MBASHE RIVER TRENDS REPORT (2007-2010)

DEPARTMENT OF WATER AFFAIRS

RIVER HEALTH PROGRAMME

EASTERN CAPE

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water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

CHAPTER 1: INTRODUCTION

1.1. The South African Environmental Health Monitoring Programme (SAEHMP)

The main aim of the programme is to serve as a source of information regarding the ecological status of the Rivers in South Africa, and the information gathered assist in making informed decisions on the management of these systems. The information is obtained through the use of instream and riparian biological information and these are used to assess the response of aquatic environment to disturbances. The ecological health of the system is determined through the use of the biotic components (invertebrates, fish and vegetation) and the abiotic components i.e. water quality and geomorphology.

1.2 The indices used in SAEHMP

1.2.1 Macro invertebrates (SASS 5)

Benthic macro invertebrates are those organisms that inhabit the bottom substrate (i.e. sediments, logs and debris etc) of freshwater habitats for at least part of their life cycle. The macro invertebrates have been widely used as indicators for environmental health. This may be attributed to their ease of identification and sampling, inexpensive and results are obtainable within a short period of time. To assess the macro invertebrates a rapid method called SASS 5 (South African Scoring System 5) has been developed, and this method has been tested and is now widely used in South Africa for the assessment of water quality and river health.

1.2.2 Fish (FRAI)

The Fish Assemblage Integrity Index (FAII) has been developed to assess the Integrity of fish assemblages (Kleynhans, 1999). The index is based on expected fish assemblages under natural conditions and observed fish assemblages at the time of sampling. The FAII score calculated as the ratio of the observed conditions versus expected conditions in the absence of anthropogenic disturbances (Kleynhans, 1999).

1.2.3 GAI

Geomorphology is one of several important components used to assess the overall condition of a river. The geomorphological processes and flow determine the morphology of the channel, which in turn, provides the physical framework for the stream biota. Water and sediment

therefore predominantly shape the river channel and also affect water quality with high sedimentation and silt loading contributing to water quality deterioration. The geomorphological index (GI) is used in SAEHMP implementation to assess the physical condition of river channels morphology.

1.2.4 VEGRAI

Riparian vegetation is the vegetation found in close proximity to rivers. The riparian zone is therefore that area located next to a river, influenced by river processes such as flooding and alluvial deposition, and characterised by vegetation adapted to mesic conditions and occasional inundation. The riparian vegetation index was developed for the use in SAEHMP to assess and monitor the degree of modification of riparian vegetation (Maseti, 2005).

1.3 Explanation of the method

1.3.1 SASS 5

Macro invertebrates are sampled by collecting organisms from each biotope, namely stones, GSM (gravel, sand and mud) and vegetation. The sample is then tipped into a SASS tray half filled with water. A maximum of 15 minutes is allocated for identification of these macro invertebrates, and their scores differ depending on their sensitivity to pollution. Those that are highly sensitive to pollution are given the high score on the SASS sheet and a less score is given those tolerant to pollution. There are three indices calculated for SASS namely SASS score, Number of Taxa and ASPT (Average Score Per Taxon). The calculation is done by noting any families seen in any of the biotopes in the total column of the scoring sheet. The SASS score is calculated by summing up all the numbers in the total column. The total number of taxa found = No. of taxa, and, dividing the score by number of Taxa provides the ASPT (Dickens & Graham, 2002). The default benchmark boundary table was used as a reference to which the average ASPT scores calculated were compared to provide an indication of the water quality state based on the SASS 5 (Table 1).

Table 1. Default benchmark river health class boundaries for SASS 5 (Palmer et al. 2004).

CLASS BOUNDARY	RANGE OF ASPT SCORES
Natural	7
Good	6
Fair	5
Poor	<5

1.3.2 Fish

Fishes are known as good indicators of long-term changes and broad habitat conditions because they are relatively long-lived and mobile. Fish are relatively easy to collect and identify to species level, and most specimens can be sorted and identified in the field by fisheries specialists and subsequently released unharmed. The fish samples were collected using an electric fish shocker. The species were caught and put into a bucket for later identification. The species were identified up to species level (where possible) using a fish field guide prescribed for freshwater fishes (Skelton, 2001).

1.4 Objectives

The main objectives of the survey were to review the overall Present Ecological State of the Mbashe River catchment, and to determine the influence of seasonal variations on the aquatic biota. The results of the survey would serve as an input to the National Aquatic Environmental Health Monitoring Programme (River Health Programme), Reserve determination for Resource Directed Measures and Rivers National Database. The data was collected over a period of five years representing three seasons, namely spring, autumn and winter season.

CHAPTER 2: STUDY AREA

2.1 Brief description of the Study site

The Mbashe River is one of the major rivers in the Eastern Cape fed by perennial tributaries of Mgwali, Mnyolo, and Xuka. The Mbashe River meanders along its way towards the Indian Ocean. There is evidence of deposited debris on the riverbank throughout the system, suggesting that volume of flow could have increased significantly during annual floods. During these periods of flood events people could be at risk of loosing their lives and property while trying to swim across the river.

A total of eleven sites were sampled at Mbashe River and its tributaries (Xuka and Mgwali). There were four sites in Mgwali and three at Xuka River. The other remaining sites were in the main channel of the Mbashe River.

2.1 Ecoregion

The Mbashe River system is situated in the Mzimvubu to Keiskamma Water Management Area, in the former Transkei area in the Eastern Cape Province. This system 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 sterm fall within this ecoregion. The catchment has a total surface area of 8 679km^2, a mean annual precipitation of 810mm and a natural mean annual runoff of 1 129 milliom m^3 (Fig.2).

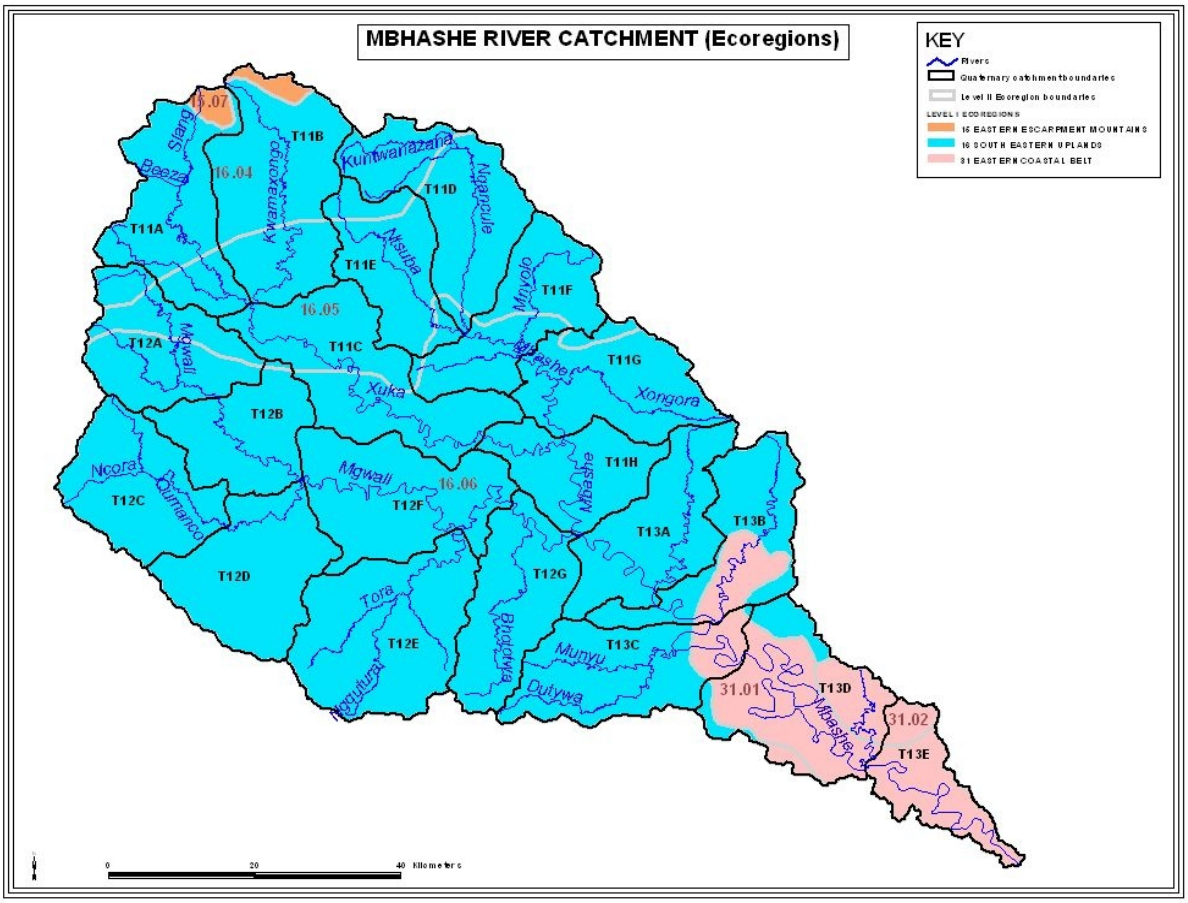

Fig.2. A map showing the ecoregions of the Mbashe River.

