State of the Crocodile River

Mpumalanga

A REPORT OF THE SOUTH AFRICAN RIVER HEALTH PROGRAMME, SUB-PROGRAMME OF THE NATIONAL AQUATIC ECOSYSTEM BIOMONITORING PROGRAMME (NAEBP)

Acknowledgements

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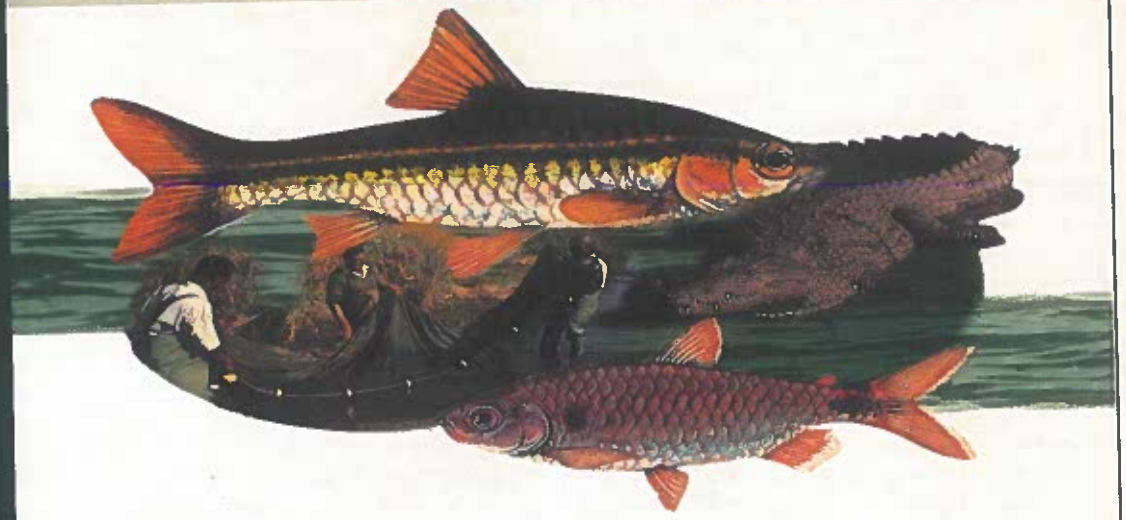

Background

A river is shaped by the changes that take place in its catchment, whether those changes are natural or induced by humans. Rivers have a natural capacity to resist adverse changes, maintaining the chemical and physical habitats necessary for the many plants, animals and people that depend on these systems. However, the degree to which a river can resist and neutralise adverse effects has limits. If these limits are exceeded for extended periods, the river will lose its nurturing power and its value as a habitat for plants and animals and as a natural resource for humans will decrease.

An ecologically healthy river is also one of which the water is good to drink and to swim in, and whose fish are edible for humans as well as other predatory animals (for example fish eagles, otters and crocodiles). To know whether a river is healthy or not, or whether it is getting less healthy or perhaps recovering from bad health, requires regular monitoring of the "vital signs" of the river.

The River Health Programme

The Department of Water Affairs and Forestry, the Water Research Commission and the Department of Environmental Affairs and Tourism have combined forces to develop, with the assistance of various consultants and universities, the River Health Programme. This programme aims at using standardised and proven scientific techniques to measure the health of all major rivers in South Africa.

A multitude of factors determine the health of a river ecosystem: its geomorphological characteristics, hydrological and hydraulic regimes, chemical and physical water quality and the nature of instream and riparian habitats. Monitoring every factor is impractical, so scientists select indicators representative of the main components of a riverine ecosystem to obtain a cost-effective measure of the health of the system.

What are indicators of river health?

Indicators of river health are biological, physical and chemical characteristics of the river that can provide quantitative (how much) and qualitative (how good) information on the ecological condition of a river.

The River Health Programme focuses primarily on biological characteristics as indicators of river health. These biological characteristics would typically be the composition or abundance of species within a particular biological community, for example a fish community.

Aquatic organisms are adapted to live within certain environmental conditions. Changes within their environment may adversely affect composition and abundance characteristics of a specific biological community. If a river is inhabited by healthy biological communities, the river as a whole is resilient and healthy.

This programme aims at using standardised and proven scientific techniques to measure the health of all major rivers in South Africa.

The Mpumalanga Initiative

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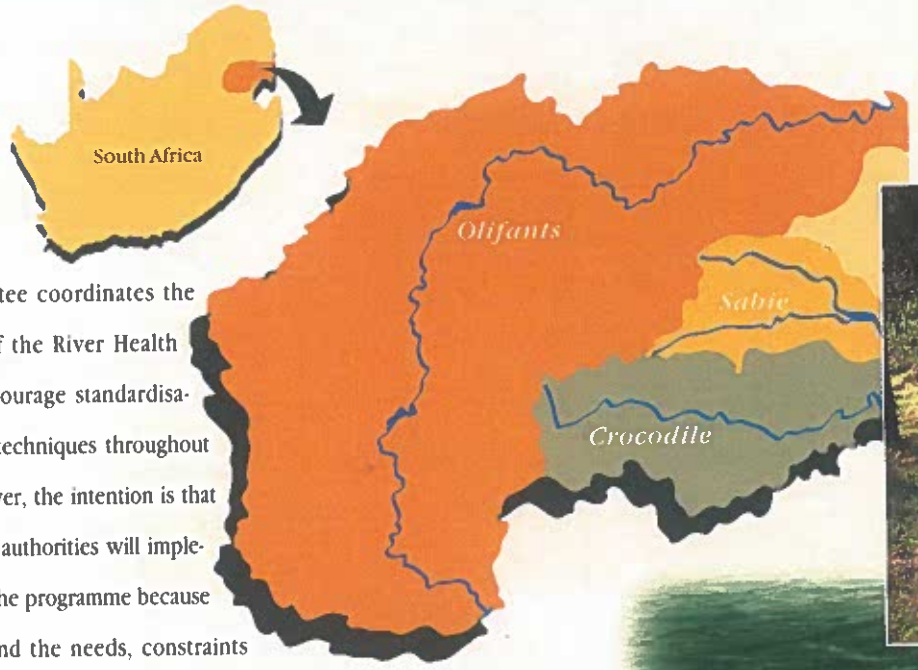

Locality of the three main rivers in this study

The Crocodile Ri near its source i Dullstroom area

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The Crocodile River survey

During late 1996 to early 1997, the implementation of the River Health Programme in the Province of Mpumalanga began with the monitoring of the Crocodile River and some of its tributaries. This monitoring exercise focussed on the community characteristics of fish, invertebrate organisms (e.g. snails, crabs, worms, insect larvae, mussels, beetles) and riparian vegetation (e.g. reeds, grass, shrubs, trees). In addition to these biological indicators, scientists collected information on the diversity and quality of aquatic habitats.

The destruction of a particular type of habitat will lead to the disappearance of certain species.

River Habitats

Loss of habitat is the single most important factor which has contributed towards the extinction of species in the last century. The destruction of a particular type of habitat will lead to the disappearance of certain species. Examples of such aquatic habitat types include pools, rapids, sandbanks, stones on the river bed and vegetation fringing the water's edges.

As the availability and diversity of habitat are major determinants of whether a given system is acceptable to a specific suite of biota or not, knowledge of the quality of habitats is very important in an overall assessment of ecosystem health.

Invertebrate Organisms

A variety of invertebrate organisms require specific river habitat types for at least part of their life cycles. Changes in the structure of aquatic invertebrate communities are a clear sign of changes in overall river condition. As most invertebrate species are fairly short-lived and remain in one area during their aquatic life phase, they are particularly good indicators of localised conditions in a river over the short term.

