cyprinidae, 34.1% Cichlidae, 0.25% Claridae, 0.67% Austroglanidae and 0.36% Poecilidae (Fig. 2). During this study, the abundance of the fish increased from upstream to downstream along with changes in the species populations.

Similarly at other sites, there were indications that the fish suffered significant changes in species abundance from middle reaches. This phenomenon can be attributed to fish migration, natural barriers and habitat diversity such as stones in current and out of current, marginal vegetation in current and out of current as well as overhanging vegetations and woody debris.

The number of endemic *A. sclateri* was relatively low and only appeared to be relatively abundant at site three (Groblershoop). The scarcity of the *A. sclateri* can be ascribed to their preference for rocky habitats and flow manipulations. It comprised of a relative abundance of 0.67% (Table 1) and was uncommon or absent at most of the sites. However during this study, two fish species were recorded in the swallow pool in slow moving water at site four (Prieska). *O. mossambicus* was considered not common in the lower Orange river. During this study, only twelve specimens were recorded and only at site seven (Sendelingsdrift). It contributed a relative abundance of 0.09% (Table 1). This does not support the study conducted by Naesje *et al*. (2007) who reported higher

Table 1: Recorded fish species sampled in the middle and lower Orange river system

	Sites								
Species	1	2	3	4	5	6	7	Total	Percentage
Cyprinidae									
Barbus anoplus	2	8	13	5	3	5	12	48	0.35
Barbus paludinosus	-	77	28	56	25	43	46	275	2.00
Barbus hospes	-	-	-	435	543	623	325	1926	14.0
Barbus trimaculatus	2	3	10	12	16	13	6	62	0.45
*Cyprinus carpio**	1	3	2	3	5	3	1	18	0.13
Labeo capensis	193	295	579	717	312	598	352	3046	22.1
Labeobarbus aeneus	11	16	209	162	112	159	152	821	5.96
Labeobarbus kimberleyensis	3	2	5	1	5	3	1	20	0.15
Labeo umbratus	-	3	2	-	-	-	-	5	0.04
Mesobola brevinalis	-	-	-	578	722	786	592	2678	19.5
Cichlidae									
Tilapia sparmanni	132	453	323	234	400	124	143	1809	13.2
Pseudocrilabrus philander	521	531	684	435	364	231	100	2866	20.8
Oreochromis mossambicus #	-	-	-	-	-	-	12	12	0.09
Claridae									
Clarias gariepinus	5	3	12	6	4	2	2	34	0.25
Austroglanidae									
Austroglanis sclateri	1	-	89	2	-	-	-	92	0.67
Poecilidae									
*Gambusia affinis**	-	5	7	12	23	3	-	50	0.36
Total	871	1399	1963	2658	2534	2593	1744	13762	100
Relative abundance of sites	6.33	10.2	14.3	19.3	18.4	18.8	12.7	100	-

*Indicates alien species and # indicates introduced species. 1 = Hopetown, 2 = Prieska, 3 = Groblershoop, 4 = Blouputs, 5 = Goodhouse, 6 = Vioolsdrift, 7 = Sendelingsdrift