2.4 Climate

The characteristic climatic condition of South Africa varies considerably from West to East. In fact the country consists of arid regions on the West and high rainfall areas on the East with the exception of the Mediterranean region of the Western Cape. The Mbhashe River catchment receives its rainfall in Summer. The figure below shows the distribution of rainfall on the Mbhashe River catchment. Note that rainfall starts early along the coast and much later towards the South Africa interior (Fig.3).

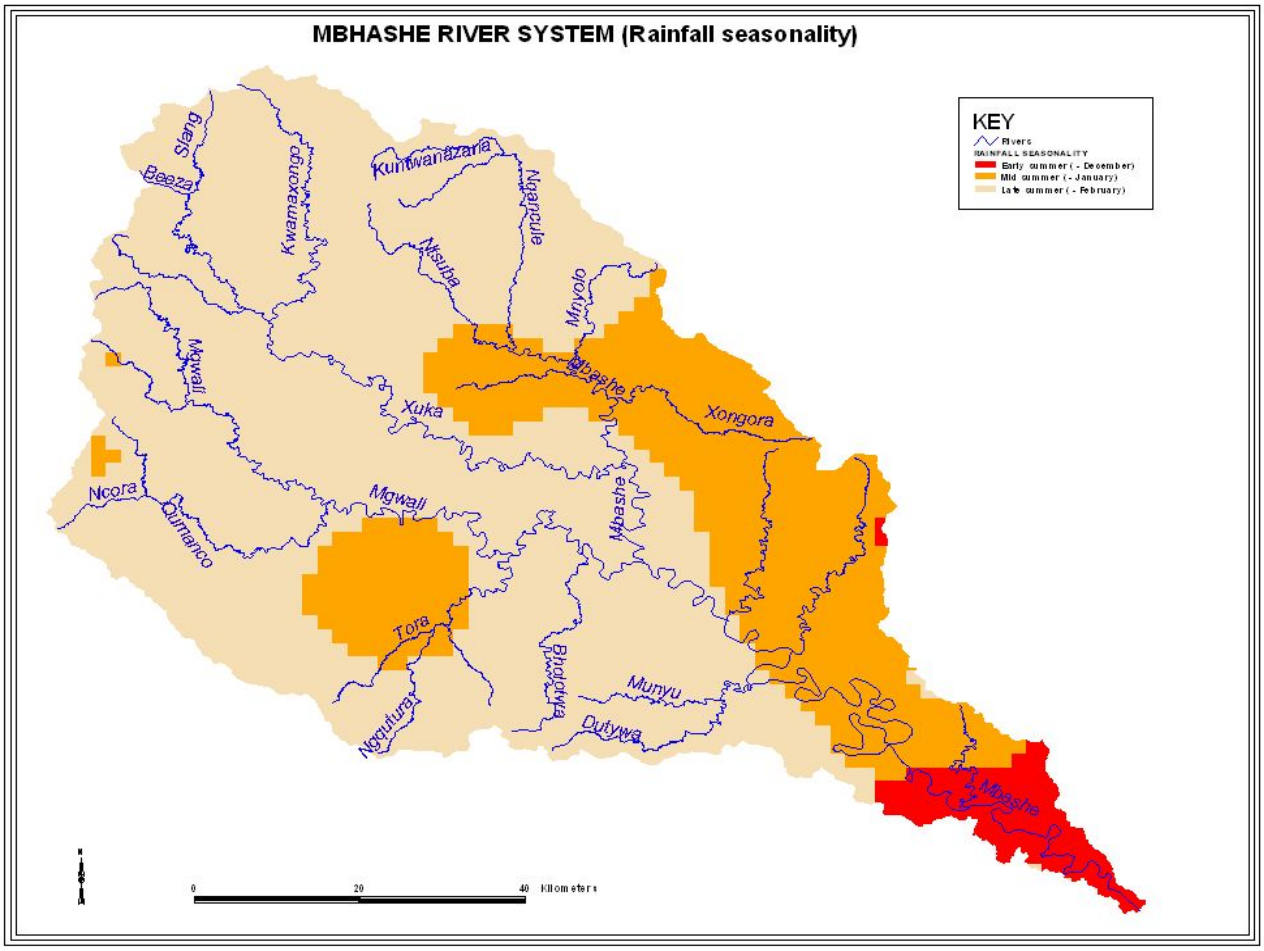

Fig.3. Rainfall seasonality of the Mbhashe River Basin.

2.3 Geology and soils

The Mbhashe River catchment consists of different geological rock types. The whole catchment is dominated by sandstones and mudstones of the Adelaide Formation, the Clarens, Elliot, Molteno Formation, the Ecca Formation and the Tarkastad Formation along the coast. This means that soils in the catchment are vulnerable to erosion as they originate from their easily weathered parent material. The figure below shows the geology and soils of the Mbhashe River catchment (Fig. 4).

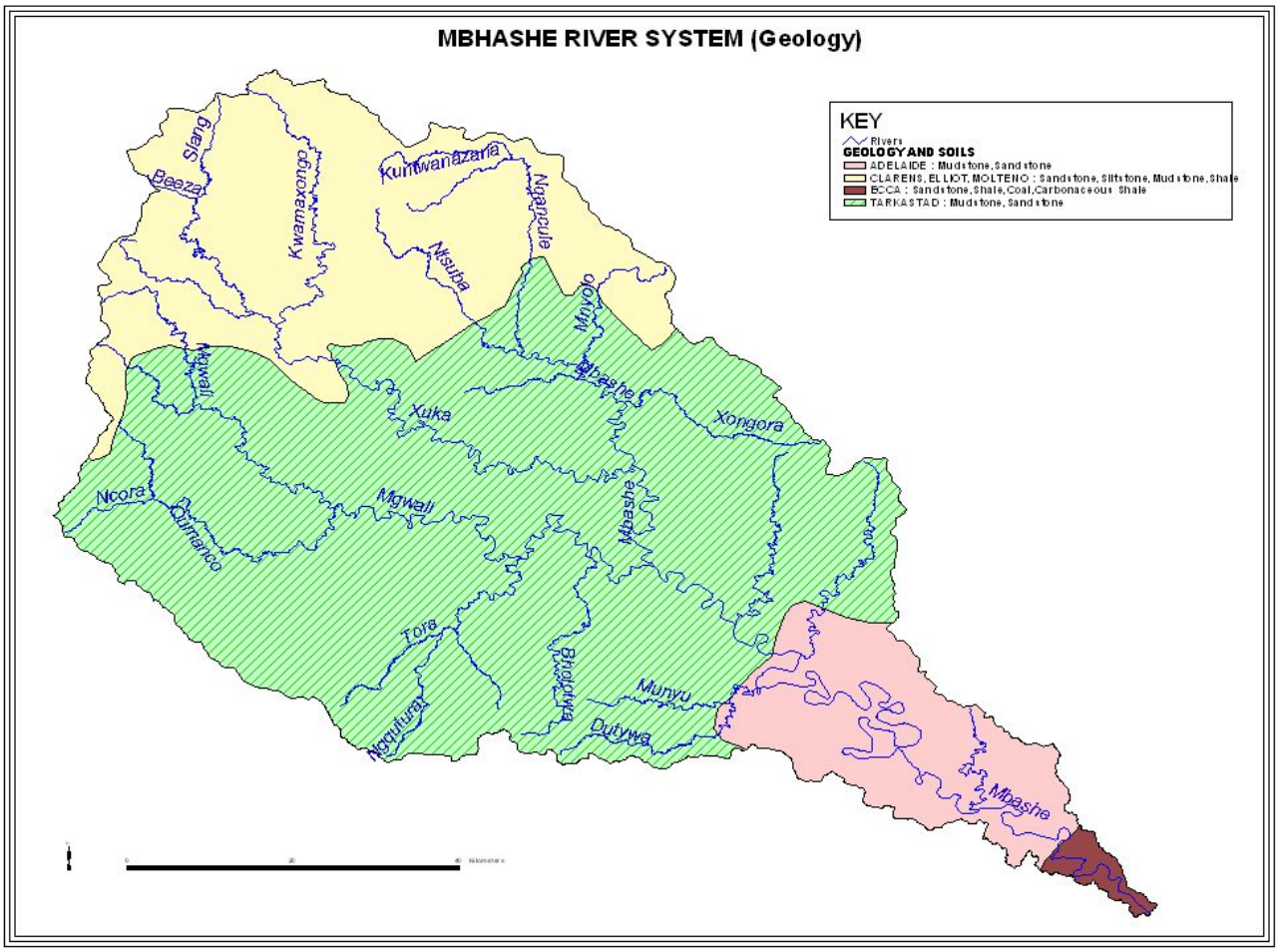

Fig 4. Geology and soils of the Mbhashe River drainage basin.