Fish Communities

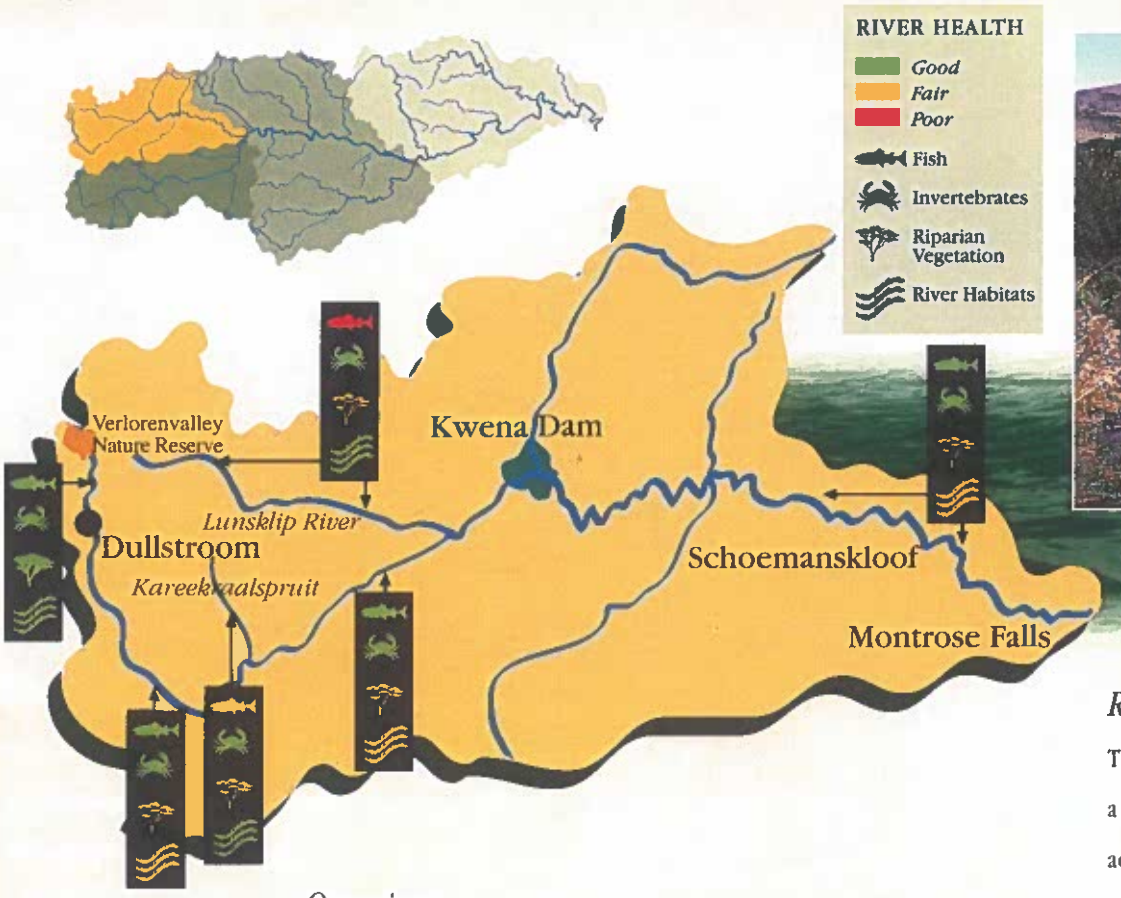
Fish, being relatively long-lived and mobile, are good indicators of long-term influences on a river reach and of the general habitat conditions within the reach. The number of different kinds or species of fish that occur in a specific river reach, as well as factors such as different size classes and the presence of parasites on the fish, can be used as indicators of river health.

Riparian Vegetation

Healthy riparian zones maintain channel form and serve as important filters for light, nutrients and sediment. Changes in the structure and function of riparian vegetation commonly result from changes in the flow regime of a river, exploitation for firewood, or use of the riparian zone for grazing or ploughing.

Upper Crocodile River

In general this reach is in good health. The long-term influence of trout farming in the upper parts and flow modification in the lower parts are possible causes for concern.



Crocodile River upstream of Kwena Dam

Overview

The Crocodile River rises at an altitude of approximately 2 000 metres above sea level near Dullstroom in the Drakensberg Mountains. The upper catchment consists of steep-sided valleys, often with sharply defined cliff slopes on the eastern edge of the escarpment. From the escarpment, the Crocodile River levels out into the basin of the Kwena Dam. Downstream of the Kwena Dam, the river winds along the valleys of Schoemanskloof for some 55 km to Montrose Falls.

River habitats

This reach shows a great diversity of aquatic habitats, as there is a transition from Alpine veld types to Lowveld veld types. The aquatic ecosystem in the Verlorenvalley Nature Reserve is unique and ecologically important. Just downstream of the reserve, trout farming on the plateau, primarily in the vicinity of Dullstroom, has contributed to habitat modification. The scenic reach between Kwena Dam and Montrose has exceptional riffle and rapid habitat, but aseasonal releases from the dam alter aquatic habitats. These changes disrupt the natural ecological processes that occur in the river.

Southern Kneria (*Kneria auriculata*)

Scientists identifying invertebrate organisms.

Invertebrate organisms

Forty one different families of aquatic invertebrates were found in this section. Two of these families occurred only in this section of the Crocodile River. These were damselfly larvae (Lestidae) and the water scavenger beetle (Hydrophilidae). Larvae of the blackfly (Simuliidae) were very common in the section between Kwena Dam and Montrose Falls. These larvae attach themselves to stones, rock or other stable substrate, and prefer fast flowing water. The mayfly families which occurred in this section included the very sensitive water spec (Prosopistomatidae).

Fish communities

The most upper reaches of the Crocodile River contain only one fish species, namely the chubbyhead barb (*Barbus anoplus*). Further down, but upstream of the Kwena Dam, rainbow trout occur. Trout is an exotic fish that only occurs in cool, clear water of good quality. Rainbow trout occur in most of the Lunsklip River. The predaceous nature of trout has resulted in the total loss of chubbyhead barb from some sites on this river.

Sharptooth catfish, exotic carp and exotic largemouth bass have been introduced into the Kwena Dam. These species generally prefer standing or slow flowing water and do not appear to pose a threat to the indigenous riverine species upstream or downstream of the dam.

Nine species of fish occur downstream of Kwena Dam. The rare southern kneria (*Kneria auriculata*) occurs in the small, clear and rocky tributaries of the Crocodile River between Kwena Dam and Montrose. The only other place where this species occurs is in the streams of the eastern highlands of Zimbabwe. The vulnerable incomati suckermouth (*Chiloglanis bifurcus*), which is endemic to the Crocodile-Incomati system, also occurs in this section of the Crocodile River.

Riparian vegetation

The Crocodile River has its source in almost pristine grassveld of the Verlorenvalley Nature Reserve. Around Dullstroom and most parts of the escarpment, commercial plantations, exotic species and trout and farm dams pose a threat to riparian vegetation. Further downstream trees and shrubs predominate in the natural riparian vegetation. Here irrigation farming and flow regulation below Kwena Dam increase the risks to riparian habitats.

