

Freshwater Fish Species of the Oorlogskloof River, Northern Cape Province, South Africa

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Abstract

The freshwater fish of Oorlogskloof River were sampled in March 2010. The study aimed to determine the distribution and relative abundance of freshwater fish in the Oorlogskloof River. A total of 4643 individuals represented by five fish species belonging to two families were sampled. The *Barbus anoplus* was only sampled in the upper reaches of the Oorlogskloof River gorge while endangered *Labeobarbus capensis* appeared downstream in the Oorlogskloof River. *Barbus serra* dominated the fish species in the system. The invasion of *Tilapia sparamanni* in this system was confirmed during the survey and the species appeared to be widespread throughout the system. At this stage it does not appear to be posing a serious threat to the endangered fish species. The Oorlogskloof River can be considered as a potential refuge site for the conservation of some endemic and threatened freshwater fishes of South Africa.

Key words: Abundance, conservation, distribution, endemic, Oorlogskloof River

Introduction

The Oorlogskloof River plays a pertinent role as a spawning and nursery site for endemic and endangered fish species. The sound conservation management of the Oorlogskloof River within the 5 000 hectare Oorlogskloof Nature Reserve commenced in 1987. The relative inaccessibility of the Oorlogskloof River, where it flows through the Oorlogskloof gorge south of Nieuwoudtville, has prevented habitat destruction and other impacts prevalent along its upper catchment and other tributaries of the Olifants-Doring system. This has ensured that the Oorlogskloof River, within the Oorlogskloof Nature

Reserve, is of unparalleled importance in the Olifants-Doring system as a fish sanctuary (Impson, 1995). On the southern side of the Oorlogskloof Nature Reserve, the Oorlogskloof River becomes known as the Kobee River where the Klein Kobee River joins it. The Kobee is a tributary of the Doring River which runs into the Olifants River at Melkboom in the Western Cape Province. The Kobee River probably forms an important link for the clanwilliam yellowfish (*Labeobarbus capensis*), sawfin (*Barbus serra*) and clanwilliam sandfish (*Labeo seeberi*) on their migration from the Doring River to the spawning and nursery

grounds in the Oorlogskloof River gorge (Abrahams and Pretorius, 2000).

The Oorlogskloof River has a relatively low diversity of indigenous fish species and is dominated by cyprinids. Abrahams and Pretorius (2000) recorded a total of six fish species in the Oorlogskloof-Kobee River, with two alien species namely the smallmouth bass (*Micropterus dolomieu*) and bluegill sunfish (*Lepomis macrochirus*) recorded in the lower reaches of the Oorlogskloof River. A natural barrier of huge boulders is located in the lower reaches of the Oorlogskloof River (south of the Oorlogskloof Nature Reserve) and appears to be preventing these two species from migrating further upstream and reaching the Oorlogskloof Nature Reserve. Both the endangered sawfin (*B. serra*) and clanwilliam sandfish (*L. seeberi*) are endemic and spawn successfully within the Oorlogskloof River. The value of the reserve for indigenous fish conservation is further enhanced, as *Barbus anoplus* also occurs in the Oorlogskloof River system. According to Impson (1995) *B. anoplus* in the Oorlogskloof River may be a subspecies, as it is genetically distinct from other populations of the Olifants River and Orange-Vaal River system. The clanwilliam yellowfish (*L. capensis*), classified as vulnerable, has also been recorded in the Oorlogskloof and Kobee rivers. The last time it was recorded in the Oorlogskloof Nature Reserve was in 1982 and the cause for its decline in the reserve is unknown and need further investigation (Abrahams and Pretorius, 2000).

In 2009 reports were received that there were numerous small fish in the Nieuwoudtville municipal dam (pers. comm. Pretorius), which lies within the

catchment of the Oorlogskloof River north of the Oorlogskloof Nature Reserve. These were subsequently netted using a seine net and proved to be banded tilapia (*Tilapia sparamanni*). In March 2010 a survey was conducted in the Oorlogskloof River by a team of officials from the Northern Cape Department of Environment and Nature Conservation and CapeNature. The aim was to investigate the distribution and abundance of the indigenous species known to occur in this river, as well as investigate whether the *T. sparamanni* had invaded the Oorlogskloof River from the Nieuwoudtville municipal dam. The Nieuwoudtville area was flooded in July 2007 making this a distinct possibility.

