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Prepared for

Klipkop Conservancy

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1. Terms of reference

Econ@uj, a consortium of environmental specialists based in the Zoology Department of the University of Johannesburg, has been requested to provide a proposal and quotation for the completion of a fish study of the aquatic ecosystems in the Klipkop Conservancy. The study will have the following parts:

- Sampling of fish from the Klipkop Conservancy aquatic ecosystems.
- Identify any problems associated with alien fish if present.
- Provide a general indication of the fish health within the aquatic ecosystems.

2. Introduction

The use of fish communities in the monitoring of aquatic ecosystems have been widely used to determine the overall condition of aquatic ecosystems. Fish communities have certain advantages when used as indicators of ecosystem integrity namely (Kotze, 1999):

- Fish are present in most aquatic ecosystems except when the system is highly degraded.
- Fish can be easily identified and then returned to the aquatic ecosystem.
- Most fish species have background information available in terms of life-history and environmental response information.
- Fish are mobile and can integrate contaminant exposure or habitat degradation over a river reach.
- Fish are generally long-lived and as such can provide long term information regarding environmental stress.
- Fish communities are composed of various trophic levels and can indicate stressor responses at many trophic levels.
- Fishes often exhibit physiological, morphological, or behavioral responses to stresses, which have been grouped into chemical stressors, physical stressors, and perceived stressors.
- Due to the importance relating to the safe consumption of fish and the recreational, subsistence and commercial fishing activities, the public is likely to relate to information concerning fish communities rather than other biotic communities.

It is important to consider some disadvantages relating to the use of fish as bioindicators. Some disadvantages include:

- The select nature of sampling techniques and equipment for certain species, sizes and habitats of fishes.
- Sampling bias due to the seasonal migration and/or movement of fishes.
- A large sampling effort is often required to adequately characterize fish assemblages.
- Some fish species may be influenced by the sampling techniques.
- Being mobile, fish can avoid local disturbances and not be exposed to environmental impacts.
- Due to fishes often representing higher trophic levels, lower level organisms may provide an earlier indication of water quality pollution.

The RHP (Mangold, 2001) and FRAI (Kleynhans 2007) sampling methodologies were used to assess the fish populations in two dams within the Klipkop Conservancy. The dams are situated on the Pienaars River and one of its smaller tributaries. The dams are the Klipkop Dam on the Pienaars River and the Tweedragt Dam on the tributary. The area is situated in the upper catchment of the system with the source only being a few kilometers upstream. The conservancy does not fall within the irreplaceable category as defined in the Gauteng conservation plan but some small areas do fall into the important category. The ridges within the area are deemed more important than the aquatic ecosystem.

3. Materials and Methods

The Klipkop conservancy have two major streams running through it in the form of the Pienaars River and a tributary (Figure 1). These two streams feed the Klipkop and Tweedragt dams respectively. The instream channels of both streams are dominated by reed growth and extensive wetlands at places. The majority of open water is found within the dams and to some degree below the dams before the streams exit the conservancy. The marginal vegetation is dominated by reeds as well as sedges. The dams both contain significant quantities of water grass and in the Tweedragt Dams' case almost completely cover the water surface.

