

BIOMONITORING MBHASHE RIVER SYSTEM SEPTEMBER 2008 (DRAFT)



water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA



EXECUTIVE SUMMARY

The National Aquatic Ecosystem Biomonitoring Programme was set up in South Africa in 1994. The aim of this programme was to monitor the health of aquatic ecosystems using biological organisms. The first focus of the programme was on rivers, with the River Health Programme (RHP) adopted on a national level and framework documents for implementation being produced in 1996. The programme aims to promote standardised and continuous monitoring and reporting on river health, and is operated at both national and provincial level. Field indices used for data collection included the South African Scoring System version 5.0 (SASS5) for macro invertebrates, the Fish Assemblage Integrity Index for fish (FAII), (VEGRAI), the Geomorphology Assessment Index (GAI) and a water quality assessment

SOUTH AFRICAN RIVER HEALTH PROGRAMME

Biological monitoring, or bio monitoring, is a method for determining the present state or ecological health of a system by assessing the health status of the organisms living in and around that system. It is based on the recognition that monitoring of physico-chemical water variables only is not sufficient to achieve integrated ecosystem monitoring, but that the additional monitoring of biological communities offers a more holistic approach. A range of communities are assessed, e.g. in-stream communities such as fish, macro invertebrates, algal forms such as diatoms, and in-stream, fringing and riparian vegetation, as well as the physical template upon which the biota depend. Physical parameters include the hydrology and water quality of the system, as well as the geomorphological shape and form of the river channel. If information on all these physical indicators is not available, a habitat integrity assessment can be conducted as it provides qualitative information on all physical indicators used in the RHP. This index primarily assesses the impact of human disturbances on riparian and in-stream habitats.

Bio monitoring is therefore an *effects or response-oriented* approach which measures various indicators, and from these measurements, makes an assessment about the health of the aquatic ecosystem. The focus of this approach is therefore the resource, specifically the status of that resource (Uys et al., 1996; Roux, 2003). Biological indicators are therefore able to provide early warning of deterioration of the system or of unsustainable use of its resources, and act as *red flags* indicating that deterioration may be taking place, but without providing any causal links. The bio monitoring technique is usually favoured for its speed, simplicity, effective results and ease of interpretation as well as for recognizing that a freshwater ecosystem is made up of many mutually dependent parts.

1. MBASHE RIVER SYSTEM

The Mbashe River is located in Mzimvubu to Keiskamma Water Management area (WMA12), has a catchment area of about 8679 km². The river begins in the Drakensburg Mountain range and passes through Elliot, Engcobo and Idutywa. The major tributaries of the system are Mnyolo, Mgwali and Xuka.

The mean annual precipitation (MAP) in the area is 810 mm and the total MAR is 1 129 million m³/a. The main river is the Mbashe River at (T11 and T13).

ECO REGIONS

The Mbashe river catchment falls within two level 1 ecoregions, namely, Ecoregion 16- South Eastern Uplands and Ecoregion 31 – Eastern Coastal Belt.