Materials and methods

Site description

The Oorlogskloof River originates in the Roggeveld Mountains near Calvinia in the Northern Cape Province, South Africa. It can be regarded as naturally seasonal, with flows in summer ceasing until the first major rains in the catchment in winter. However, the flow regime is highly variable and unpredictable (Abrahams and Pretorius, 2000). In its upper catchment, it flows through livestock farms and arable fields. Fields are often overgrazed and much of the riparian vegetation is disturbed with alien terrestrial plants such as mesquite (*Prosopis glandulosa*). An area approximately six kilometres upstream of the northern boundary of Oorlogskloof Nature Reserve has been invaded by mesquite and blue gum (*Eucalyptus camaldulensis*). The Oorlogskloof Nature Reserve, where most of the survey took place, is situated on the Bokkeveld Plateau in the Nieuwoudtville

area and falls within an area marked by sharp climatic, geomorphological and biological transition (Abrahams and Pretorius, 2000). South of Nieuwoudtville the Oorlogskloof River drops into a deep ravine which forms the eastern boundary of Oorlogskloof Nature Reserve. The terrain bordering the river is rocky and almost inaccessible and has prevented habitat destruction and other adverse anthropogenic impacts prevalent along its upper catchment.

Study area

The same 32 sites sampled in 2000 by Abrahams and Pretorius were sampled again in March 2010. These sites were all located in the Oorlogskloof River gorge above the Klein Kobee River and Oorlogskloof River junction. In addition the Nieuwoudtville municipal dam was also sampled. Fish were collected using a seine net (6m x 1m) at each sampling site. Gill nets were not used due to the high numbers of endemic and endangered fish species in the study area. A subsample of 50 specimens was measured for the standard length and total length and the remaining were counted for total numbers.

Data Analysis

Fish data collected was analyzed using Shannon-Wiener Index (H) to evaluate species diversity. 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) = n_i/N ,
 n_i = the number of individuals within a species,

N = total number of individuals in all species,

\ln = natural log, = sum of the values for each species. Therefore percentage ($\%P_i$) = the number of individuals within a species (n_i) divided by the total number of individuals (N) present in the entire sample x 100. The relative abundance gave comparisons of diversity at all the sampled sites.

Results

M. dolomieu and *L. macrochirus* have previously been recorded in the lower reaches of the Oorlogskloof River, below a natural barrier. This study showed that these alien fish were still not present above the natural barrier. The fish species recorded in the Oorlogskloof river gorge above the natural barriers were namely: *B. serra*, *B. anoplus*, *L. seeberi*, *L. capensis* and translocated *T. sparmanni*. Of the indigenous fish caught in the Oorlogskloof River *B. serra* comprised the largest proportion of 80.4% ($n = 3735$), followed by *L. seeberi* 8.01% ($n=372$), *B. anoplus* 8.00% ($n = 371$), *L. capensis* 0.60% ($n=28$) and *T. sparmanni* 3.00% ($n = 137$) occurred throughout the range sampled with the small species *B. anoplus* largely restricted to the Oorlogskloof River (Tab. 1).

a) *B. anoplus*

During this study the indigenous *B. anoplus* was distributed in low numbers and contributed a relative abundance of 8.0% (Tab. 1). The population appeared to be more abundant in upstream than in downstream. All the sites where it was recorded comprised predominantly of juveniles of 2-4 years of age and ranged in

length from 29 mm to 95 mm. Most individuals were recorded at site 2 (n=183) and site 3 (n=110) (Tab. 1). Most individuals appeared to be embedded with digenean cysts.

b) *L. seeberi*

During this study *L. seeberi* (endangered) was found to be substantially distributed in the Oorlogskloof River system. It contributed a relative abundance of 8.01% (Tab. 1). Total length ranged from 22mm to 270mm with a good distribution of juveniles, sub-adults and adults.

c) *B. serra*

The endangered *B. serra* was the most abundant species in the system and it exceptionally comprised of 80.4% of the total catch (Tab. 1). The bigger the pools the more fish were recorded during this study. Its populations were dominated by juvenile fish and subadults. Its standard-lengths varied between 16mm and 270 mm.

d) *L. capensis*

The numbers of endemic *L. capensis* were relatively low, contributing to a relative abundance of 0.60% (Tab. 1). They were recorded at only six of the sampled sites. Total length ranged from 75mm to 125mm. Its populations were dominated by sub adults fish.

e) *T. sparmanni*

During this study *T. sparmanni* comprised 3.00% of total catch (Tab. 1). It appeared remarkably widespread in the system with site 14 comprising the highest recorded number of (n=45). Most of the *T. sparmanni* juveniles at the sampled sites were between 30mm and 80mm, but sub adults of up to

145mm were also present. Very small juveniles ranging from 30mm were found more frequently at other sites.

Discussion

Generally in aquatic ecosystem there are factors that affect fish species composition, distribution and abundance. The variation in individual growth in fish populations occur because growth is strongly dependent on food availability, flow dynamics and water temperature (Persson and De Roos, 2001; DeAngelis Rose *et al.*, 1993; Cincotta and Staffeur, 1984). However in natural populations there is a trend of species size dissimilarity amongst individuals born at the same time in the same environment, affected and influenced by biotic and abiotic factors (Persson and De Roos, 2001; Husset *et al.*, 2007). Depending on size reached at certain times of the season, variability in life history among individuals can be crucial for whether a total recruitment failure will take place or whether some larger individuals can survive (Huss *et al.*, 2007). When favourable conditions are attained, the survival improves and the dominant group begins to grow.