Summary

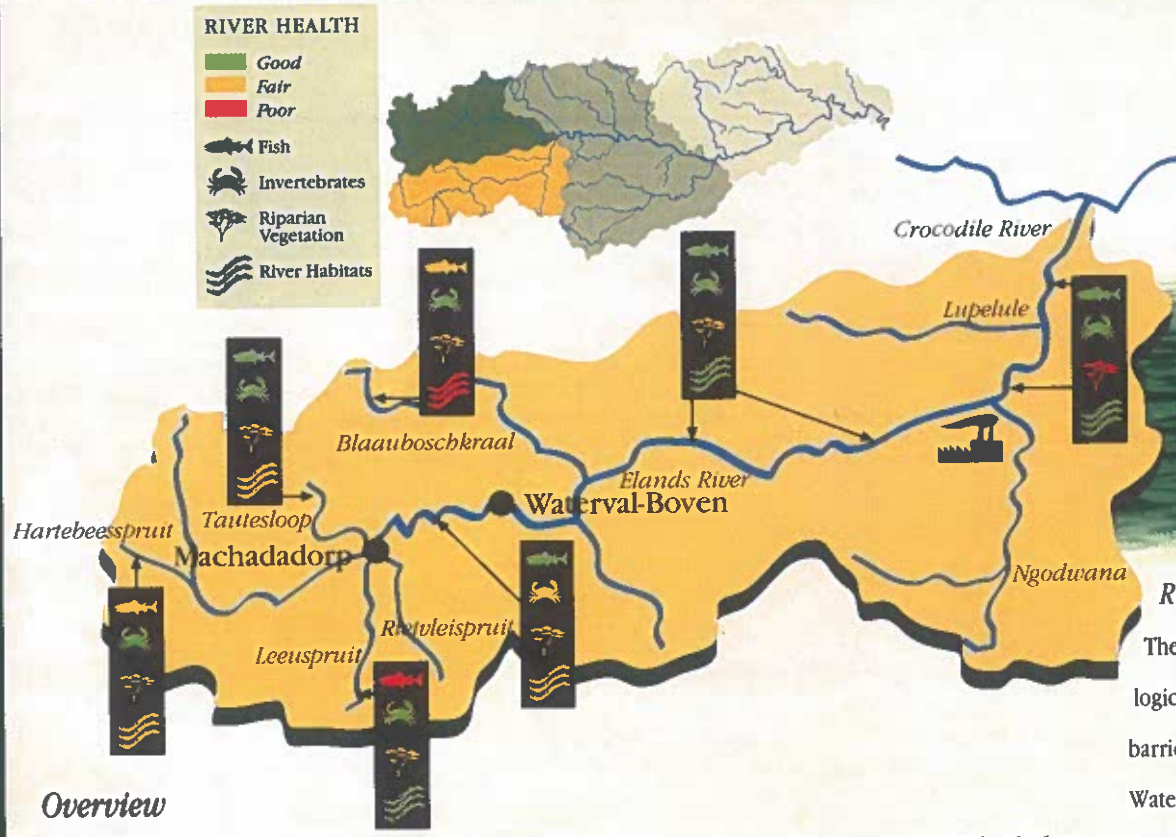
The increase in species diversity from the upper to the lower part of this river reach (for example from one to nine fish species) can be attributed to the associated increases in temperature, habitat types and food availability. This is a natural phenomenon of many rivers that rise on mountain plateaus.

Several fish species in the section downstream from Kwena Dam were not as abundant as expected. The most likely reason is that regulated water releases from the dam cause the river to lose its natural flow patterns and habitat diversity essential for fish survival and reproduction.

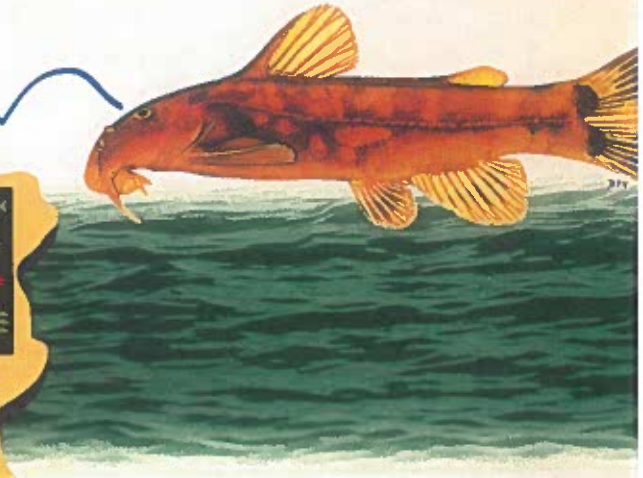
In general this reach is in good health. The long-term influence of trout farming in the upper parts and flow modification in the lower parts are possible causes for concern.

Elands River

In general, the Elands River is in very good health. The presence of exotic trees and shrubs in the riparian areas needs to be controlled.



Incomati suckermouth *(Chiloglanis bifurcus)*



Overview

The Elands River rises in a gently sloping Highveld zone near the town of Machadodorp. Trout farming is of economic and recreational importance in the Machadodorp area. Further downstream, Sappi's paper mill at Ngodwana is a well-known landmark.

Downstream of its source, the Elands River has a steeper gradient for most of its length. It joins the Crocodile River 2 km downstream of Montrose Falls. During the survey, scientists sampled four of the tributaries of the Elands River, namely the Hartbeesspruit, Leeuspruit, Tautesloop and Blouboskraalspruit.

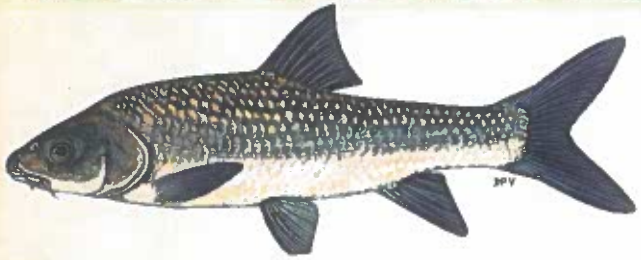
River habitats

The waterfall at Waterval Boven is an outstanding geomorphological feature of this river reach. It forms a natural physical barrier to the upstream migration of fish. The section from Waterval Boven to Ngodwana is characterised by exceptional riffle and rapid habitat.

Invertebrate organisms

Scientists collected forty-eight invertebrate families in the Elands River. These included sensitive mayflies (e.g. Prosopistomatidae) and caddisflies (Platycnemididae and Ecnomidae), the backswimmer (Notonectidae) as well as more tolerant bugs, beetles, worms and fly larvae.

Laundry and invertebrate collection day in the lower Elands River.



Smallscale yellowfish *(Barbus polylepis)*

The survey team compares scores for habitat condition.

Fish communities

Fish specialists found exotic largemouth bass and rainbow trout in the Leeuspruit, and juvenile rainbow trout in the Tautesloop. The vulnerable incomati suckermouth (*Chiloglanis bifurcus*) occurs in the Elands River. Smallscale yellowfish (*Barbus polylepis*) can be found in isolated localities downstream from Waterval Boven.