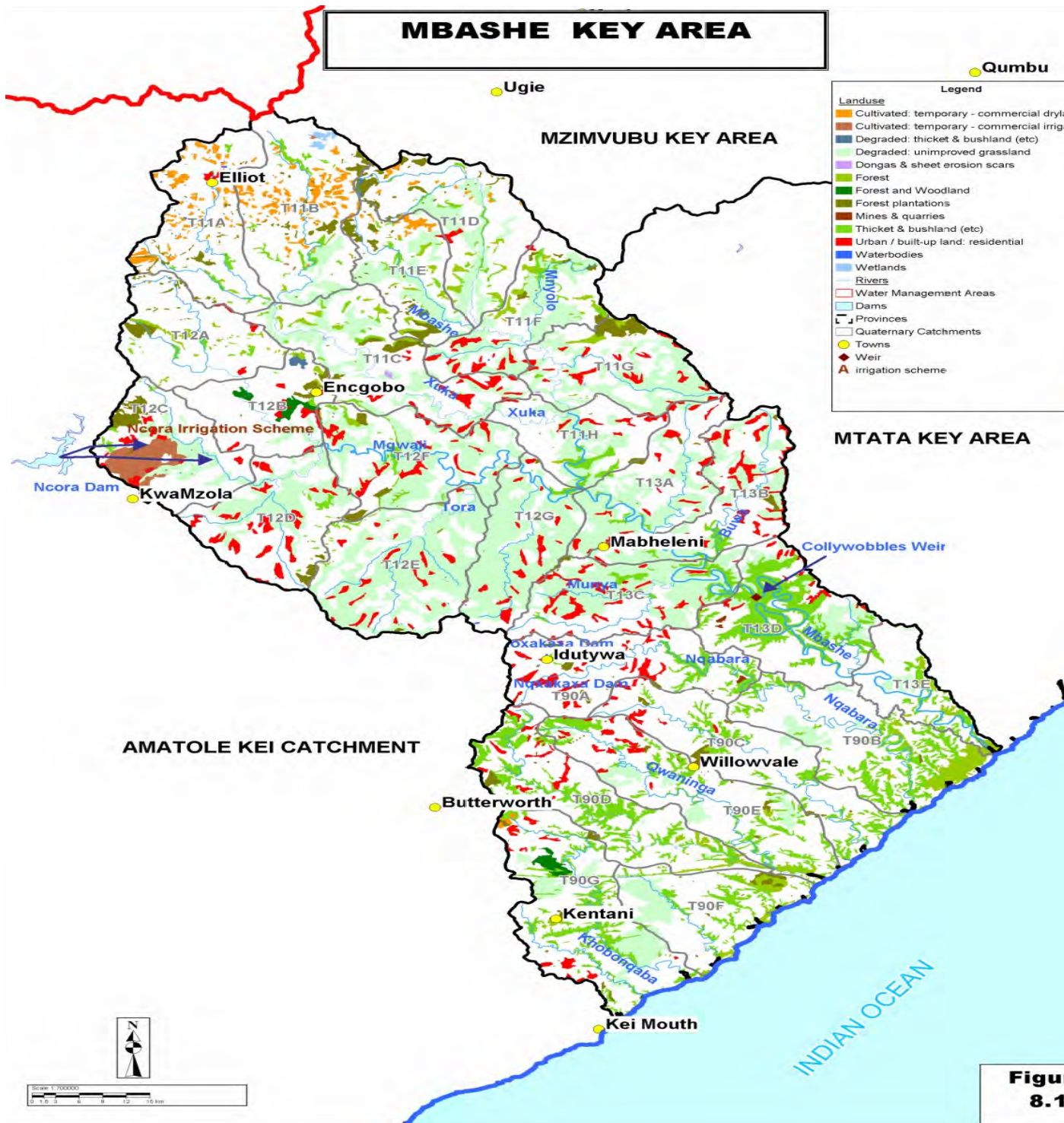


Figure 1: Showing the Quaternary Catchments of the Mbashe River System.

1.1 MBASHE RIVER SYSTEM BIOMONITORING

This was the second biomonitoring by the ECRHP for 2008. The autumn biomonitoring was done in May 2008. As this biomonitoring was conducted on the first week of the spring season temperatures were still cold, representing the winter season. The seasonal Biomonitoring is done to understand how the system works in different temperatures and for data collection to update the riversdatabase.

11 sites from the Mbashe River Catchment were selected by the ECRHP team for Biomonitoring, **3 sites from Mbashe River, 1 site from Mnyolo River, 3 sites from Xuka River and from 4 Mgwali River.**

(See diagram below)