2.4 The Natural Vegetation

Vegetation of any region is determined by these two factors: climate and soil type. Other variables determining vegetation type are facet and relief of a segment and its distance from the sea. As a result of these factors, the grasslands in the upper dominate the Mbhashe River Basin and the middle reaches, as well as the tropical forests and bushvelds towards the coast. The vegetation varies from fertile coastal forests to grasslands being the dominant vegetation type in most parts of the catchment. The figure below shows the vegetation types found on the Mbhashe River Basin (Fig.5).

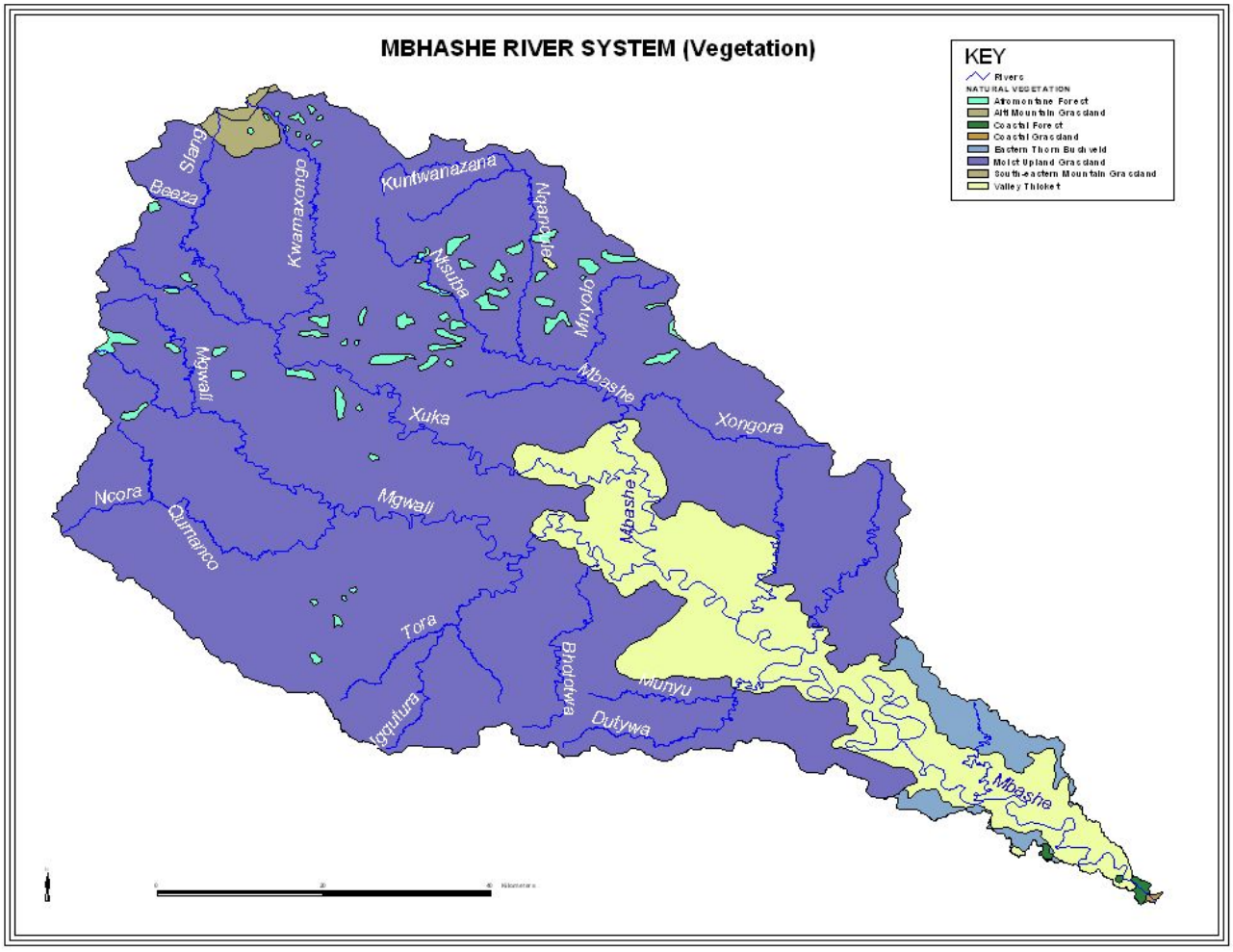

Fig. 5. Vegetation of Mbhashe River drainage basin.

2.5 Land use

Land use activities include commercial dry land agriculture in the upper reaches of the catchment around Elliot. There is also 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. Subsistence farming is mainly for maize and vegetables.

In the catchment there is an irrigation development called Ncora Irrigation Scheme that uses water transferred from the Ncora dam in the Kei catchment. Most of the catchment is degraded, mainly due to overgrazing. The soils are also naturally erodable. This causes severe erosion.

Site1

Location: Mbashe upper	**Co-ordinates:** S31^{o}3154.2; E28 ^{o}09 14.5

This is a pool-rapid site although riffles and bedrock fall are also present. Downstream of the site there is a lot of sand bars with no vegetation. Alien vegetation infestation is also evident along the river reach, while the indigenous vegetation had been removed. Bank undercut, livestock paths, hillslope erosion and subsistence agriculture (maize field) could be observed. These play a significant part as source of sediment in the river channel, hence non-vegetated mid-channel and lateral bars in the active channel. As a result of sedimentation, biotope abundance and diversity might have been lost downstream. However, upstream of the site different habitat types are plentiful. Thus it can be concluded that the river at that reach is moderately modified because of change in natural and biota that occurred though basic ecosystem functioning appears primarily unimpacted (C class).

Fig.6. Photograph of Site 1 (Mbashe Upper) showing the diversity of biotopes and substrate.

Site 2

Location: Mnyolo	**Co-ordinates:** S31°31'02"; E28 °17 25.7

Mnyolo River is a tributary of Mbashe River. As the site consists of few boulders, and a large number of cobble, gravel and sand; the site is located in an alluvial channel. Erosion on the adjacent hillslope, overgrazing and decrease in indigenous vegetation contribute to the deposition of fine sediment on bars. Due to this sedimentation, there has been a decrease in habitat diversity and habitat types. Animal trampling and alien invasion (mainly *Eucalyptus spp.)* could result in formation gullies, which act as a source of sediment. However the channel bed is stable as it consists of a mixture of boulders, cobbles and bedrock, while the riverbank is unstable as a result of alien invasion, indigenous vegetation removal and animal trampling. For these reasons, the river is seriously modified at that reach (D Class).

Fig. 7. Photograph of Site 2 (Mnyolo) showing the diversity of biotopes and substrate.

Site 3

Location: Silindini	**Co-ordinates:** S31^{o}34 46.3; E27 ^{o}57 34.5

The site is located on the tributary of Mbashe River in the upper reaches. This is the mixed channel dominated by bedrock, but boulders and cobbles are also present as dominant morphological units. There is evidence of vegetated island bars, suggesting that there has been sediment input in the site, though it does not occur more frequently hence growth in vegetation. The site is also invaded by alien plants (namely *Eucalyptus spp.*). This, together with animal trampling and vegetation removal results in sheet erosion and consequently riverbank failure, which also contribute to sediment input in the site. Due to this, diversity of habitat types may have been reduced. Since the river channel is expected to widen, water temperatures can increase as well, due to rapid penetration of sunlight, which can also result in decline in dissolved oxygen.

It can be argued that the river is moderately modified in the site as there is no recognized development in the adjacent hillslope and the flood plain (C class).

Fig. 8. Photograph of Site 3 (Silindini) showing the diversity of biotopes and substrate.

Site 4

Location: Xuka R61 bridge	**Co-ordinates:** S31°40 05.1; E28 °06'43.3"

At this site the river is a single channel characterized by a pool-riffle habitat type. The site is dominated by bedrock; alluvium mainly in the riparian zone. Animal trampling and grazing accompanied by vegetation removal is also evident. Root exposure at a site is sign of bank undercutting that can result in bank failure and channel widening. The bridge is downstream of the site, and therefore playing a major role in inhibiting migration of species from upstream of the site. This bridge also traps the litter as well as debris from upstream.