Riparian vegetation

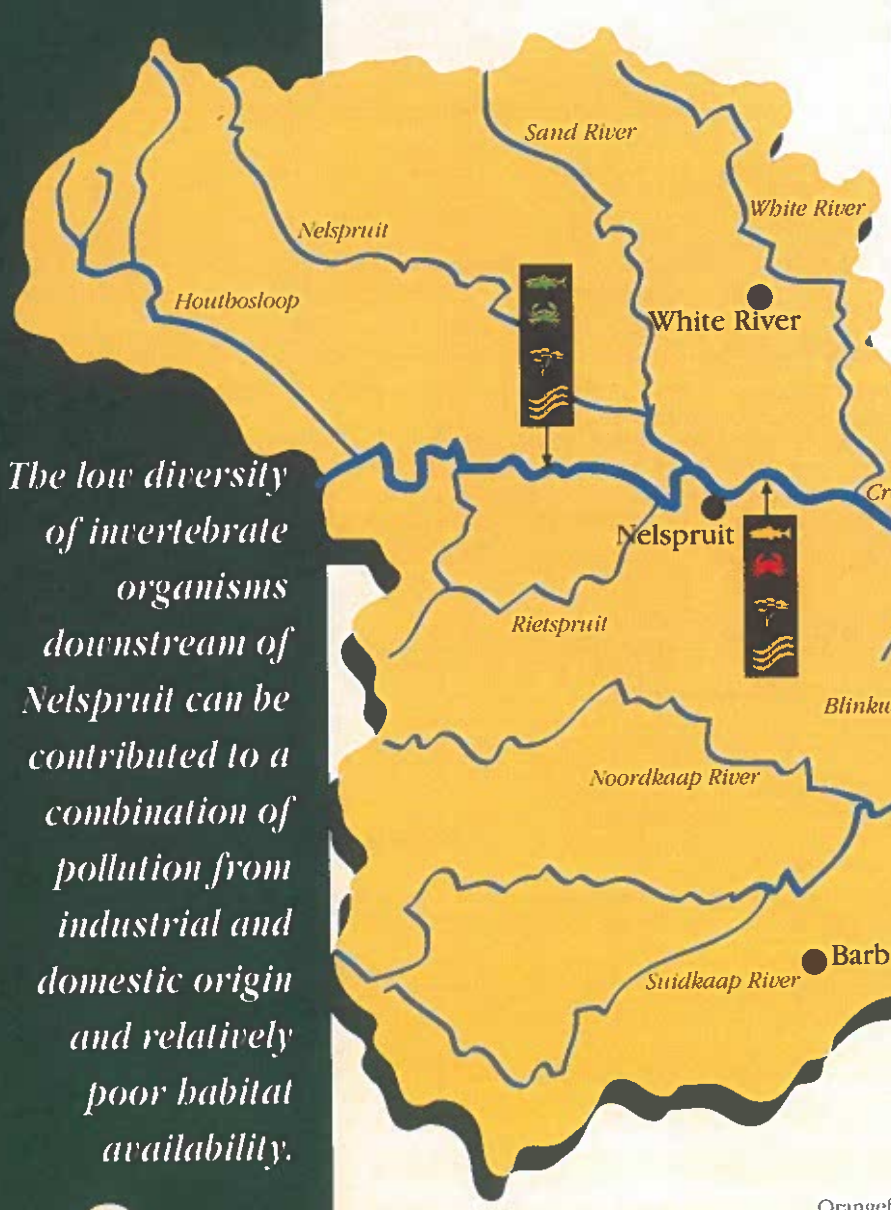
The primarily herbaceous vegetation of upper reaches of the Elands river is impacted by numerous farm dams, exotic species and bank erosion. This is particularly true for the Blouboskraalspruit. Exotic plantations are extensive in the area from Waterval Boven to just before the confluence of the Crocodile River resulting in a poor condition of the riparian vegetation. The short reach, of about five kilometres, just before the confluence is characterised by a healthy stand of mature riparian trees and shrubs in excellent condition.

Summary

The paper mill at Ngodwana had an accidental effluent spill in 1989, which resulted in massive mortalities of aquatic life as far downstream as Nelspruit in the middle parts of the Crocodile River. Recent surveys show that the health of the fish and aquatic invertebrate communities downstream from the mill have recovered to practically the same conditions that they were in before the spill.

In general, the Elands River is in very good health. The presence of exotic trees and shrubs in the riparian areas needs to be controlled.

Middle Crocodile River



Overview

From Montrose Falls to Mataffin Weir, the Crocodile River is slightly incised into a broad, flat bottomed valley. For some 20 km downstream of Mataffin Weir, the Crocodile River gradient increases sharply. The steep-sided river banks are densely colonized with riparian vegetation and reedbeds, making access extremely difficult. Further downstream, the river flows through a gorge after which its gradient drops sharply immediately upstream of the confluence with the Kaap River.

The low diversity of invertebrate organisms downstream of Nelspruit can be contributed to a combination of pollution from industrial and domestic origin and relatively poor habitat availability.

Fish are identified and inspected before being returned to the river.

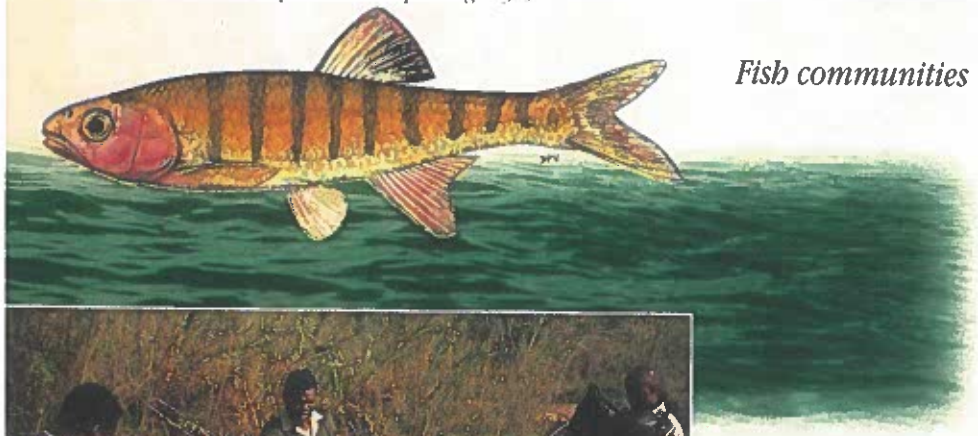
Orangefin barb (*Barbus eutaenia*)

River habitats

Water hyacinth (*Eichhornia crassipes*) can pose a threat to aquatic habitats and hence aquatic organisms in this area, especially in slow flowing waters such as at weirs. Hyacinth occurred abundantly in the lower parts of this reach prior to the 1996 floods.

For the last 15 kilometres of this reach, the river flows through a scenic gorge characterised by fast flowing and rocky habitats.

Barred minnow (*Opsaridium peringueyi*)



Netting for small fish.

Invertebrate organisms

In the part downstream of Nelspruit, scientists sampled between five and ten invertebrate families per site. In general, these were families that show some tolerance of pollution. This low diversity can be contributed to a combination of pollution, from industrial and domestic origin, and relatively poor habitat availability in this area. A total of 41 families were sampled in the middle Crocodile River, including the giant water bug (Belostomatidae).

Fish communities

A higher diversity of fish species occurs in this reach than in the upper reaches, and specialists collected 24 different fish species here during the survey. Amongst these were the southern barred minnow (*Opsaridium peringueyi*) which is a red data species unique to South Africa and with a very limited distribution. Other sensitive species in this reach include the orangefin barb (*Barbus eutaenia*) and the shortspine suckermouth (*Chiloglanis pretoriae*). Fish specialists could not find the incomati suckermouth (*Chiloglanis bifurcus*) in the section around and immediately upstream of Nelspruit, an area which forms part of their original distribution.

Riparian vegetation

Dense stands of trees and shrubs dominate the riparian vegetation, which is in fair to good condition. Areas within the riparian zone and adjacent are occasionally used for irrigation of citrus. In the area below Mataffin Weir the river bed is covered in extensive reed beds as a consequence of flow regulation and nutrient enrichment from irrigation return flows and urban and industrial effluent.