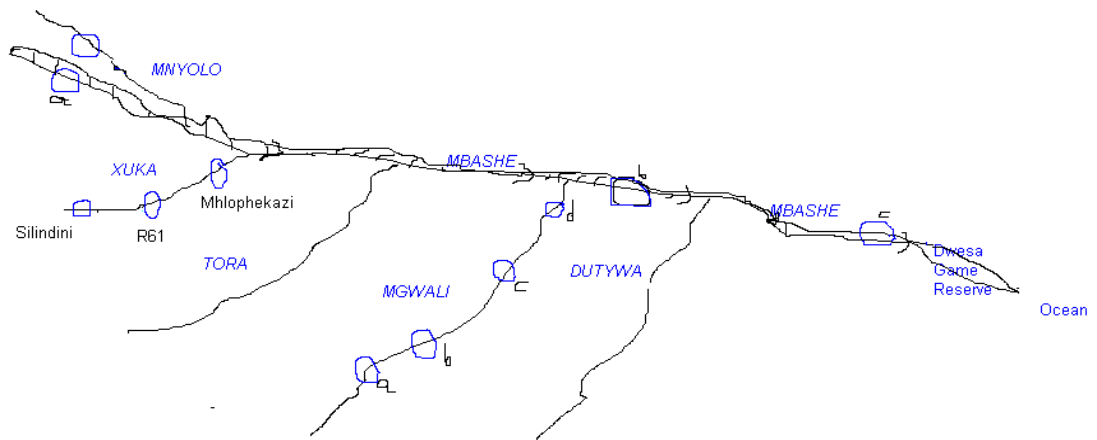


Figure 1.1: Showing the Biomonitoring sites in the Mbashe River Catchment.

Site	Description	Coordinates	Site Code
1	Mbashe upper reaches	S31°32.879; E28°09.772	T1MBAS-UPPER
2	Mnyolo river bridge	S31°42.082; E28°14.801	T1MNYO-BRIDG
3	Xuka at Slindini	S 31 34 21.1 E 27 57 14.7	T1XUKA-SILIN
4	Xuka river at R61 bridge	S31°40.32; E28°06.57	T1XUKA-R61BR
5	Xuka river at Mhlophekazi	S31°43.615; E28°16.167	T1XUKA-MHLOP
6	Mgwali river at R61 bridge	S31°44.004; E27°56.963	T1MGWA-R61BR
7	Mgwali river at Ngcacu bridge	S31°46.152; E28°07.340	T1MGWA-NGCAC
8	Mgwali river at Tora	S31°49.243; E 28°10.615	T1MGWA-TORA
9	Mgwali river at Makhobokeni	S31°50.808; E28°18.878	T1MGWA-MAKHO
10	Mbashe river at N2 bridge	S E	T1MBAS-N2BRI
11	Mbashe river at Mpozolo	S E	T1MBAS-MPOZO

Table 1.1: showing the GPS Co-ordinates and Site Codes.

The following field indices were used to assess the ecological health of the Mbashe system:

1. SASS 5 – Macroinvertebrates

Aquatic invertebrate communities respond relatively quickly to localised conditions in a river, especially water quality and habitat diversity. These communities are common, have a wide range of sensitivities, and have a suitable life-cycle duration that indicates short to medium-term impacts of water quality. Reports use the South African Scoring System or SASS to express the sensitivity of macro-invertebrates as an index score, also called the average score per taxon (ASPT).

2. FISH

Fish are relatively long-lived and mobile, so they indicate longer-term changes in the condition of river habitats due to changes in river flow, river structure or the chemical composition of the water. To determine the fish habitat index, the FUZZY FISH INDEX was used, to assess the characteristics of a fish assemblage in a specific river reach, including the number sensitivity to disturbance and preferences regarding environmental conditions.

3. WATER QUALITY

Water quality variables that determine the ability of a river to support aquatic ecosystems include turbidity, suspended solids, temperature, pH, salinity, dissolved ions, nutrients and metals. Pollution associated with human activity in the river basin and natural geomorphic processes can alter the quality of the water to detrimental or lethal levels for aquatic organisms.

1.2 MATERIALS AND METHOD

Macroinvertebrates were sampled using SASS 5 method and Fish were sampled using a Fish Shocker. Water Quality parameters (pH, Conductivity, Temperature, DO) were measured on site using a multimeter, 1 L samples were sent to the laboratory for other parameters.

2. RESULTS FOR ALL SITES

2.1 SASS 5

Site	Description	SASS SCORE	NO OF TAXA	ASPT	CLASS
1	Mbashe upper reaches	112	32	5.9	FAIR/C
2	Mnyolo river bridge	74	10	7.4	NATURAL/ A
3	Xuka at Slindini	66	10	6.6	GOOD/B
4	Xuka river at R61 bridge	112	19	5.9	FAIR/C
5	Xuka river at Mhlophekazi	148	22	6.7	GOOD/B
6	Mgwali river at R61 bridge	218	32	6.8	GOOD/B
7	Mgwali river at Ngcacu bridge	130	20	6,5	GOOD/B
8	Mgwali river at Tora	105	18	5.8	FAIR/C
9	Mgwali river at Makhobokeni	54	11	4.8	POOR/D
10	Mbashe river at N2 bridge	78	15	5.8	FAIR/C
11	Mbashe river at Mpozolo	58	7	8.2	NATURAL/ A

Key: ASPT interpretation
<5 = poor (highly impacted site)
5-5.9= Fair (Impacted site)
6-6.9= Good site
7& above = natural site

2.2 FISH

The (A) next to the fish species indicates alien species and (I) indicates indigenous species. (J) under the column number of species are the juveniles whereas (A) are the adults.