Sediment mining is also evident on the site, which serves as a source of sediment input. In addition, the river at a site experiences massive alien vegetation encroachment. Combining the abovementioned modification the site can be considered as largely impacted due to assumed loss of natural habitat and biota as well as reduction in basic ecosystem functioning (Class D).

Fig. 9. Photograph of Site 4 (Xuka R61) showing the diversity of biotopes and substrate.

Site 5

Location: Xuka Mhlophekazi	**Co-ordinates:** S31°43'37.5; E28°16'09.7

The site is a pool-riffle system and an alluvial channel (consisting of boulders, cobbles, gravel and sand). The water was very turbid during site visit suggesting a lot of fine sediment input. Vegetated bars show that the channel bed is becoming stable. Both alien and indigenous vegetation were sparse, i.e. there is an evidence of vegetation removal (especially trees and shrubs). The riverbank on the right is stabilized by short grass (*Cynodom dactylon*). Bank failure occurs on the left bank acting as a source of sediment at a local scale, hence the availability of different kinds of bars. However, this alternation of deposition and erosion is a typical characteristic of a meandering river. Therefore in terms of geomorphology the river can be classified as D.

Fig. 10. Photograph of Site 5 (Xuka Mhlopekazi) showing the diversity of biotopes and substrate.

Site 6

Location:Mgwali at R61 bridge	**Co-ordinates:** S31^{o}43'58.8"; E27 ^{o}56'57.3

This is another site located on the tributary of Mbashe River, Mgwali. The channel on a site area is a mixed channel, with bedrock and alluvium. Because the site is on the upper reaches of the catchment, it is characterized by v-shaped valley but due to overgrazing, there is a lot of sheet erosion. As a result, the sediment is transported to the main stream and consequently there are island bars along the entire reach. Gullies can also be noticed in the hillslope, contributing a lot of sediment to the river. The bridge upstream of the site has noticeable impact on the river 'health' as it traps the sediment and converting the magnitude and direction of natural flows. Construction of bridge on the site and presence of invasive alien plants can contribute to localized disturbance to river bed and bank. In addition, the bridge constructed on the river can hinder the movement and migration of invertebrates and fishes, causing them to be stuck and therefore vulnerable to predation. Condition of local catchment, e.g. livestock, alien invasion, bridge construction, gabion structures and massive erosion mean that the habitat quality, diversity and size have been largely impacted (Class D).

Fig. 11. Photograph of Site 6 (Mgwali R61bridge) showing the diversity of biotopes and substrate.

Site 7

Location: Mgwali at Ngcacu	**Co-ordinates:** S31^{o}46'09.6; E28^{o} 07'22.0"

This is the tributary of Mbashe River, which is a mixed channel (bedrock, boulders and cobbles). It is a pool-rapid system although runs and riffles also exist. Livestock trampling, sediment mining, alien invasion, gravel roads and bridge could have negative impact on morphology of the river system. Sediment mining, gravel roads and bank erosion serve as sources of sediment on the riverbed. However the impact of the bridge on the riparian zone has been minimized by anti-erosion structures (gabions). Bars with various morphological units serve as medium for vegetation growth hence sedges and grass on some of them. Irrigation scheme upstream could also be noted as it could reduce base flows, which can result in sedimentation as well. For these reasons, the river at a reach can be judged as moderately modified (C category) because there has been a decrease in natural habitat though basic ecosystem functioning is predominantly unchanged.

Fig. 12. Photograph of Site 7 (Mgwali Ngcacu) showing the diversity of biotopes and substrate.

Site 8

Location: Mgwali at Tora	**Co-ordinates:** S31^{o}49. 243; E28 ^{o}10.615

The river system at a site is a mixed channel, meaning that it consists of diversity of morphological units including boulders, cobbles, gravel, sand and silt although **bedrock** is the most dominant feature. It is a pool-rapid system, where the deep pools can serve as refugia for aquatic fauna during times of stress. Since it consists of runs, riffles and rapids, the river system at a site can be considered as rich in terms of habitat diversity for aquatic invertebrates and fish. In addition, the bars (both instream and lateral) serve as a medium for plant growth, hence instream and marginal vegetation; both as habitat for other aquatic species. However, the river system at that reach experience presence of alien plants, decrease in indigenous vegetation on the riparian zone and impacts of livestock. These combined result in erosion both on the floodbank and on the hillslope. The resultant response on the channel is deposition of sediments. For these reasons, the site area can be considered as moderately modified (C class) due to changes in natural habitat although basic ecosystem functioning appears to be predominantly unchanged.

Fig. 13. Photograph of Site 8 (Mgwali Tora) showing the diversity of biotopes and substrate.

Site 9

Location:Mgwali at Makhobokeni	**Co-ordinates:** S31^{o}50'48.2; E28 ^{o}18'51.5

The river at a site area is a meandering structure, where expectations should be alternate erosion and deposition on either side of the channel. The site area is a pool-riffle system and an incised channel. The biotopes consist of side pools, deep pools in the active channel, riffles, a rapid and runs. Mid channel bar and lateral bars with vegetation suggest that although sediment deposition occurs, the river channel is stable hence the vegetation growth occurs. However, the river bank is unstable due to animal trampling causing headcuts and vegetation removal on the riparian zone hence bank erosion with the resultant channel widening and sediment input on the river bed. Hill slopes abutting to the active channel on both the left and the right banks also accelerate sediment input. For these reasons, the site area can considered as moderately modified (C class) due to changes in natural environment although basic ecosystem functioning appears to be largely unimpacted.

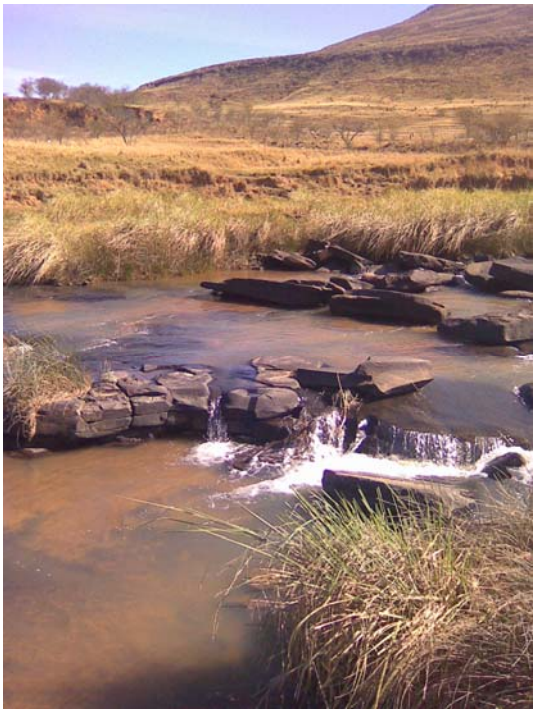

Fig. 14. Photograph of Site 9 (Mgwali Makhobokeni) showing the diversity of biotopes and substrate.

Site 10

Location: Mbashe at N2 bridge	**Co-ordinates:** 31° 55'21.3";E28 27'15.1"

This is a pool-rapid alluvial channel although the riffles, runs and glides could also be observed. These can be regarded as the habitats for diversity of aquatic fauna. The river is sinuous at a reach scale, with a lot of alternative erosion and deposition on both left and a right bank. The tributary at a right bank contributes a lot of fine sediments, probably from the eroded hillslope. The left bank was stable, consisting of bedrock, while the left bank was unstable with fine sediment and sparse vegetation. Mid channel and side bars consisted of cobbles, gravel, sand and silt, with vegetation (mainly shrubs, grass and sedges). Indigenous vegetation was sparse and negligible alien plants and livestock step on. The most problematic practice at a site was sediment mining, which was abundant, upstream of the site. This, together with animal trampling and vegetation removal could play a major role as sources of sediment hence observation of bars downstream. Since the modifications at that time were at a small number of localities (few livestock, sediment mining) and the impact of habitat quality and diversity were fairly limited, the river at a site could be judged as at a moderately impacted (C class).

Fig. 15. Photograph of Site 10 (Mbashe N2) showing the diversity of biotopes and substrate.

Site 11

Location: Mbashe at Mpozolo	**Co-ordinates:** 32^{o} 08'48.0";E 28^{o} 47'59.7"

The site is located at a pool-riffle river system and is an alluvial channel. It is a sinuous meandering system where alternative erosion and deposition is expected on both the left and the right bank. The right and a left bank are stabilized by grass (mainly *Cynodom dactylon*). Due to the fact that the river at a site is at a lower foothill, sand bars, deep pools and riffles were evident. The bridge, alien invasive plants, livestock trampling, sediment mining, footpaths and subsistence crop production could have negative impact on physical environment on the river system. Because these occur locally, the river at the site is moderately modified (therefore C category), that is, there is a decrease in natural habitat although basic ecosystem functioning is predominantly unchanged.