Summary

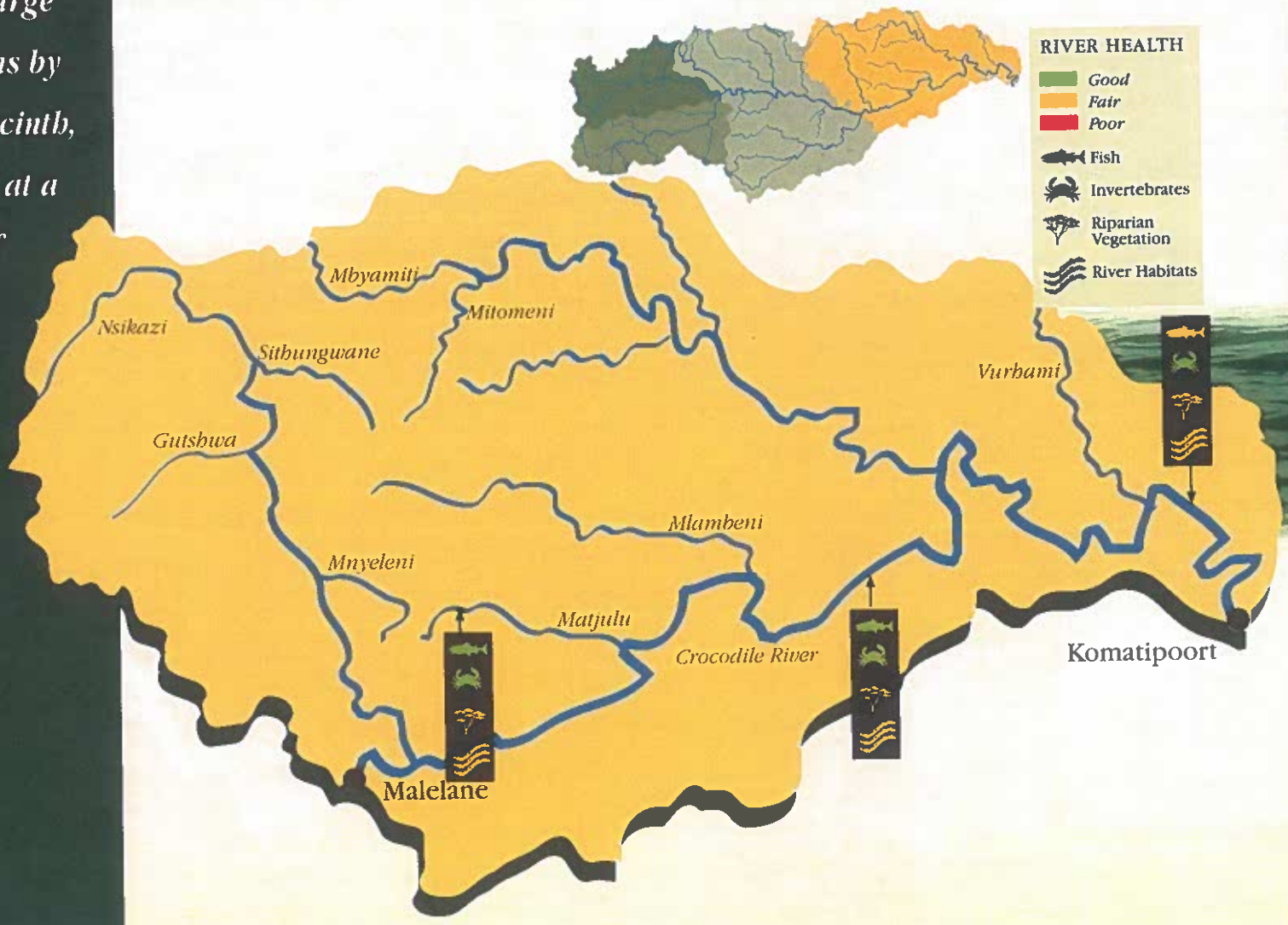
The middle Crocodile River catchment is characterised by intensive agricultural, industrial and urban land uses. Large areas are used for irrigation agriculture, ranging from fruit and nut orchards to vegetables and tobacco, with sugar cane a relatively recent introduction. Nelspruit has a relatively large industrial area, with metal processing forming a key part of the economic activities. Together with fruit processing in the vicinity of Nelspruit, urban runoff from Nelspruit and domestic wastes from Kanyamazani, the activities in this reach have a significant impact on the health of the Crocodile River. As an example, the incomati suckermouth is absent around and immediately upstream of Nelspruit, most likely because of the inundation caused by Mataffin Weir as well as urban and industrial pollution originating from Nelspruit.

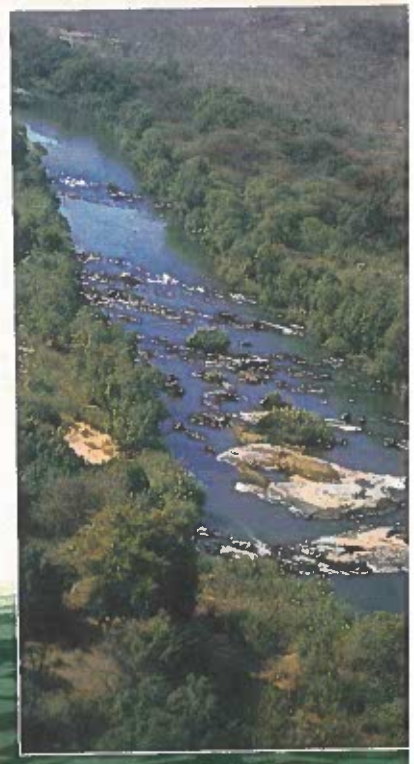
Lower Crocodile River

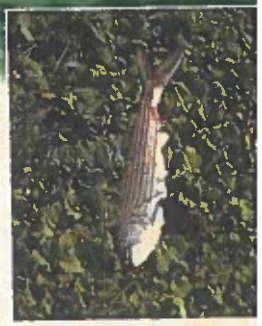
This slow flowing reach of the Crocodile River is prone to large infestations by water hyacinth, especially at a number of weirs.

Overview

Downstream of its confluence with the Kaap River, the gradient of the Crocodile River flattens out until its confluence with the Komati River at the town of Komatipoort. In this zone the Crocodile River forms meanders, incised into a wide sandy river bed. In other sections the river flows through multiple bedrock channels.







Above: Lower Crocodile River.

Dead tigerfish on dense mat of water hyacinth.

Non-lethal electro-fishing is one of the techniques used for fish collection.

Assessing riparian vegetation.

River habitats

This slow flowing reach is prone to large infestations by water hyacinth, especially at a number of weirs. Nutrient enrichment originating from human settlements exacerbate these infestations. In the lower parts the severity of drought conditions increases because riverside farmers and residents withdraw large amounts of water, posing a serious threat to the availability of aquatic habitats.

Invertebrate organisms

The Lower Crocodile River yielded 35 different families of aquatic invertebrates. Two Mollusc families, namely the orb snail (Planorbidae) and the freshwater mussel (Unionidae) were found only in this lower section of the river. This is a result of the more sandy bottom and slower flow in this part of the river, which provide a suitable habitat for these organisms.

Fish communities

This reach is inhabited by typical Lowveld species, most of which prefer slow flowing habitats. Fish specialists found 26 different species here, including three species of the tigerfish family, namely the tigerfish (*Hydrocynus vittatus*), the silver robber (*Micralestes acutidens*) and the imberi (*Brycinus imberi*).

Riparian vegetation

The riparian vegetation is in good condition on the northern bank within the Kruger National Park. Vegetation on the south bank has been impacted by sugar cane and citrus farming. Vegetation removal for a number of reasons, including tourist lodges and resorts, has also modified large tracts on the southern bank. Extensive reed encroachment of the river bed is evident.

Summary

Dense mats of water hyacinth may cause fish mortalities by depleting oxygen in the water.