SITE	SPECIES	NUMBER OF FISH SAMPLED
1. Mbhashe upper reaches	<i>Barbus pallidus</i>	1 J
2. Mnyolo @ Mnyolo Bridge	No fish caught	
3. Xuka @ Slindini	<i>Labeobarbus aeneus</i> (A)	8 A 4J 1 J
4 Xuka @ R61	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I)	5-J 2-A 1 with parasitic infestation 1 adult
5. Xuka @ Mhlopekazi	<i>Labeobarbus aeneus</i> (A) <i>Barbus pallidus</i> (I)	10 A 4 J
6. Mgwali @ R61	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I) <i>Anguilla marorata</i> (I)	2-A - caught by local fisherman 1-J caught in SASS net Indigenous knowledge Indigenous knowledge
7. Mgwali @ Ngcacu	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I)	24 J 1- J
8.. Mgwali @ Torha	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I)	13-A, 1-A
9.Mgwali @ makhobokeni	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I) <i>Barbus pallidus</i> (I) <i>Barbus anoplus</i> (J)	22-A 27-J, 19 with parasitic infestation 4 J 1 J
10. Mbhashe @ N2	<i>Labeobarbus aeneus</i> (A) <i>Barbus pallidus</i> (I) <i>Barbus anoplus</i> (J)	24-A 5-J, 3-J

11. Mbashe @ Mpozolo	<i>Barbus anoplus (J)</i> <i>Myxus capensis (I)</i>	4 J 1 A

2.3 WATER QUALITY

<i>Sites</i>	Temp	Conductivity (ms/m)	DO (mg/l)	pH
Mbashe upper	14.6	0.07	0.03	8.47
Mnyolo@ mnyolo bridge River	16.1	0.03	0.01	8.36
Xuka silindini	9.6	0.11	0.05	8.84
Xuka River (R61)	15	0.12	0.06	8.6
Xuka (Mhlophekazi)	18.4	0.15	0.07	8.83
Mgwali(R61)	14.2	0.07	0.03	8.62
Mgwali @Ngcacu Bridge	16	0.07	0.03	8.6
Mgwali River (Tora Bridge)	12.9	0.05	0.03	8.53
Mgwali River (Makhobokeni)	15.3	0.07	0.04	8.54
N2 Bridge Mbashe	17.1	0.08	0.04	8.62
Mbashe @ mpozolo	20.7	0.12	0.1	8.75

SITE SELECTION AND DIRECTIONS TO THE SITES

Representative sites were selected in the upper, middle and lower reaches
The following sites were selected for biological monitoring.

1. Xuka River

Site 1 - Bridge (R61)

From Engcobo, drive towards Cochlan until you see Xuka bridge and turn left just before the bridge, the site is at (S 31⁰40.32 , E 28⁰06.57)± 200m upstream of weir.

Site 2

Cochlain –turn right to Dutywa/Clarkebury turn and pass Xuka bridge. Continue with the road and turn left at Mhlophekazi and drive straight to the river (S 31⁰43.615, E 28⁰16.167).

2. Mnyolo River

Site 1

From Engcobo, drive to Nkondlo, take left turn to Evansdale, take right at first Y junction, take right at second Y junction and continue until you reach the Mnyolo Bridge at (S 31⁰42.082¹ , E 28⁰14.801¹).

3. Mbashe river

Site 1 - Upper Reaches

From Engcobo, take R61 to Nkondlo and turn left to Lower Gqobonco, take left at Y junction in Lower Gqobonco and drive straight. Take left junction to Sitoza, then turn right to Sigidi, ignore left turn to forest , drive straight and pass shop (Mbutuma) General dealer, and continue the site is before you reach Ngxangxasi village at (S 31⁰32.879 , E 28⁰09.772).