During this survey, only a hand drawn seine net was used to sample the fish populations. This net may have been biased in that only fairly shallow pools, or shallow areas in large pools, could be netted and therefore larger individuals may be absent from the sample. However, despite a possible bias towards smaller size, the fish results manifested that the Oorlogskloof River contains healthy endemic fish populations with juveniles of sawfin and sandfish in particular, occurring in multiple pools netted. The Oorlogskloof-Kobee Rivers also provide connectivity for the

Table 1. Species composition recorded during the sampling surveys 2010

Locality	<i>B. anoplus</i>	<i>B. serra</i>	<i>L. capensis</i>	<i>L. seeberi</i>	<i>T. sparmanni</i>	Total
Site A1	4	17		20		41
Site 1	53	49		4		106
Site 2	183	27		75	3	288
Site 3	110	15		83		208
Site 4	4	18		3		25
Site 5	7	50			3	60
Site 6		141		1	9	151
Site 7						
Site 8		442		33	1	476
Site 9					11	11
Site 10				1		1
Site 11				1		1
Site 12		120			5	125
Site 13		58		2	1	61
Site 14		2		1	45	48
Site 15	5	402		23	2	432
Site 16		120	1	12		133
Site 17		72		24		96
Site 18	5	88		14	5	112
Site 19		63		3		66
Site 20		49		3	3	55
Site 21		46		6		52
Site 22		80		1		81
Site 23		219		6		225
Site 24		20	1	1	9	31
Site 25		181		3	5	189
Site 26		124	14	7	3	148
Site 27		51	8	26	11	96
Site 28		353		3	1	357
Site 29		40		2		42
Site 30		49	3			52
Site 31		687	1	11	5	704
Site 32		152		3	15	170
Total	371	3735	28	372	137	4643
% pi	8.00%	80.4%	0.60%	8.01%	3.00%	100%

upstream migration of these fish and the dispersal of sub adult fish from their nursery grounds to the main stem Doring River (Impson, 1997).

a) *B. anoplus*

This species prefers cold waters and occurs in a wide range of habitats varying from shallow streams to the shorelines of large impoundments (Cambray *et al.*, 1978; Skelton, 2001). It breeds in the summer when rivers are filled with water. It is omnivorous and is preyed upon by larger fish and birds. Unlike other fish species that migrates upstream in order to spawn, spawning migration of *B. anoplus* is not necessary because they can spawn locally if there is an increase in the water flows and inundation of the marginal vegetation (Cambray *et al.*, 1978).

During this study the indigenous *B. anoplus* was distributed in low numbers and contributed a relative abundance of 8.00% (Tab. 1). The high numbers of *B. anoplus* occurring upstream in the Oorlogskloof Nature Reserve can probably be attributed to bigger size of the pools with associated diversity of marginal vegetation. The number of juveniles versus adults could be due to a bias in the seine netting, with adults possibly preferring the deeper vegetated areas of the pools. According to Cambray and Bruton (1985), size of 73mm fork length females reflects age of 3-4 and size 60mm of males reflects 2-3 years. Most of the individuals recorded during this study appeared to be within the aforementioned range. *B. anoplus* can survive harsh environmental conditions but if the area is affected by climate change many

individuals may die as the shallow, deep and remnant pools dry out.

b) *L. seeberi*

L. seeberi prefers pool waters and deep runs of the river (Skelton, 2001). It is distributed in the Olifants-Doring river system but seems to be absent in the Upper Olifants river. The invasive alien fish species such as *M. dolomieu*, *M. salmoides*, and *L. macrochirus* coupled with agricultural activities have made a significant population decline of *L. seeberi* (Impson 1997). The results of this study concurred with the study conducted by Abrahams and Pretorius (2000) who reported high numbers at most of the sampled sites. The abundance of *L. seeberi* in the river can probably be attributed to successful spawning due to intact habitat, and the lack of the more aggressive predatory alien fish, as well as the presence of unlimited food availability from the decomposed vegetation. This in turn encourages the rapid increase of freshwater invertebrates, a diet for several other fish species. Results of fish measurements showed that the Oorlogskloof river populations have a good distribution of juveniles, sub-adults and adults. What was encouraging was that juveniles with <50mm total length occurred at the sites occupied by the translocated species *T. sparmanni*. Indications are therefore that the *T. sparmanni* may not pose a threat to abundance and distribution of *L. seeberi* at this stage. According to Skelton (2001) the decline in the recruitment of *L. seeberi* is caused by poor water quality, habitat modification and dam construction which cause significant changes in the annual flow

patterns. The damming of the Oorlogskloof River and habitat destruction should be discouraged in order to ensure the conservation of this species. Climate change predictions should also be taken into account during any conservation planning, as an increase in extreme events such as droughts, could cause a crowding effect on fish resulting in massive fish kills due to lack of oxygen. Due to the relative abundance of *L. seeberi* and good age distributions recorded, this population is of huge importance and due to its conservation status; it should be monitored regularly to determine population decrease.