The Kaap River, which flows into the Crocodile River at the beginning of this reach, may have a negative impact on the water quality of this reach. This suspected impact is linked to pollution associated with mining activities in the catchment of this tributary. As the past survey did not include the Kaap River, this potential impact could not be assessed.

Silver robber (*Micralestes acutidens*)

Future activities

More fish species occur in the Crocodile River System than in any other system in South Africa.

The Crocodile River system is not only one of the most economically productive catchments in South Africa, it is also one of the most biologically diverse. Forty-nine fish species occur in this river system, more than in any other system in South Africa. One reason for this diversity is the broad range of available habitats - from cold mountain streams in the Drakensberg to the slow flowing warm waters where the river meanders through the Lowveld.

Use of the information in this brochure

In the strive to optimise the balance between the conservation of natural resources and the development of the country's economy and people, we need to monitor key ecological, economic and social indicators. The River Health Programme aims at providing early warning where development takes place at the expense of our rivers, in a manner that is not sustainable. This programme will highlight problem areas so that the appropriate authorities can take action before the deterioration becomes irreversible. Once the River Health Programme has become established in a certain catchment, the observation of longer term health trends will inform resource managers whether their actions achieve the desired result.

Future activities in Mpumalanga

The Mpumalanga river monitoring team have continued their work with a survey of the Sabie River, and are assessing and interpreting their data. At the same time, they are planning a survey of the Olifants River system for 1998. This river crosses three provinces and the study will involve agencies from each of these provinces.

The monitoring team members plan to return to the Crocodile river in about the year 2000, and to establish a three yearly sampling frequency for each of the three main rivers that flow through Mpumalanga.

Dynamic nature of monitoring programmes

Monitoring programmes should always be dynamic, to change with the needs of people that make use of the information as well as to incorporate the latest findings of researchers. We can expect the River Health Programme to also adapt with the times. On the Crocodile River, for example, we may introduce additional monitoring sites to provide information on important tributaries such as the Kaap, Ngodwana and Nels Rivers. We may also use further indicators of river health (e.g. the geomorphology of the river and water chemistry) in future surveys. Such information will provide valuable additional insight into the present condition of the Crocodile River, and future trends in its state of health.

More Information

For more information regarding the River Health Programme in the Province of Mpumalanga, please contact one of the following people:

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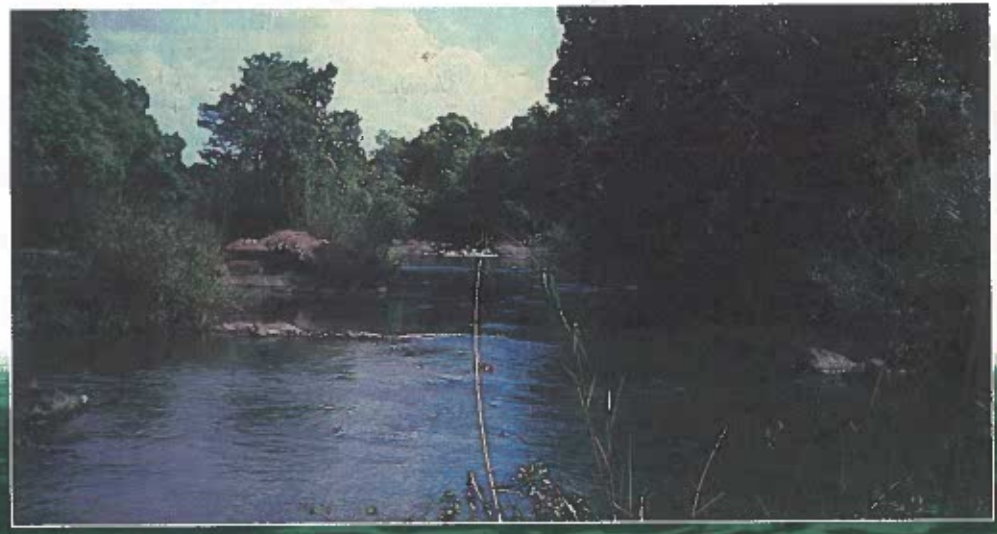
Fax: (013) 735-5467

Information on the national River Health Programme is available at:
http://iwqs.pwv.gov.za/michael/biomon/index.htm



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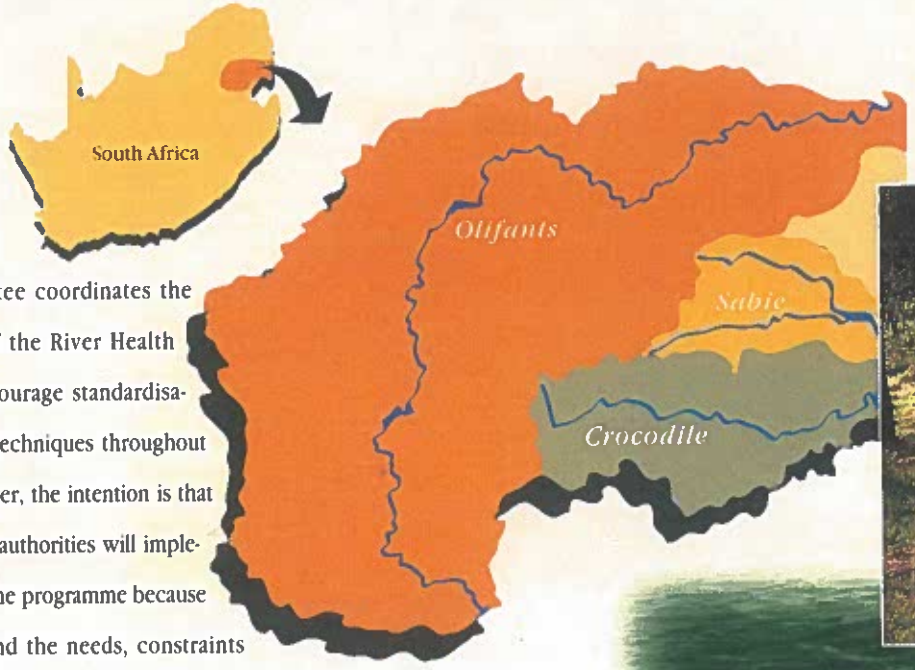