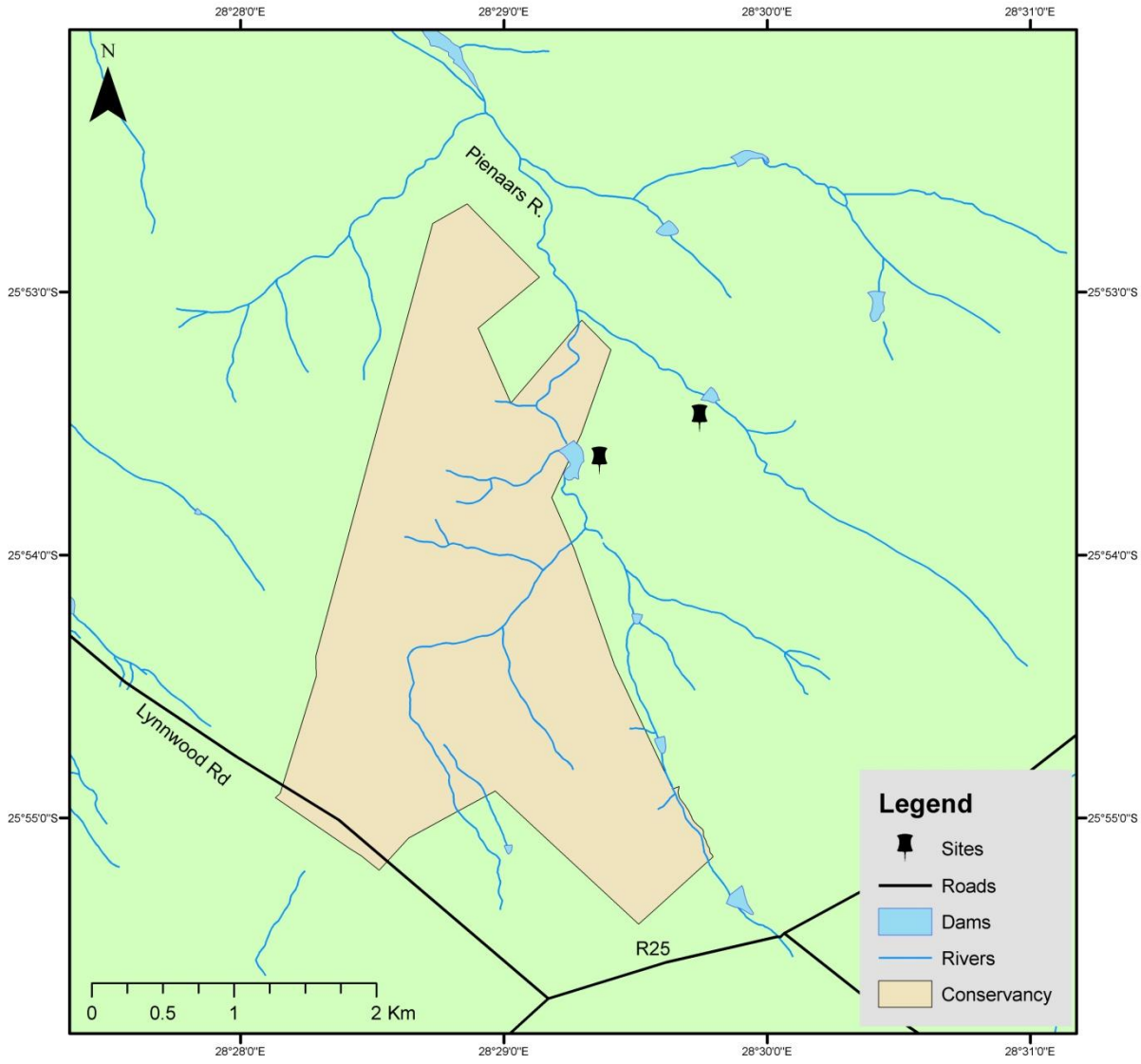

Figure 1: Map of the Klipkop Conservancy and the sites used for the fish sampling during the study.

The technique used to sample the fish community was electroshocking (Meador *et al*., 1993; Barbour *et al.*, 1999). A Samus battery operated electroshocking apparatus was used to sample fish in the available habitat at each dam. The electroshocking technique was implemented for between 20 to 30 min depending on the dam and habitat availability. All the fish caught were identified and returned. When the fish could not be identified on site it was preserved in 10% formalin for identification in the laboratory.

Furthermore, fyke nets were employed for between 2 – 4 hours in each dam to sample deeper water. Fyke nets were checked every hour to ensure survival of fish. Additionally, a

gill net was employed in Klipkop Dam for a period of 2 hours. The use of rod and reel was also employed for around 0.5 to 1 hour to sample specific species. A short section of a gill net was also employed for a time period of around one hour in the Klipkop Dam. It was not very effective as the amount of open water were limited due to water grass.

Table 1: Reference species list for the Pienaars River in the upper catchment from the FROC database (Kleynhans *et al.*, 2007). Site 3CWF112 was used to compile the list. However, no sampling has been completed to confirm the occurrences of these species.

Species Name	CODE	FFROC	CONFIDENCE
***Clarias gariepinus**	CGAR	1	4
Barbus anoplus	BANO	1	3
Anguilla mossambica	AMOS	1	3
Labeo molybdinus	LMOL	2	3
Chiloglanis pretoriae	CPRE	2	3
Mesobola brevianalis	MBRE	3	4
***Pseudocrenilabrus philander**	PPHI	3	3
***Tilapia sparrmanii**	TSPA	3	3
Barbus trimaculatus	BTRI	3	3
***Barbus unitaeniatus**	BUNI	3	3
***Barbus paludinosus**	BPAU	3	3
***Oreochromis mossambicus**	OMOS	3	4
***Labeobarbus marequensis**	BMAR	4	3

* Species sampled downstream from this RHP monitoring site

The list of expected species for the upper catchment of the Pienaars River is provided in Table 1. This information was taken from the Reference Fish Frequency of Occurrence compiled by Kleynhans *et al.* (2007). A FROC score of 1 would indicate the species occurs at < 10% of sites while 4-5 will indicate species occurs at more than 90% of sites. The proposed site used for the list (3CWF112) has unfortunately not been previously sampled and the list was compiled using expert opinion and sampled sites in other similar catchments. The site is a few kilometers downstream from the Klipkop conservancy but is still within the same river type and ecoregion. The list in Table 1 also indicates species that were sampled at a River Health Programme (RHP) site further downstream.