Site 2

N2 Bridge to Mthatha.

Site 3 – Coastal Site at mpozolo

4. Mgwali river

Site 1

From Engcobo, take R61 to Tsomo. The site is at the bridge.

S31⁰44.004 E27⁰56.963

Site 2

From Engcobo, drive towards Dutywa and go past Umgwali Bridge, then turn left at Mjanyana clinic junction. Turn right at Y junction and drive straight until you pass Cobongo bridge (where there is an abstraction pump). Continue with the road until you reach Mangweni village and turn left without entering the village to Ngcacu village, the site is at Ngcacu Bridge. S31⁰46.152 E28⁰07.340

Site 3

From Ngcacu Bridge, continue with the road to Ngcacu village and turn right after a small bridge at a T-junction. Drive towards Mhlophekazi and turn right at a T-junction at a Stop sign and pass a bridge like structure, then a school on your right hand side. Drive straight and turn right again at T junction (Stop sign). Continue with the road, pass the left turn to Clarkebury clinic and turn right at the junction to Mdanjelwa clinic. Drive straight and turn right at the crossroads to Mroshozweni. Drive until you cross Tora Bridge and continue for about 500m, and turn right at a small road to the river.

S31°49.243 E28°10.615

Site 4

From Site 3, drive straight back and turn right at crossroads to Dutywa. Drive past Bolotwa, then Ntsimba and turn left at the junction to Lota and drive to Makhobokeni, via Nyandeni. The site is after Makhobokeni where the river bends.