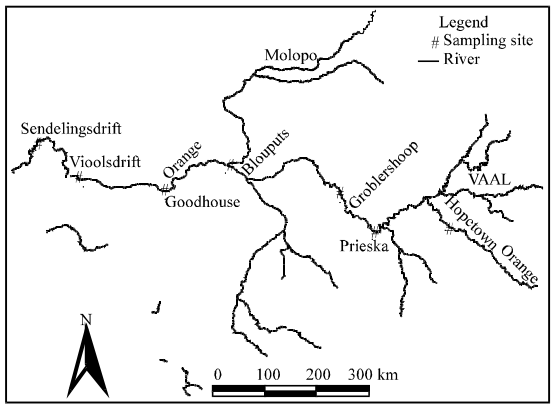

Fig. 1: Map showing the sampling sites in the Orange river

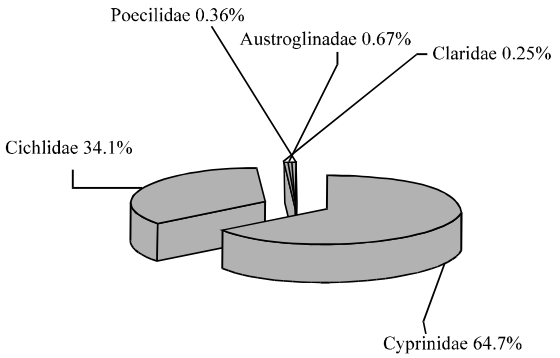

Fig. 2: Relative abundance of each family of fish

numbers at site seven (Sendelingsdrift). This species is the abundant in the Fish river, a tributary of the lower Orange river from Namibian side. Its appearance in the Orange river is definitely from the Fish river. *P. philander* was abundant in a wide variety of habitats and contributed 20.8% of relative abundance (Table 1). Large numbers of juveniles were sampled indicating successful recruitment in the system further, signifying its distribution in the system. *T. sparmanni* was abundant in vegetation and in stone out of current where the water flow was either slow or medium. It contributed a relative abundance of 13.2% (Table 1). *C. gariepinus* was numerically low but widely distributed at all sites. It was sampled mostly at the edges of the river and contributed 0.25% to the abundance (Table 1). The endemic *B. hospes* is confined to below Augrabies falls and its distribution is controlled by a natural barrier as it cannot migrate upstream (Benade, 1993; Skelton, 2001). It contributed 14.0% of relative abundance and was widely distributed in the lower Orange river with a large number of juveniles indicating successful recruitment. *B. anoplus* was widely distributed in low numbers. It contributed a relative abundance of 0.35% (Table 1). *B. paludinosus* was recorded in low numbers and comprised of 2.00% of relative abundance (Table 1). This species was more often recorded in the vegetation than any other biotope. *B. trimaculatus* was sampled in low numbers in vegetation and comprised of 0.45% catch (Table 1). The alien *Cyprinus carpio* were very low in numbers with

eighteen specimens recorded at three sites. It contributed 0.13% catch (Table 1). The water in the Orange river during the sampling was transparent which can be the reason why low numbers were recorded because the carp prefers turbid waters. If the water is clear other indigenous adult fish defends themselves by predating on their larval fish (carp). This species seemed not to be posing a potential threat to the indigenous freshwater fish species. The endemic *L. capensis* appeared to be the most abundant species in the system and was caught in all biotopes. It occurred predominantly near the riffles and shallow pools. This species comprised of 22.1% of relative abundance (Table 1).

The high abundance of *L. capensis* corroborates with the results of the study conducted by Benade (1993) and Naesje *et al.* (2007). The endemic *L. aeneus* appeared to be abundant in all biotopes. This species comprised of 5.96% of relative abundance (Table 1).

It was also recorded in high numbers during this study and agreed with the results of the previous studies conducted by Benade (1993), Cambray (1984) and Naesje *et al.* (2007). The endemic *M. brevianalis* contributed 19.4% of the catch (Table 1). Its distribution was widespread throughout the sampled sites below the natural barrier, Augrabies falls and was therefore, the most common species in the lower Orange river. *L. kimberlyensis* is endemic to the Orange-Vaal river system and was recorded in low numbers. It only contributed a relative abundance of 0.15% (Table 1).

This study supported previous findings of low numbers (Cambray, 1984; Benade, 1993; Skelton and Cambray, 1981; Naesje *et al.*, 2007). This can be ascribed to its predatory habits and the fact that it is a very slow grower where sexual maturity in females is reached after 8 years and in males after 6 years. The endemic *L. umbratus* was relatively low and uncommon at most of the sampled sites. It only contributed to a relative abundance of 0.04% (Table 1). The scarcity of *L. umbratus* concurred with the findings of Benade (1993), Naesje *et al.* (2007) and Ecosun (2005). According to Benade (1993) and Skelton (2001), the low numbers can be attributed to the river regulation and the scarceness of the slow moving water and shallow habitats. Hay reported that *L. capensis* and *L. umbratus* were hybridizing at Hardap dam in the Fish river, a tributary of the lower Orange river. Perhaps the low numbers could be attributed to hybridization. The previously fish studies conducted (Jubb and Farquharson, 1965; Jubb, 1967, 1972; Skelton and Cambray, 1981; Skelton, 1993; Benade, 1993; Ecosun, 2005; Naesje *et al.*, 2007) did not record an alien mosquito fish (*G. affinis*). This study therefore has revealed a new distribution of mosquito fish which seems to be widespread in the lower Orange river. It was caught in their preferred vegetated zones mainly because they feed on benthic insects. It constituted 0.36% of relative abundance (Table 1). It is still not known whether it will pose a significant threat to indigenous fish. The most likely explanation for the appearance of *G. affinis* in the Orange river can be attributed to rapid colonization from the Riet and Harts river and the Vaal river which is the principal tributary of the Orange river. In the present study, the overall hydrological regime, natural barriers and the characteristics of biotopes along the river stretches were the most likely factors explaining the variability in species distribution and abundance amongst the sampled sites.