Fig. 16. Photograph of Site 11 (Mbashe Mpozolo) showing the diversity of biotopes and substrate.

RESULTS

a) Physical parameters

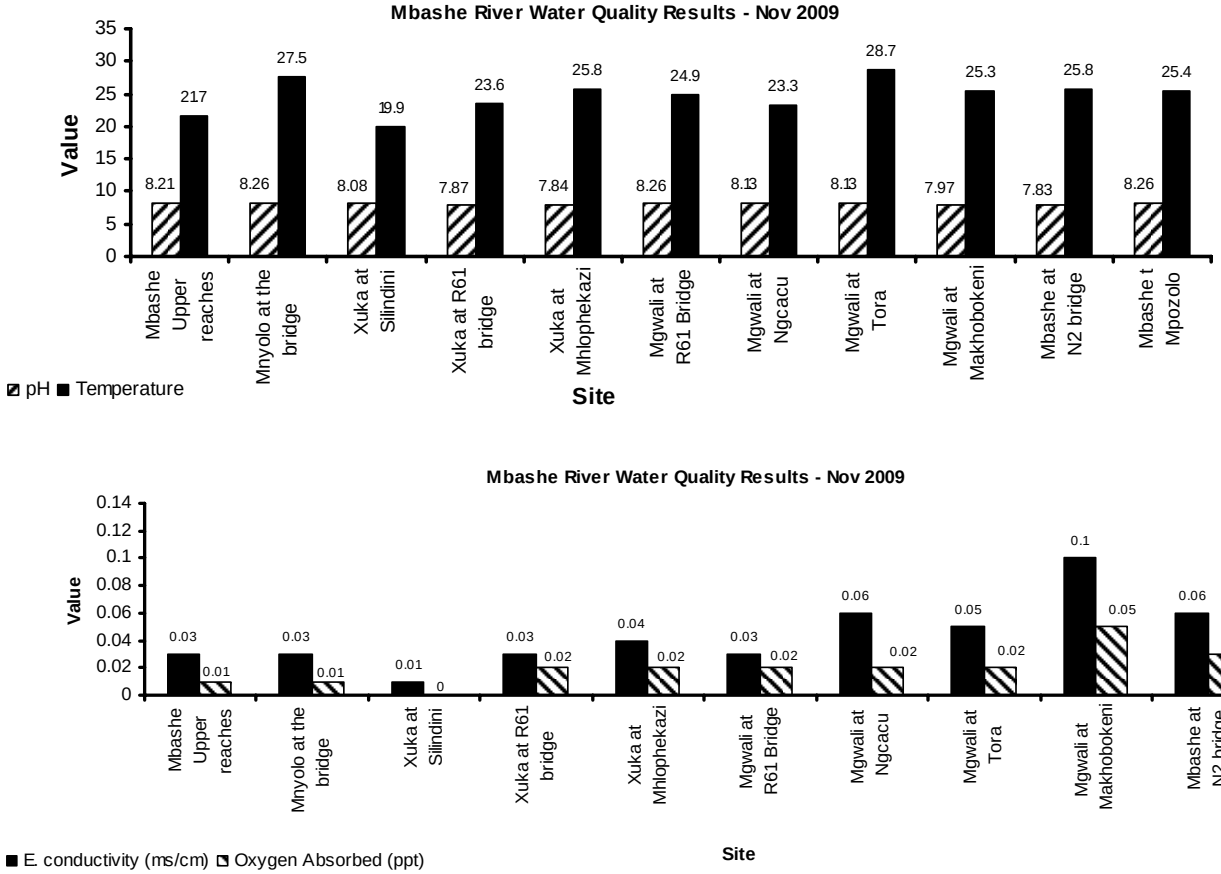

Fig 17. Graphs showing physical parameters recorded at Mbashe River during spring.

The physical parameters recorded at Mbashe River at its tributaries were constant throughout the system. The temperature was high throughout the system ranging from 19.1- 28.7^{o}C. The temperature seems to have not influence on the pH results. A same pattern was observed in the autumn survey conducted in 2010 (Fig. 17).

There was a correlation in conductivity and dissolved oxygen. The conductivity increased towards the middle and lower reaches and the dissolved oxygen followed the same pattern (fig. 18).

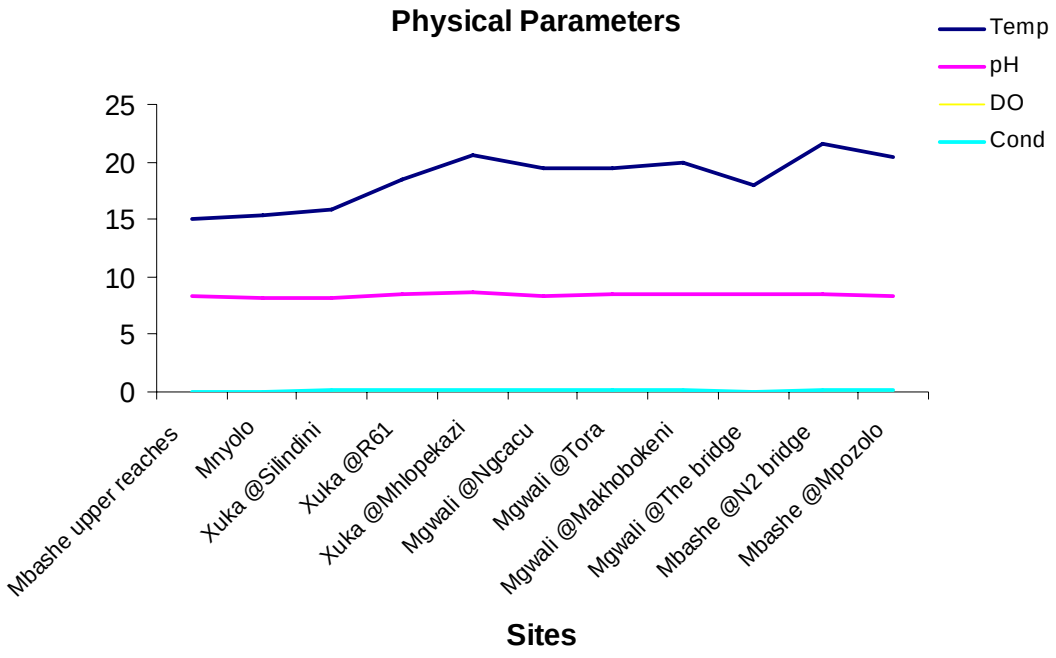

Fig 18. A graph showing the physical parameters at the Mbashe River in autumn 2010.

b) Invertebrates

SASS Scores

The SASS Scores were low at the upper reaches and increased gradually towards the middle reaches in Spring 2007. The results improved in spring 2008 and increased again at the middle reaches and decreased when approaching the lower reaches. During the survey of 2009 a similar pattern in SASS scores was observed at the upper and middle reaches. The sampling could not be done at some sites (Xuka R61 bridge, Mgwali bridge, Mgwali Tora, Mgwali Makhobokeni, Mbashe N2 bridge and Mpozolo, this was due to high flows and therefore, no sampling conducted (Fig. 19).

During the recent survey that was conducted in autumn the sites at the Mbashe Upper, Makhobokeni and Silindini had high SASS Score numbers, respectively (Fig 20). At the site in the lower (Mbashe River at Mpozolo) reaches of this river the SASS Score was very low compared to all the sites sampled at this river.