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Upper Crocodile River

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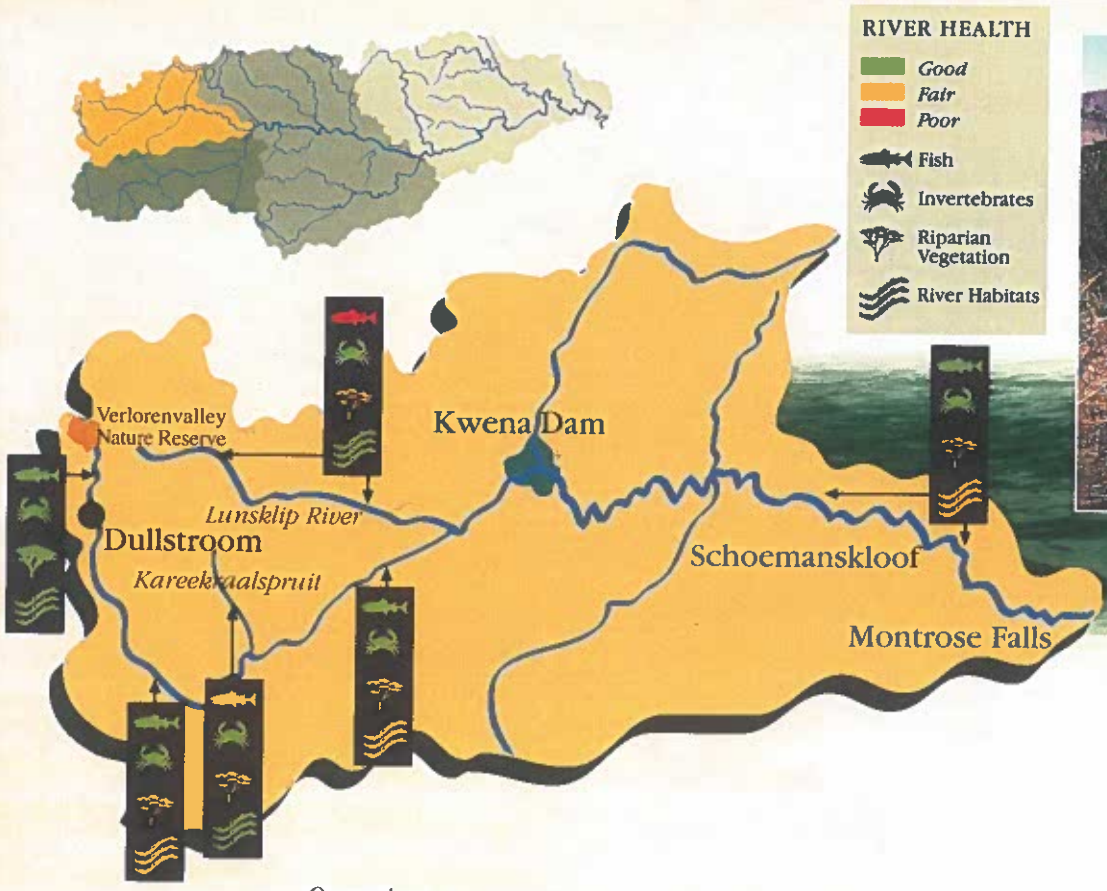


Croc
River
upstr
of Kw
Dam

Overview

The Crocodile River rises at an altitude of approximately 2 000 metres above sea level near Dullstroom in the Drakensberg Mountains. The upper catchment consists of steep-sided valleys, often with sharply defined cliff slopes on the eastern edge of the escarpment. From the escarpment, the Crocodile River levels out into the basin of the Kwena Dam. Downstream of the Kwena Dam, the river winds along the valleys of Schoemanskloof for some 55 km to Montrose Falls.

River habitats

This reach shows a great diversity of aquatic habitats, as there is a transition from Alpine veld types to Lowveld veld types. The aquatic ecosystem in the Verlorenvalley Nature Reserve is unique and ecologically important. Just downstream of the reserve, trout farming on the plateau, primarily in the vicinity of Dullstroom, has contributed to habitat modification. The scenic reach between Kwena Dam and Montrose has exceptional riffle and rapid habitat, but aseasonal releases from the dam alter aquatic habitats. These changes disrupt the natural ecological processes that occur in the river.

Southern Kneria (*Kneria auriculata*)

Scientists identifying invertebrate organisms.

Invertebrate organisms

Forty one different families of aquatic invertebrates were found in this section. Two of these families occurred only in this section of the Crocodile River. These were damselfly larvae (Lestidae) and the water scavenger beetle (Hydrophilidae). Larvae of the blackfly (Simuliidae) were very common in the section between Kwena Dam and Montrose Falls. These larvae attach themselves to stones, rock or other stable substrate, and prefer fast flowing water. The mayfly families which occurred in this section included the very sensitive water spec (Prosopistomatidae).

Fish communities

The most upper reaches of the Crocodile River contain only one fish species, namely the chubbyhead barb (*Barbus anoplus*). Further down, but upstream of the Kwena Dam, rainbow trout occur. Trout is an exotic fish that only occurs in cool, clear water of good quality. Rainbow trout occur in most of the Lunsklip River. The predaceous nature of trout has resulted in the total loss of chubbyhead barb from some sites on this river.

Sharptooth catfish, exotic carp and exotic largemouth bass have been introduced into the Kwena Dam. These species generally prefer standing or slow flowing water and do not appear to pose a threat to the indigenous riverine species upstream or downstream of the dam.

Nine species of fish occur downstream of Kwena Dam. The rare southern kneria (*Kneria auriculata*) occurs in the small, clear and rocky tributaries of the Crocodile River between Kwena Dam and Montrose. The only other place where this species occurs is in the streams of the eastern highlands of Zimbabwe. The vulnerable incomati suckermouth (*Chiloglanis bifurcus*), which is endemic to the Crocodile-Incomati system, also occurs in this section of the Crocodile River.

Riparian vegetation

The Crocodile River has its source in almost pristine grassveld of the Verlorenvalley Nature Reserve. Around Dullstroom and most parts of the escarpment, commercial plantations, exotic species and trout and farm dams pose a threat to riparian vegetation. Further downstream trees and shrubs predominate in the natural riparian vegetation. Here irrigation farming and flow regulation below Kwena Dam increase the risks to riparian habitats.

Summary

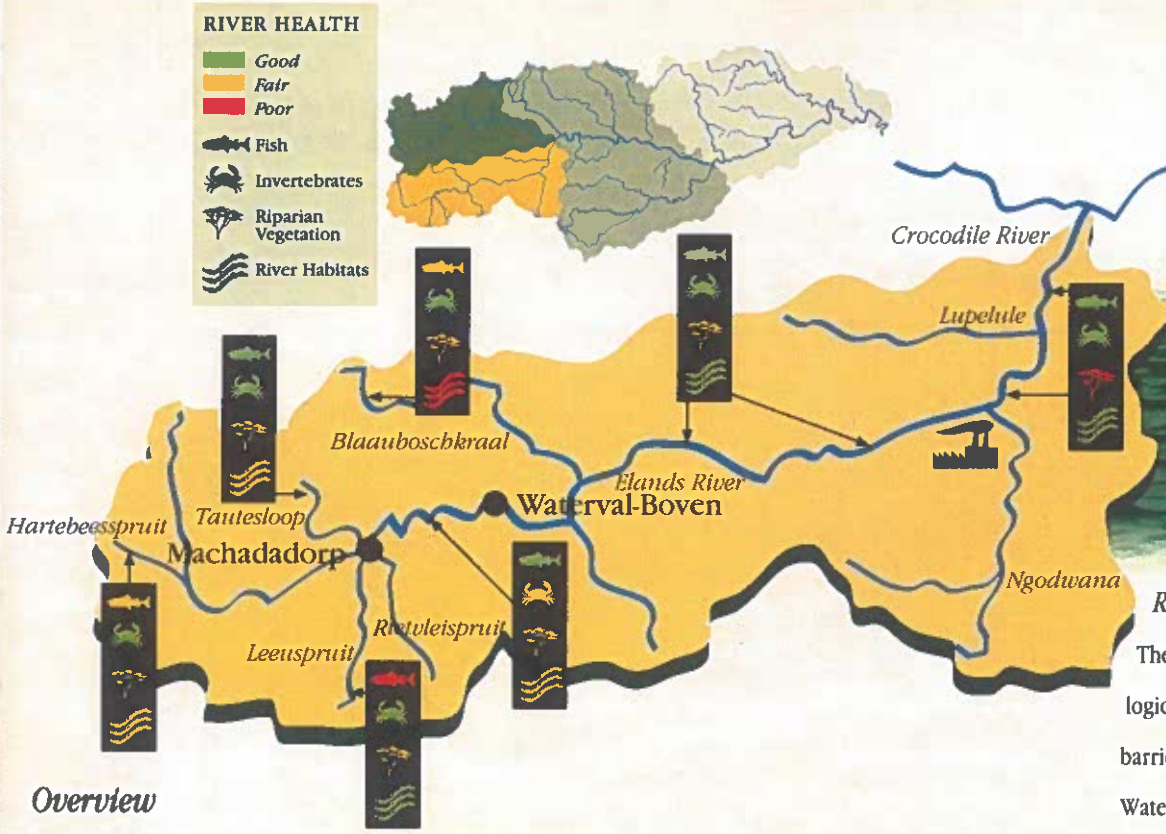
The increase in species diversity from the upper to the lower part of this river reach (for example from one to nine fish species) can be attributed to the associated increases in temperature, habitat types and food availability. This is a natural phenomenon of many rivers that rise on mountain plateaus.