c) *B. serra*

This fish favours deep pools (Skelton, 2001). It used to be widespread and substantially abundant in the Olifants River but the number have decline due to invasive alien fish and habitat degradation and fragmentation (Impson, 1999). In late spring and summer the school of adults migrate upstream to shallow riffles and cobbles to spawn (King *et al.*, 1998; Skelton, 2001). According to Paxton *et al.* (2002) the Oorlogskloof-Kobee River system is the most important in terms of *B. serra* habitat and recruiting populations are known to occur in the Oorlogskloof Nature Reserve. The high numbers and good age distribution of *B. serra* recorded during this survey indicated a healthy population status and that there is still significant recruitment of this species in the system. Relatively high numbers of fish were collected and showed distinct cohorts and thus supported the findings of Abrahams and Pretorius (2000) and Paxton *et al.* (2002). The size variations showed that the predation by *T.*

sparmanni is low and therefore not affecting the distribution and abundance of fish at this juncture. The increase in the numbers of *B. serra* at some of the sites may have been the result of a variety of substrate, appearance of submerged vegetation and woody debris which are an important refuge for small fish. Another factor may have been changes in the water velocity and depth at certain sites, which favours the establishment of these species.

d) *L. capensis*

L. capensis is endemic to the Olifants-Doring River system and it prefers deep pool waters (Skelton, 2001). It is widespread in the Doring River but the numbers appear to be declining due to bass invasion/predation (Paxton *et al.*, 2002). The numbers recorded during this study supported previous findings of Abrahams and Pretorius (2001) which recorded low numbers of fish. Results showed a poor reproductive success or perhaps high mortality of juveniles, which likely will lead to long-term population decline.

Causes for the poor success of *L. capensis* in this system could possibly be ascribed to environmental flows, habitat integrity and competition of food or perhaps invasion by *T. sparmanni*. The mature individuals of *L. capensis* migrate upstream to spawn in summer in response to the increased water flows (King *et al.*, 1998; Skelton, 2001). There are indications that they might not spawn every year due to environmental factors, which may be why juvenile fish numbers were so low. However, *L. capensis* is a multiple spawner during the breeding season (Cambray, 1999), so if there were spawning events

over the last few years, more sub adults and juveniles should have been recorded. The bias of the seine net also needs to be taken into account, but as healthy numbers of juvenile and sub adults of the other fish sampled were recorded, one would have expected a fairly good representation of juvenile and sub adult numbers of *L. capensis* as well.

e) *T. sparmanni*

T. sparmanni is tolerant of a wide range of habitats, preferring slow moving or standing waters with submerged or emergent vegetation (Skelton, 2001). It is omnivorous and feeds on algae, soft plants, small invertebrates such as insects and small fish (Skelton, 2001). Its presence in the system is likely attributed to the flooding of Municipal dam in 2007. Individuals were also netted in this dam during this study and in 2009 (pers. comm. Pretorius). It was considered common along the entire length of the Oorlogskloof River gorge surveyed, but were more abundant downstream than upstream probably due to habitat requirements. According to Skelton (2001) it attains a standard length of about 230mm but none were recorded, perhaps due to seine net bias or due to habitat limitations. Large numbers of juvenile and sub adult *T. sparmanni* were recorded indicating successful recruitment in the system, further signifying its distribution in the system.

Conclusion

The Oorlogskloof River has a relatively low diversity of indigenous fish species and is dominated by cyprinids. This survey reaffirmed the importance of the Oorlogskloof Nature Reserve as an important breeding

and nursery area for endangered *L. seeberi*, *B. serra* and *B. anoplus*, despite the invasion of *T. sparmanni*. The Oorlogskloof River supports a healthy fish species composition and provides good breeding and nursery ground for endangered fish species. It is one of a few potential statutory conservation areas and a natural riverine sanctuary on the Olifants-Doring River system. Accordingly it is of immense importance to the survival of at least two (possibly three, including *L. capensis*) threatened fish species and the genetically-unique *B. anoplus*. *L. seeberi* was widespread throughout in the system while *B. serra* was the most dominant species. Interestingly no *B. anoplus* were recorded at the sites where *L. capensis* were recorded and this apparent association needs further investigation, as well as why *L. capensis* does not appear to be recruiting or surviving well in this system. Regular monitoring and more research are urgently required in the Oorlogskloof Kobee river system in order to ensure the conservation of these important fish species and their habitat.

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