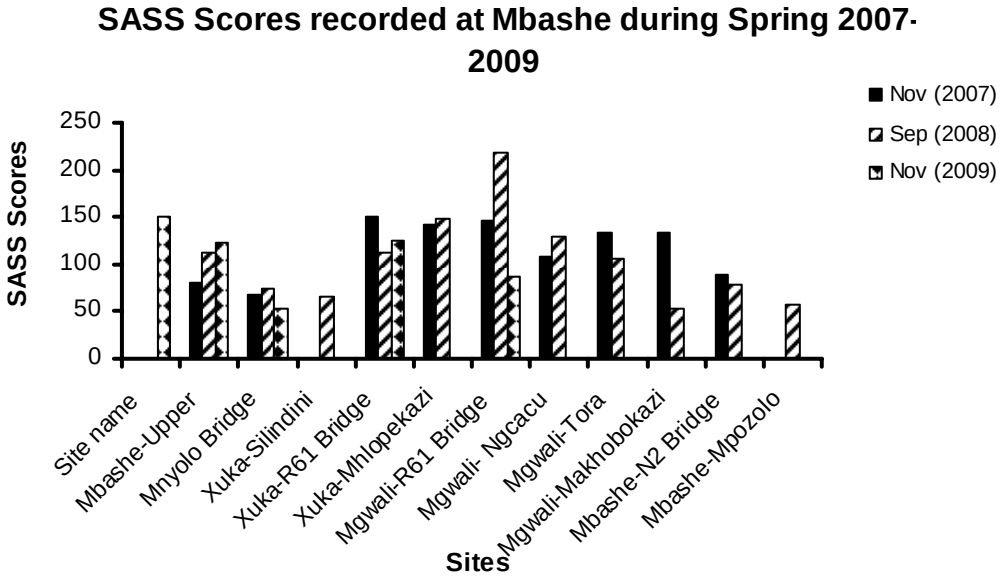

Fig. 19. Graph showing the SASS Score results obtained at Mbashe River during Spring 2007-2010.

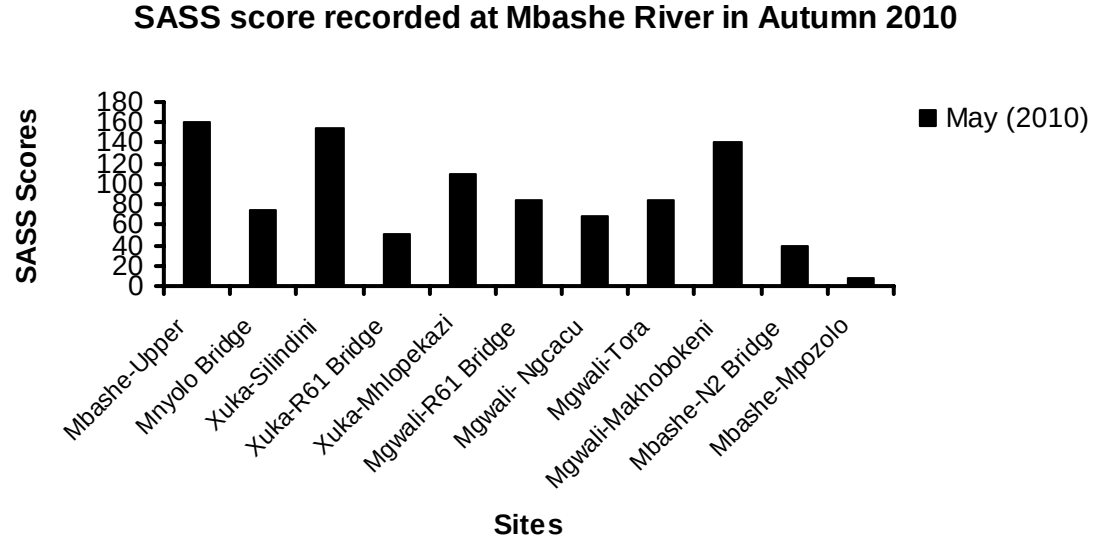

Fig. 20. A graph showing SASS Score results at Mbashe River in Autumn, 2010.

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No of Taxa

The species abundance was low at the upper reaches and increased towards the middle reaches but decreased gradually at the lower reaches during spring of 2007. At the Mbashe upper the species diversity was high and decreased when approaching the middle reaches and started to decrease towards the lower reaches. In 2009 the highest species diversity was

obtained at the Mbashe upper and decreased gradually at the middle reaches (Xuka Silindini), and increased considerably at Xuka Mhlophekazi and Mgwali at Ngcacu (Fig 21).

A similar pattern was observed in species abundance during the Autumn survey conducted in 2010. The results in species diversity were in agreement with the results obtained in SASS Scores. At the sites that had high SASS Scores, high species diversity was observed. At the site in one of the Mbashe tributaries the species diversity was reduced, a similar pattern was observed when approaching the lower reaches (Fig 22).

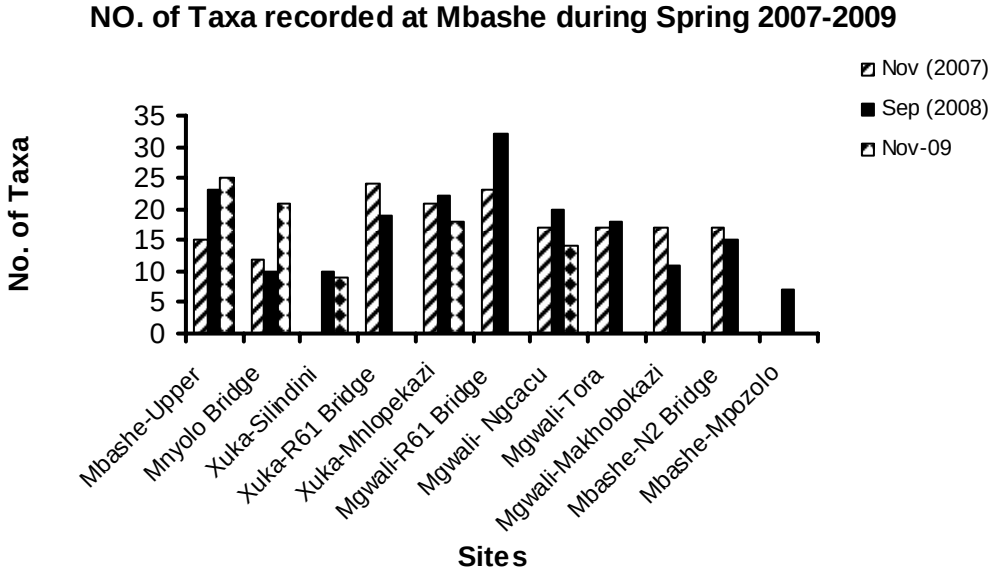


Fig. 21. Graph showing the No of Taxa recorded at Mbashe River during Spring 2007-2009.

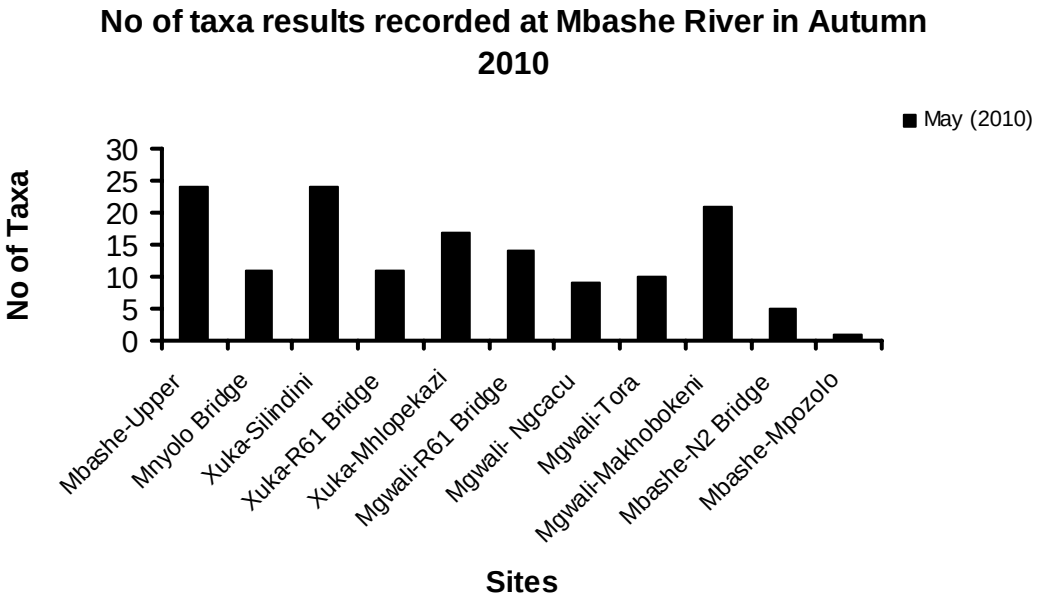


Fig. 22. A graph showing No of Taxa recorded at Mbashe River in Autumn 2010.

ASPT

The average Score per Taxon values followed the same pattern observed in SASS Scores and Number of Taxa at the upper and middle reaches of the Mbashe River and its tributaries. Although there were sites where species abundance was low, the ASPT showed that the Spring results in 2007 were ranging from fair to natural. A drastic improvement in ASPT was observed at the site at Mnyolo where the ASPT was high reaching the natural state, and this was in contrast with the species abundance where the species diversity was low and increased ASPT. The site that had poor results in ASPT was the site at Mgwali Makhobokeni in 2008, although a natural state was obtained in the previous years. In 2009 the ASPT ranged from fair to good.