S31°50.808 E28°18.878

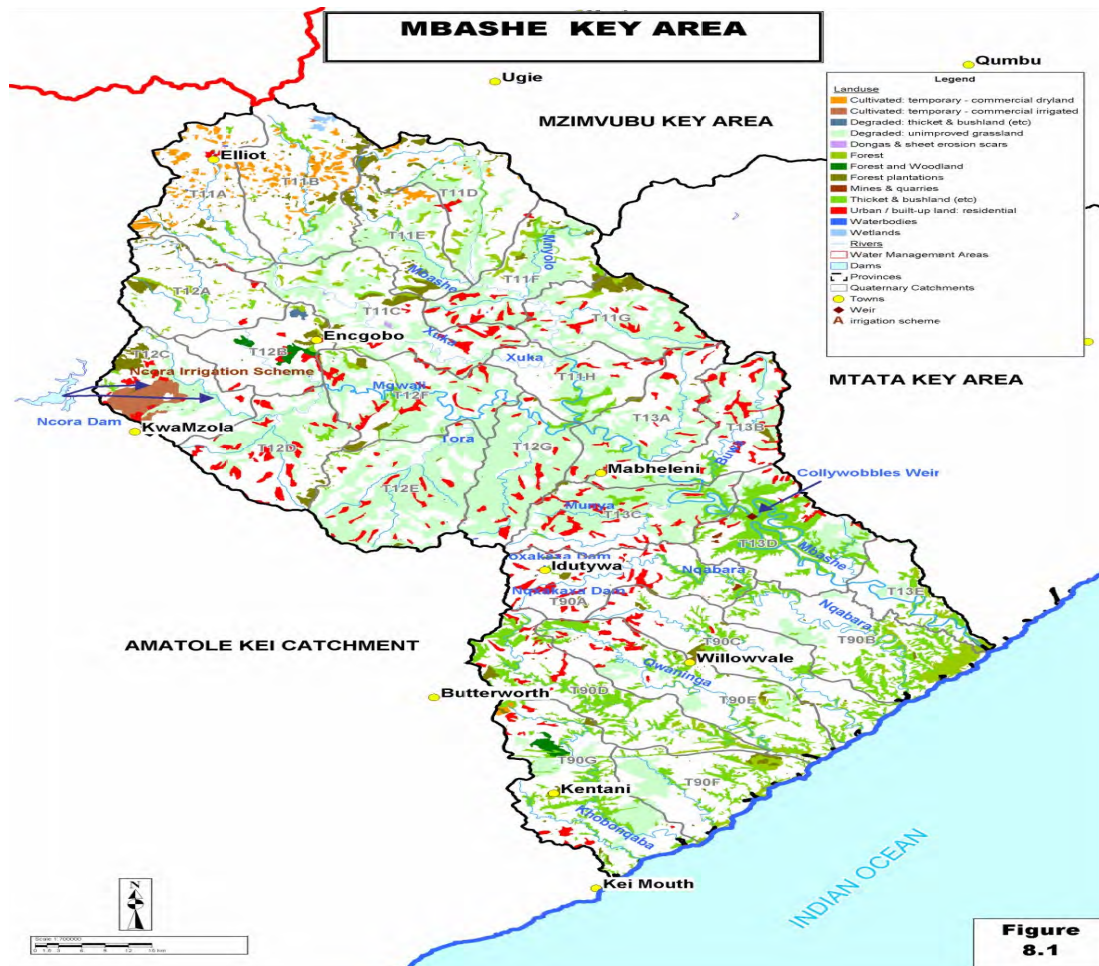
ECORIGIONS

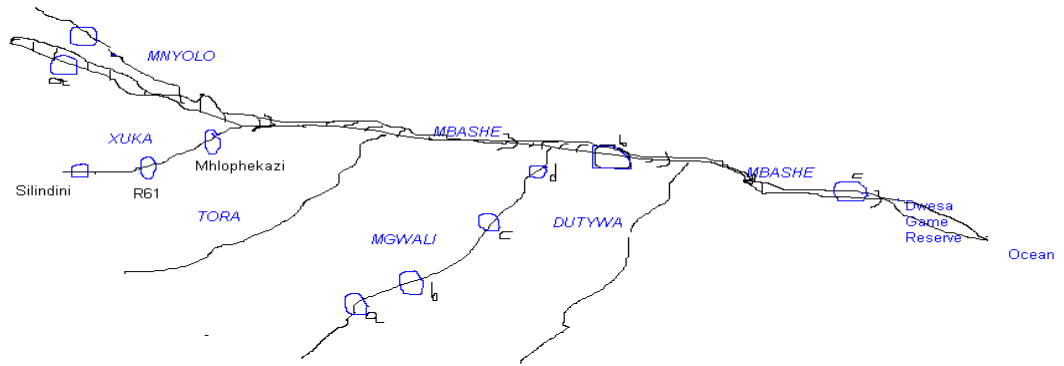
The Mbashe river catchment falls within two level 1 ecoregions, namely, Ecoregion 16- South Eastern Uplands and Ecoregion 31 – Eastern Coastal Belt. Most of this catchment falls within the Eastern Coastal Belt Ecoregion, hence more sites were selected in this ecoregion. All the tributaries of the Mbashe main stem fall within this ecoregion.

MAIN ATTRIBUTES	EASTERN COASTAL BELT
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains: Moderate Relief (limited); Closed Hills, Mountains; Moderate and High Relief;
Vegetation types (dominant types in bold) (Secondary)	Coastal Bushveld\Grassland (Limited); Eastern Thorn Bushveld; Valley Thicket; Dune Thicket (limited); Short Mistbelt Grassland (limited); Coastal Grassland Patches Coastal forest and Patches Afromontane Forest
Altitude (m a.m.s.l) (Secondary)	0-500, 500-900 (limited)
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	<15 to 50
Rainfall seasonality	Early to very late summer to all year
Mean annual temp. (°C)	16 to 20
Mean daily max. temp. (°C): February	24 to 28
Mean daily max. temp. (°C): July	18 to 22
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	20 to >250

LAND USE

Activities include commercial dry land agriculture in the upper reaches of the catchment around Elliot. There is a little of commercial forestry in the area, but mostly because Mbashe area is rural the rest of the area is used for subsistence farming and cattle grazing





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10	Mbashe river at N2 bridge	S E	T1MBAS-N2BRI
11	Mbashe river at Mpozolo	S E	T1MBAS-MPOZO

Invertebrates SASS 5 results of Mbhashe River

SITE NAME/CODE	SASS SCORE	NO OF TAXA	ASPT	CLASS
T1MGWA-R61BR	218	32	6.8	GOOR /B
T1MGWA-TORA	105	18	5.8	FAIR/C
T1MGWA-MAKHO	54	11	4.8	POOR/D
T1MGWA-NGCAC	130	20	6,5	GOOD/B
T1XUKA-SILIN	66	10	6.6	GOOD/B
T1XUKA-R61BR	112	19	5.9	FAIR/C
T1XUKA-MHLOP	148	22	6.7	GOOD/B
T1MNYO-BRIDG	74	10	7.4	NATURAL/A
T1MBAS-UPPER	112	23	5,9	FAIR /C
T1MBAS-N2BRI	78	15	5.8	FAIR /C
T1MBAS-MPOZO	58	7	8.2	NATURAL/A