4. Results and Discussion

The results of the fish survey are presented in Table 2 together with the fish results from the 2006 survey. This sampling survey only caught two fish species and identified a third species with visual observation. The fish caught was *Clarias gariepinus* and *Barbus anoplus*. The exotic fish *Cyprinus carpio* were seen during the survey but was not caught. This is due to the extensive water grass present in the Klipkop Dam which serves as habitat for the carp. None of the other species on the expected list were sampled.

However it must be noted that the possibility of all these fish being present within the conservancy are unlikely, even historically as the upper reaches of systems quite often will not be able to support the larger fish species. Some of the fish species also prefer riffles which are limited due to wetland formation and stream flow disruptions. The fish species that were realistically expected to occur might still be present but only occurs in reduced abundances making them harder to sample.

Table 2: Results of the fish sampling during the 2010 sampling survey. The 2006 sampling results are included for comparison.

Species Name	CODE	2006	2010	
		Klipkop	Klipkop	Tweedragt
Clarias gariepinus	CGAR	10	1	1
Barbus anoplus	BANO	35	34	70
Anguilla mossambica	AMOS	-	-	-
Labeo molybdinus	LMOL	-	-	-
Chiloglanis pretoriae	CPRE	-	-	-
Mesobola brevianalis	MBRE	-	-	-
Pseudocrenilabrus philander	PPHI	-	-	-
Tilapia sparrmanii	TSPA	-	-	-
Barbus trimaculatus	BTRI	-	-	-
Barbus unitaeniatus	BUNI	-	-	-
Barbus paludinosus	BPAU	-	-	-
Oreochromis mossambicus	OMOS	-	-	-
Labeobarbus marequensis	BMAR	-	-	-
*Cyprinus carpio**	CCAR	-	Visual obs	-

*Exotic species

The extensive water grass problem in both dams can possibly be attributed to nutrient inputs from upstream sources. The water grass could be a problem that has caused many of the expected species to become less abundant and possibly decreased. The carp have also proliferated due to more food availability within the dams. Although no carp were seen in the Tweedragt Dam the possibility are significant that they do occur there. The *B. anoplus* that are present within both of these dams were healthy and the abundances were fairly high. The bright yellow colours of the fish are an indication of breeding as these colours are only visible during the breeding season. The previous survey in 2006 also sampled significant numbers of *B. anoplus* indicating that the community are stable and no impacts are visible on this species.

The previous survey in 2006 was launched to look at the possibility of bass, *Micropterus salmoides*, occurring within the system. During that survey, as well as during this recent survey no evidence was seen of bass within the system. Bass are predatory fish that feed on the fry of other fish as well as smaller fish like *B. anoplus*. As the *B. anoplus* community seems healthy and abundant the presence of bass are highly unlikely.

The conservancy are also worried about the decrease in certain water birds in the recent years. This was thought to be due to decreased fish abundances due to the presence of bass. However, as no bass are present within the system another source could be the cause. One possibility can be the significant growth of water grass in the system that makes the habitat available for the waterbirds less.

5. Conclusion and Recommendations

The fish community in the Klipkop conservancy are impacted as many of the expected fish species do not occur or have a significantly decreased abundance. Only two indigenous fish species were sampled i.e. *C. gariepinus* and *B. anoplus* while the exotic carp, *C. carpio* were observed in the Klipkop Dam. The presence of the water grass in both dams are a significant problem in the system and could be a cause of the decrease in fish species as well as the resulting decrease in certain waterbirds. However, a change in the land use within the area can also be the cause in the decline of waterbirds in the system.

The following recommendations can be made from this study:

- A study on the water quality upstream of the conservancy to determine if any nutrient impacts are the cause for the water grass.

- The removal of the water grass to increase the habitat availability for fish in the system.
- The removal of the *Cyprinus carpio* from the system to decrease disturbances from the bottom sediment that could be contributing to water grass proliferation.
- The removal of water grass can be done in three ways:
    - Mechanical/physical removal.
    - Chemical removal with the use of herbicides.
    - Biological removal through the introduction of grass carp, *Ctenopharyngodon idella*, to feed on the water grass.

6. References

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