There was an improvement in ASPT results in 2010 comparing with the previous surveys. The ASPT results ranged from 4.6-8.4 (fair to Natural). The site that had lowest ASPT results was the site at the Xuka R61 and thus resulted to poor status according to the benchmark table (Table 1). The sites at Mbashe Upper reaches, Ngcacu and Mgwali at Tora the ASPT were high putting the site at natural state (Fig 23 & 24).

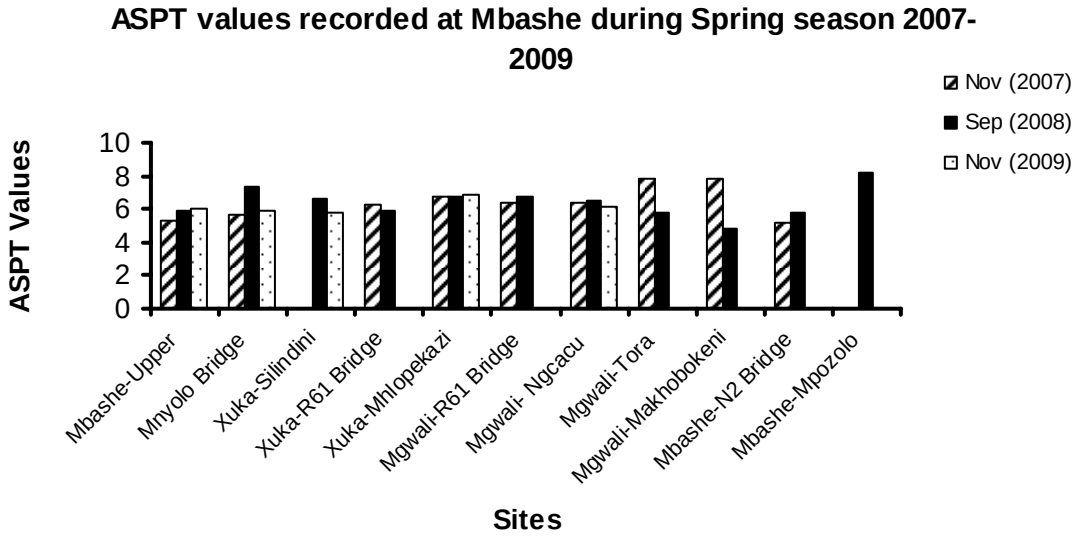


Fig. 23. Graph showing ASPT values recorded at Mbashe River during Spring 2007-2010.

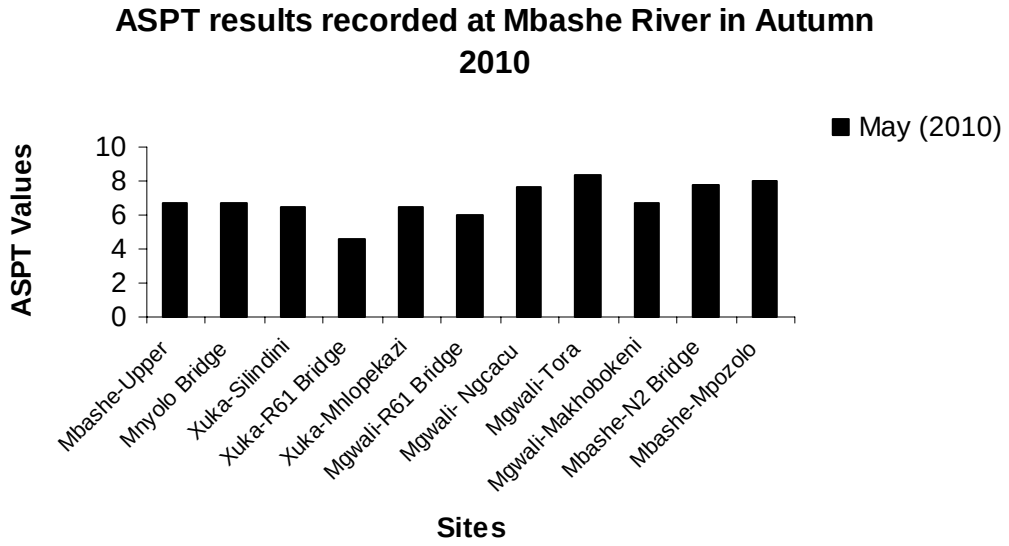
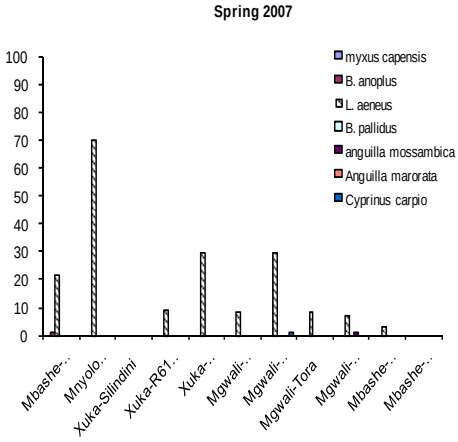


Fig. 24. Graph showing ASPT values recorded at Mbashe River in Autumn 2010.

b) Fish

The fish results indicated that the species abundances were dominated by the yellow fish at the Mbashe River. This species is an alien and it endangers the indigenous species in the system and this is proved by the absence of other species that were found in the system on previous surveys. A summary of all the species caught at Mbashe River over the years is provided in Appendix 2.



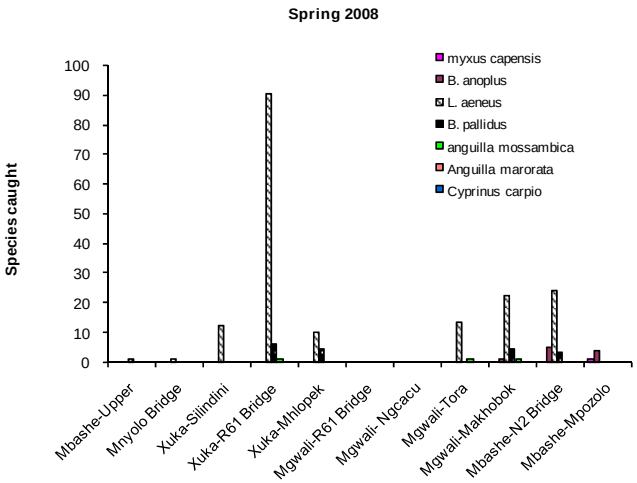


Fig 25. Graph showing fish species caught at Mbashe during spring 2007 and 2008.

Table 2. The results of fish caught in the Mbashe River and its tributaries in May 2010. The (A) next to the fish species indicates alien species and (I) indicates indigenous species. (J) under the column numbers of species are the juveniles whereas (A) are the adults**.**

SITE	**SPECIES**	**NUMBER OF FISH SAMPLED**	**COMMENTS**
Mbhashe upper reaches	*Labeobarbus aeneus (A)*	4J	Although secondary channel and backwater were present, no barbs were caught. Only yellowfish found.
Mnyolo @ Kokleni	*Labeobarbus aeneus (A)*	7J	Fast flows, sedimentation and bedrock dominating. Only yellowfish.
Xuka @ Slindini	*Labeobarbus aeneus (A)*	8A caught by local fisherman.	Fast flows, sedimentation and bedrock dominating. Only yellowfish caught by local fisherman.
Xuka @ R61	*No fish caught*		Lots of Sedimentation and bedrock dominating no fish was caught.
Xuka @ Mhlopekazi	*Labeobarbus aeneus (A)*	4J	Most cobbles out of current, bedrock and sediments dominant. Only Yellowfish was

			caught
Mgwali @ Ngcacu	*Labeobarbus aeneus (A)* *Anguilla mossambica (I)*	24 J 1- J	Backwaters, bedrock, boulders, vegetation, fast and slow flows all are features of this site and it is suitable for yellowfish and Eels, which were caught.
Mgwali @ Torha	*Labeobarbus aeneus (A)*	30-A,	Backwaters, bedrock, boulders, vegetation, fast and slow flows all are features of this site and it is suitable for yellowfish and Eel but the Eel was not found,
Mgwali @ Makhobokeni	*No fish caught*		Sedimentation and bedrock dominating no fish was caught.
Mgwali @ the Bridge	*No fish caught*		Lots of Sedimentation and bedrock dominating no fish was caught.
Mbhashe @ N2	*No fish caught*		Deep pools, fast flow.
Mbhashe @ Mpozolo	*No fish caught*		Backwaters, boulders, vegetation, deep pools, fast and slow flows all are features of this site and it is suitable for indigenous species but were not found

DISCUSSION

The results of this study indicated that Mbashe has a lot of sedimentation occurring with the channel due to widening of the river, livestock trampling and vegetation removals. The high sediment inputs lead to high turbidities in the system and also the sand mining occurring along the riverbanks of this system is another reason contributing to high sediment loads. This might be not a good indication for macroinvertebrates and fishes in the river. The water quality results at the Mbashe River and its tributaries indicated no signs of pollution throughout the years. The high sediment loads lead to high water turbidity in this system.