Key: ASPT interpretation
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FINDINGS

HIGHLY IMPACTED SITE

Mgwali at Makhobokeni

This site sits at poor because of the change of Habitat the site is mostly boulders and the season has an impact because of low flows aquatic vegetation was minimally immersed in the water. This has an impact in our score because inverts that prefer to live on vegetation were almost absent and the burrowers were almost up sent as well. During other seasons this sites sits at fair, we hope it will improve after the first rains.

UNIMPACTED SITES

MNYOLO

This site sits in the upper reaches hence natural but Black Wattle is a real problem there. Its presence encourages erosion.

MPOZOLO

At this point the river has rejuvenated, as it prepares to enter the sea (Estuary).
Point of Concern: There is not much diversity in this site; mostly you will find high scorer's e.g shrimps Perlidae, Heptageniidae *ECT*

FISH RESULTS

The results of fish caught in the Mbashe River and its tributaries. The (A) next to the fish species indicates alien species and (I) indicates indigenous species. (J) under the column number of species are the juveniles whereas (A) are the adults.

SITE	SPECIES	NUMBER OF FISH SAMPLED
Mbashe upper reaches	<i>Barbus pallidus</i>	1 J
Mgwali @ Torha	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I)	13-A, 1-A
Mgwali before confluence	<i>Labeobarbus aeneus</i> (A) <i>Anguilla mossambica</i> (I) <i>Barbus pallidus</i> (I) <i>Barbus anoplus</i> (J)	22-A 27-J, 19 with parasitic infestation 4 J 1 J
Mbashe @ N2	<i>Labeobarbus aeneus</i> (A) <i>Barbus pallidus</i> (I) <i>Barbus anoplus</i> (J)	24-A 5-J, 3-J
Xuka @ Slindini	<i>Labeobarbus aeneus</i> (A)	8 A 4J 1 J

Mgwali @ Ngcacu	<i>Labeobarbus aeneus</i> (A)	24 J
	<i>Anguilla mossambica</i> (I)	1- J
Mbhashe @ Mpozolo	<i>Barbus anoplus</i> (J)	4 J
	<i>Myxus capensis</i> (I)	1 A
Xuka @ R61	<i>Labeobarbus aeneus</i> (A)	5-J 2-A 1 with parasitic infestation
	<i>Anguilla mossambica</i> (I)	1 adult
Mbhashe @ lower Sthuleni	<i>Labeobarbus aeneus</i> (A)	2-A - caught by local fisherman 1-J caught in SASS net
	<i>Anguilla mossambica</i> (I)	Indigenous knowledge
	<i>Anguilla marorata</i> (I)	Indigenous knowledge
Mnyolo @ Mnyolo Bridge	<i>No fish caught</i>	
Xuka @ Mhlopekazi	<i>Labeobarbus aeneus</i> (A)	10 A
	<i>Barbus pallidus</i> (I)	4 J