CONCLUSION

The river has a good population of indigenous fish species. Amongst the collected fish species, the Cyprinidae family (minnows, mudfishes and yellowfishes) was the most dominant. Mosquito fish seemed to be spreading in the system. Fish species diversity was generally low and subadults and juveniles appeared in the catches at all sampled sites. However, further studies are necessary to determine the influence of ecological factors on the composition and distribution of fish communities at the entire stretches of the river.

ACKNOWLEDGEMENTS

My supervisor Ms. Elsabe Swart for her creative inputs and comments and Mr. Julius Koen for editing this document. The researcher also like to thank the department for equipments and financial support, Mr. Albert Mabunda and Ms. E. Botes for making funds available for me to conduct the research.

REFERENCES

Benade, C., 1993. Studies on fish populations in the regulated orange river system within the borders of the Cape Province. M.Sc. Thesis, University of the Orange Free State, pp: 185.

Bisht, B., A.K., Badoni and S.N. Bahuguna, 2009. Seasonal distribution and relative abundance of fish fauna of a small hill-stream dangchaura (Takoli) Gad, along with River Alaknanda. Our Nature, 7: 182-186.

Cambray, J.A., 1984. Fish populations in the middle and lower Orange River, with special reference to the effects of stream regulation. J. Limn. Soc. S. Afr., 10: 37-49.

Ecosun, C.C., 2005. Aquatic fauna assessment of the three proposed gauging weir in the Northern Cape. Project E424/06, pp: 1-34.

Jubb, R.A. and F.L. Farquharson, 1965. The freshwater fishes of the Orange river drainage basin. S. Afr. J. Sci., 61: 118-124.

Jubb, R.A., 1967. Freshwater Fishes of Southern Africa. A.A. Balkema, Capetown. Bloemfontein, South Africa, pp: 248.

Jubb, R.A., 1972. The fishes of the Orange River. The Civ. Eng. S. Afr., 14: 59-93.

Medeiros, E.S.F. and L. Maltchik, 2001. Fish assemblage stability in an intermittently flowing stream from the Brazilian semiarid region. Austr. J. Ecol., 26: 156-164.

Naesje, T.F., C.J. Hay, N. Nickar, J. Koekemoer, R, Strand and E.B. Thorstad, 2007. Fish populations, gill net catches and gill net selectivity in the lower orange, Namibia, from 1995-2001. NINA Report 231, pp: 81.

Skelton, P.H. and J.A. Cambray, 1981. The freshwater fishes of the middle and lower Orange River. Koedoe, 24: 51-66.

Skelton, P.H., 1993. A Complete Guide to the Freshwater Fishes of Southern Africa. Southern Book Publishers, South Africa, pp: 388.

Skelton, P.H., 2001. Freshwater Fishes of Southern Africa. Struik Publishers, Cape Town, South Africa, pp: 388.

Soyinka, O.O., M.P. Kuton and C.I. Ayo-Olalusi, 2010. Seasonal distribution and richness of species in the Badagry Lagoon, South West, Nigeria. Estonian J. Ecol., 59: 147-157.

Tooth, S. and T.S. McCarthy, 2004. Anabranching in mixed bedrock-alluvial rivers: The example of the Orange River above Augrabies Falls, Northern Cape Province, South Africa. Geomorphology, 57: 235-262.