The macro invertebrates analysis for the Mbashe system shows that the main channel of this river ranges from fair to natural. In 2009 there was only one site sampled at the Mbashe River main stem and this was due to high flows as the survey was conducted during the rainy season in the Eastern Cape. Therefore, that resulted to lack of data at some sites during the year. The sites that were sampled were the Mbashe Upper reaches, Mnyolo, Xuka at Mhlopekazi and Mgwali at Ngcacu (Fig 19).

The results of these surveys indicated that the seasonal variation has an impact on the aquatic biota, and this is shown by variations on the species abundance and ASPT results observed at the Mbashe River and its tributaries. Although there were variations in species abundance and ASPT no significant impacts observed at this system. Apart from the seasonal variations the sedimentation also played a role in low species diversities at some sites and led to scarcity of vegetation which affected the macro invertebrate abundances in the system. The low species abundances at some sites might be associated with habitat loss due to sedimentation and vegetation removal (Appendix 1). The geomorphological inspections in this system indicated that the system is moderately modified and the basic ecosystem functioning is still happening. During the spring survey it was observed that, Mbashe tributaries are all in good condition meaning that these systems had no impact on the main channel (see Appendix 1). The only site that was indicated as poor was the Mgwali site at Makhobokeni and even though this site is poor there were no severe impacts observed except for those mentioned above which are the sedimentation and vegetation removal. The morphological features indicated that this site consist of deep pools, which can be a suitable habitat for fish.

The fish results for this system indicated that the whole system is dominated by alien species. The most dominant species in Spring were the *Labeobarbus aeneus and A. mossambica*. The

Labeobarbus aeneus is the only species that is dominating this river throughout the years except for the survey conducted in spring 2009, where no fish sampling was done due to malfunctioning of the electro fishshocker. During the recent survey conducted in autumn the results indicated that the fish abundance has deteriorated. This may be associated with seasonal change as the most favourable breeding season for the species is summer. This species is known as one of those species that prefers clear flowing waters of larger rivers. The species such as *Barbus pallidus, Barbus anoplus and Myxus capensis* were found in the previous surveys at this system, although were not in high abundances. During the recent survey these species were not found at this system. It is therefore believed that these species are being endangered by this alien species hence not found. The abundance of this *L. aeneus* was higher in winter and decreased again in spring. This may be due to seasonal change and scarcity of food (invertebrates).

Appendix 1. Table showing the SASS results at the Mbashe River in Summer (2007), Winter and Spring (2008**).**

SUMMER 2007

Site name	SASS Score	No. of Taxa	ASPT	Class
Mbashe-Upper	80	15	5.3	Fair
Mnyolo Bridge	68	12	5.7	Fair
Xuka-Silindini	No data			
Xuka-R61 Bridge	150	24	6.3	Good
Xuka-Mhlopekazi	141	21	6.7	Good
Mgwali-R61 Bridge	147	23	6.4	Good
Mgwali- Ngcacu	109	17	6.4	Good
Mgwali-Tora	133	17	7.8	Natural
Mgwali-Makhobokazi	133	17	7.8	Natural
Mbashe-N2 Bridge	88	17	5.2	Fair
Mbashe-Mpozolo	No data			

WINTER 2008

Site name	SASS Score	No. of Taxa	ASPT	Class
Mbashe-Upper	128	20	6.4	Good
Mnyolo Bridge	138	20	6.9	Good
Xuka-Silindini	131	19	6.9	Good
Xuka-R61 Bridge	174	25	7	Good
Xuka-Mhlopekazi	165	22	7.5	Natural
Mgwali-R61 Bridge	152	23	6.6	Good
Mgwali- Ngcacu	82	14	5.9	Fair
Mgwali-Tora	153	24	6.4	Good
Mgwali-Makhobokeni	56	9	6.2	Good
Mbashe-N2 Bridge	134	20	6.7	Good
Mbashe-Mpozolo	50	6	8.3	Natural

SPRING 2008

Site name	SASS Score	No. of Taxa	ASPT	Class
Mbashe-Upper	112	23	5.9	Fair
Mnyolo Bridge	74	10	7.4	Natural
Xuka-Silindini	66	10	6.6	Good
Xuka-R61 Bridge	112	19	5.9	Fair
Xuka-Mhlopekazi	148	22	6.7	Good
Mgwali-R61 Bridge	218	32	6.8	Good
Mgwali- Ngcacu	130	20	6.5	Good
Mgwali-Tora	105	18	5.8	Fair
Mgwali-Makhobokeni	54	11	4.8	Poor
Mbashe-N2 Bridge	78	15	5.8	Fair
Mbashe-Mpozolo	58	7	8.2	Natural

AUTUMN 2010

SITES	SASS SCORE	NO. OF TAXA	ASPT	CLASS
Mbashe upper reaches	161	24	6.7	Good
Mnyolo bridge	74	11	6.7	Good
Xuka @ Slilindini	155	24	6.5	Good
Xuka@ R61	50	11	6.5	Good
Xuka @ Mhlopekazi	110	17	6.5	Good
Mgwali@ Ngcacu	69	9	7.7	Natural
Mgwali@ Tora	84	10	8.4	Natural
Mgwali@ Makhobokeni	140	21	6.7	Good
Mgwali@ the bridge	84	14	6.0	Good
Mbashe N2 bridge	39	5	7.8	natural
Mbashe @ Mpozolo	8	1	8	1 biotope & 1 taxon

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

Appendix 2.Tables showing the number of species caught at Mbashe River and its tributaries in Summer 2007, Winter and Spring 2008.

SPRING 2007

Site name	*Myxus capensis*	*B. anoplus*	*L. aeneus*	*B. pallidus*	*A. mossambica*	*A. marorata*	*C. carpio*
Mbashe-Upper	-	1	21				
Mnyolo Bridge	No data	-	70	-	-	-	-
Xuka-Silindini	-	-		-	-	-	-
Xuka-R61 Bridge	-	-	9	-	-	-	
Xuka-Mhlopek	-	-	29	-	-	-	-
Mgwali-R61 Bridge	-	-	8	-	-	-	-
Mgwali- Ngcacu	-	-	29	-	-	-	1
Mgwali-Tora	-	-	8	-	-	-	-

Mgwali-Makhobok	-	-	7	-	1	-	-
Mbashe-N2 Bridge	-	-	3	-	-	-	-
Mbashe Mpozolo	No data						

WINTER 2008

Site name	*Myxus capensis*	*B. anoplus*	*L. aeneus*	*B. pallidus*	*A. mossambica*	*A. marorata*	*C. carpio*
Mbashe-Upper	-	-	-	-	-	-	-
Mnyolo Bridge	-	-	-	-	-	-	-
Xuka-Silindini	-	-	1	-	-	-	-
Xuka-R61 Bridge	-	-	6	-	-	-	-
Xuka-Mhlopekazi	-	-	31	-	-	-	-
Mgwali-R61 Bridge	-	-	-	-	-	-	-
Mgwali- Ngcacu	-	-	11	-	-	-	-
Mgwali-Tora	-	-	12	-	-	-	-
Mgwali-Makhobokeni	-	-	53	-	-	-	-
Mbashe-N2 Bridge	-	1	81	-	-	-	-
Mbashe Mpozolo	-	-	-	-	-	-	-

SPRING 2008

Site name	*Myxus capensis*	*B. anoplus*	*L. aeneus*	*B. pallidus*	*A. mossambica*	*A. marorata*	*C. carpio*
Mbashe-Upper	-	-	-	-	-	-	-
Mnyolo Bridge	-	-	1	-	-	-	-
Xuka-Silindini	-	-	12	-	-	-	-
Xuka-R61 Bridge	-	-	90	1	6	-	-
Xuka-Mhlopekazi	-	-	10	-	4	-	-
Mgwali-R61 Bridge	-	-	-	-	-	-	-
Mgwali- Ngcacu	-	-	-	-	-	-	-
Mgwali-Tora	-	-	13	1	-	-	-
Mgwali-Makhobokeni	-	-	22	1	4	-	-
Mbashe-N2 Bridge	-	-	24	-	3	-	-
Mbashe Mpozolo	-	-	-	-		-	-

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