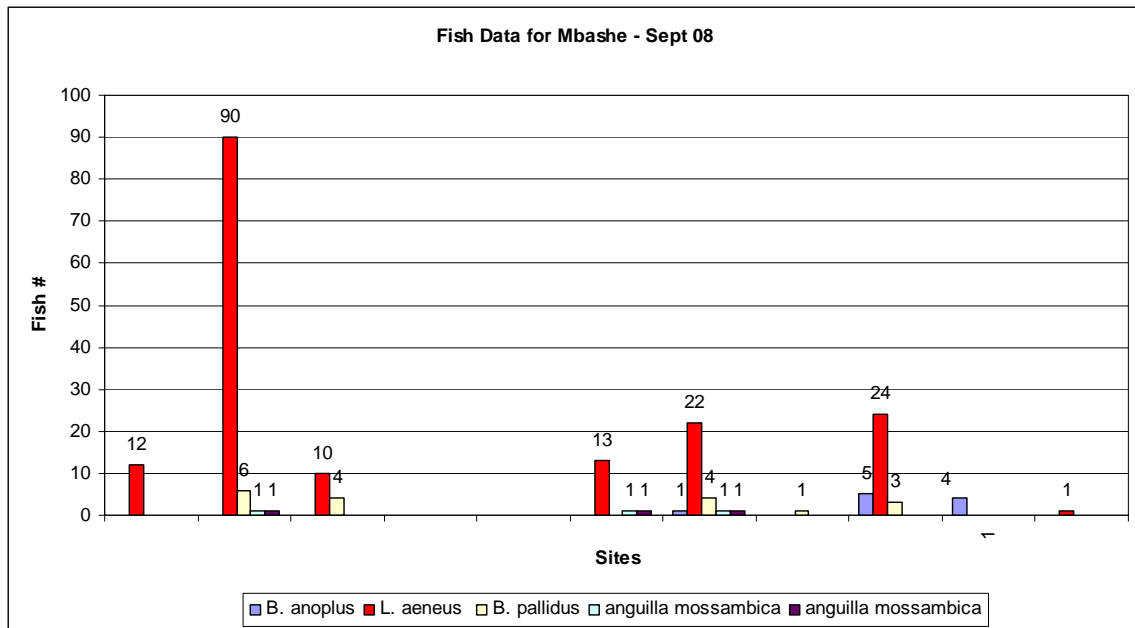
FINDINGS

Fish

The yellowfish, *Labeobarbus aeneus* is very dominant in this system; it was caught in all the sampling sites, which is an alien species. Other fishes that were caught include eel *Anguilla mossambica*, *Barbus pallidus*, *Barbus Anoplus*, *Myxus capensis* which are all indigenous species. Only *Labeobarbus aeneus* caught in Xuka upper reaches this resulted in this site being classified as fair (FFI) and at mnyolo river @ mnyolo bridge the site is found to be very poor this is because there were no fish caught, only one dead yellow fish caught, Mbhashe @ N2, Mbhashe @ mpozolo, mgwali before confluence these sites are found to be good due to the abundance of native intolerant species which are *Barbus anoplus* and *barbus pallidus*, *myxus capensis*. In all other sites the FFI was poor due to the abundance of *Labeobarbus aeneus*.



Labeobarbus aeneus, an alien fish that dominates the Mbashe river system. It was caught in all the sites.



The fish survey shows that this system is dominated with alien species therefore has significantly changed from reference conditions. The results clearly show that the *L. aeneus* have an impact on the *B. anoplus* and *Barbus pallidus*, as it was expected that there will be a lot of these species in this system and yet it was found at few sites.

Water Quality

Water Quality parameters measured on site in Mbashe River and its tributaries

Sample per site was taken in all 11 sites. The samples have been sent to a laboratory for analysis of heavy metals and nutrients.

The on-site analysis indicated low temperatures in all sites. In all sites the pH was above 8 units. On some sites the levels of dissolved substances were high as indicated by the conductivity measurements and also levels of nutrients were obviously high as indicated by the ominous presence of algae.

Parameter	Mbashe @ mpozolo	Site: Xuka River (R61)	Mgwali(R61)	Xuka (Mhlophekazi)	Mnyolo@mnyolo bridge River	Mgwali @Ngcacu Bridge	Mgwali River (Tora Bridge)	Mgwali River (Makhobokeni)	N2 Bridge Mbashe	Xuka Bridge R61	Xuka silindini
OA (mg/l)	0.1	0.06	0.03	0.07	0.01	0.03	0.03	0.04	0.04	0.06	0.05
Temp °C	20.7	15	14.2	18.4	16.1	16	12.9	15.3	17.1	15	9.6
Conductivity (Ms)	0.12	0.12	0.07	0.15	0.03	0.07	0.05	0.07	0.08	0.12	0.11
pH	8.75	8.6	8.62	8.83	8.36	8.6	8.53	8.54	8.62	8.6	8.84

NB Water Quality Results will be attached as soon as they are received from the Lab

CHALLENGES OF THIS SYSTEM

1. Illegal Dumping – We think it is done by the municipality because of the presence of Black refuse bags NB this dumping is done near a river in a rural area
2. Sand Mining