Several fish species in the section downstream from Kwena Dam were not as abundant as expected. The most likely reason is that regulated water releases from the dam cause the river to lose its natural flow patterns and habitat diversity essential for fish survival and reproduction.

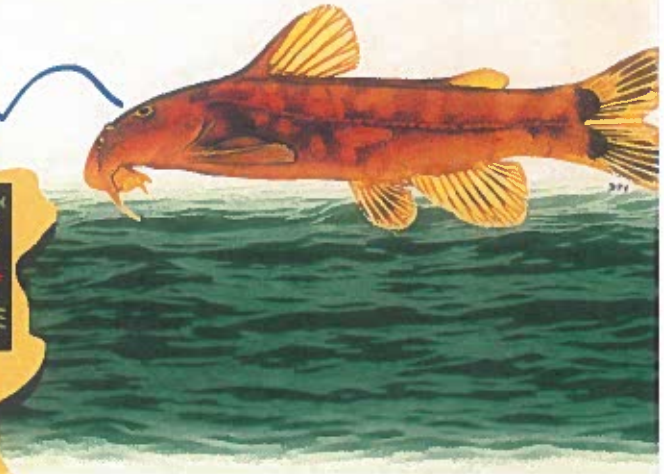
In general this reach is in good health. The long-term influence of trout farming in the upper parts and flow modification in the lower parts are possible causes for concern.

Elands River

In general, the Elands River is in very good health. The presence of exotic trees and shrubs in the riparian areas needs to be controlled.



Incomati suckermouth *(Chiloglanis bifurcus)*



Overview

The Elands River rises in a gently sloping Highveld zone near the town of Machadodorp. Trout farming is of economic and recreational importance in the Machadodorp area. Further downstream, Sappi's paper mill at Ngodwana is a well-known landmark.

Downstream of its source, the Elands River has a steeper gradient for most of its length. It joins the Crocodile River 2 km downstream of Montrose Falls. During the survey, scientists sampled four of the tributaries of the Elands River, namely the Hartbeesspruit, Leeuspruit, Tautesloop and Blouboskraalspruit.

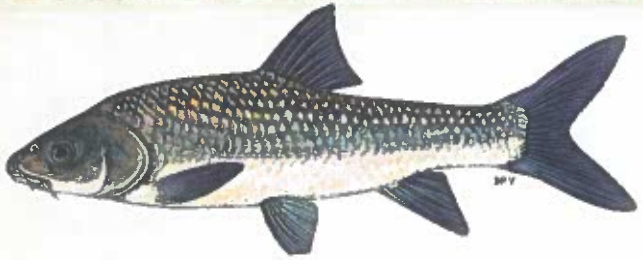
River habitats

The waterfall at Waterval Boven is an outstanding geomorphological feature of this river reach. It forms a natural physical barrier to the upstream migration of fish. The section from Waterval Boven to Ngodwana is characterised by exceptional riffle and rapid habitat.

Invertebrate organisms

Scientists collected forty-eight invertebrate families in the Elands River. These included sensitive mayflies (e.g. Prosopistomatidae) and caddisflies (Platycnemididae and Ecnomidae), the backswimmer (Notonectidae) as well as more tolerant bugs, beetles, worms and fly larvae.

Laundry and invertebrate collection day in the lower Elands River.



Smallscale yellowfish *(Barbus polylepis)*

The survey team compares scores for habitat condition.

Fish communities

Fish specialists found exotic largemouth bass and rainbow trout in the Leeuspruit, and juvenile rainbow trout in the Tautesloop. The vulnerable incomati suckermouth (*Chiloglanis bifurcus*) occurs in the Elands River. Smallscale yellowfish (*Barbus polylepis*) can be found in isolated localities downstream from Waterval Boven.

Riparian vegetation

The primarily herbaceous vegetation of upper reaches of the Elands river is impacted by numerous farm dams, exotic species and bank erosion. This is particularly true for the Blouboskraalspruit. Exotic plantations are extensive in the area from Waterval Boven to just before the confluence of the Crocodile River resulting in a poor condition of the riparian vegetation. The short reach, of about five kilometres, just before the confluence is characterised by a healthy stand of mature riparian trees and shrubs in excellent condition.

Summary

The paper mill at Ngodwana had an accidental effluent spill in 1989, which resulted in massive mortalities of aquatic life as far downstream as Nelspruit in the middle parts of the Crocodile River. Recent surveys show that the health of the fish and aquatic invertebrate communities downstream from the mill have recovered to practically the same conditions that they were in before the spill.

In general, the Elands River is in very good health. The presence of exotic trees and shrubs in the riparian areas needs to be controlled.

Middle Crocodile River

Overview

From Montrose Falls to Mataffin Weir, the Crocodile River is slightly incised into a broad, flat bottomed valley. For some 20 km downstream of Mataffin Weir, the Crocodile River gradient increases sharply. The steep-sided river banks are densely colonized with riparian vegetation and reedbeds, making access extremely difficult. Further downstream, the river flows through a gorge after which its gradient drops sharply immediately upstream of the confluence with the Kaap River.

The low diversity of invertebrate organisms downstream of Nelspruit can be contributed to a combination of pollution from industrial and domestic origin and relatively poor habitat availability.

Fish are identified and inspected before being returned to the river.

Orangefin barb (*Barbus eutaenia*)

River habitats

Water hyacinth (*Eichhornia crassipes*) can pose a threat to aquatic habitats and hence aquatic organisms in this area, especially in slow flowing waters such as at weirs. Hyacinth occurred abundantly in the lower parts of this reach prior to the 1996 floods.

For the last 15 kilometres of this reach, the river flows through a scenic gorge characterised by fast flowing and rocky habitats.

Barred minnow (*Opsaridium peringueyi*)

Netting for small fish.

Invertebrate organisms

In the part downstream of Nelspruit, scientists sampled between five and ten invertebrate families per site. In general, these were families that show some tolerance of pollution. This low diversity can be contributed to a combination of pollution, from industrial and domestic origin, and relatively poor habitat availability in this area. A total of 41 families were sampled in the middle Crocodile River, including the giant water bug (Belostomatidae).

Fish communities

A higher diversity of fish species occurs in this reach than in the upper reaches, and specialists collected 24 different fish species here during the survey. Amongst these were the southern barred minnow (*Opsaridium peringueyi*) which is a red data species unique to South Africa and with a very limited distribution. Other sensitive species in this reach include the orangefin barb (*Barbus eutaenia*) and the shortspine suckermouth (*Chiloglanis pretoriae*). Fish specialists could not find the incomati suckermouth (*Chiloglanis bifurcus*) in the section around and immediately upstream of Nelspruit, an area which forms part of their original distribution.

Riparian vegetation

Dense stands of trees and shrubs dominate the riparian vegetation, which is in fair to good condition. Areas within the riparian zone and adjacent are occasionally used for irrigation of citrus. In the area below Mataffin Weir the river bed is covered in extensive reed beds as a consequence of flow regulation and nutrient enrichment from irrigation return flows and urban and industrial effluent.

Summary

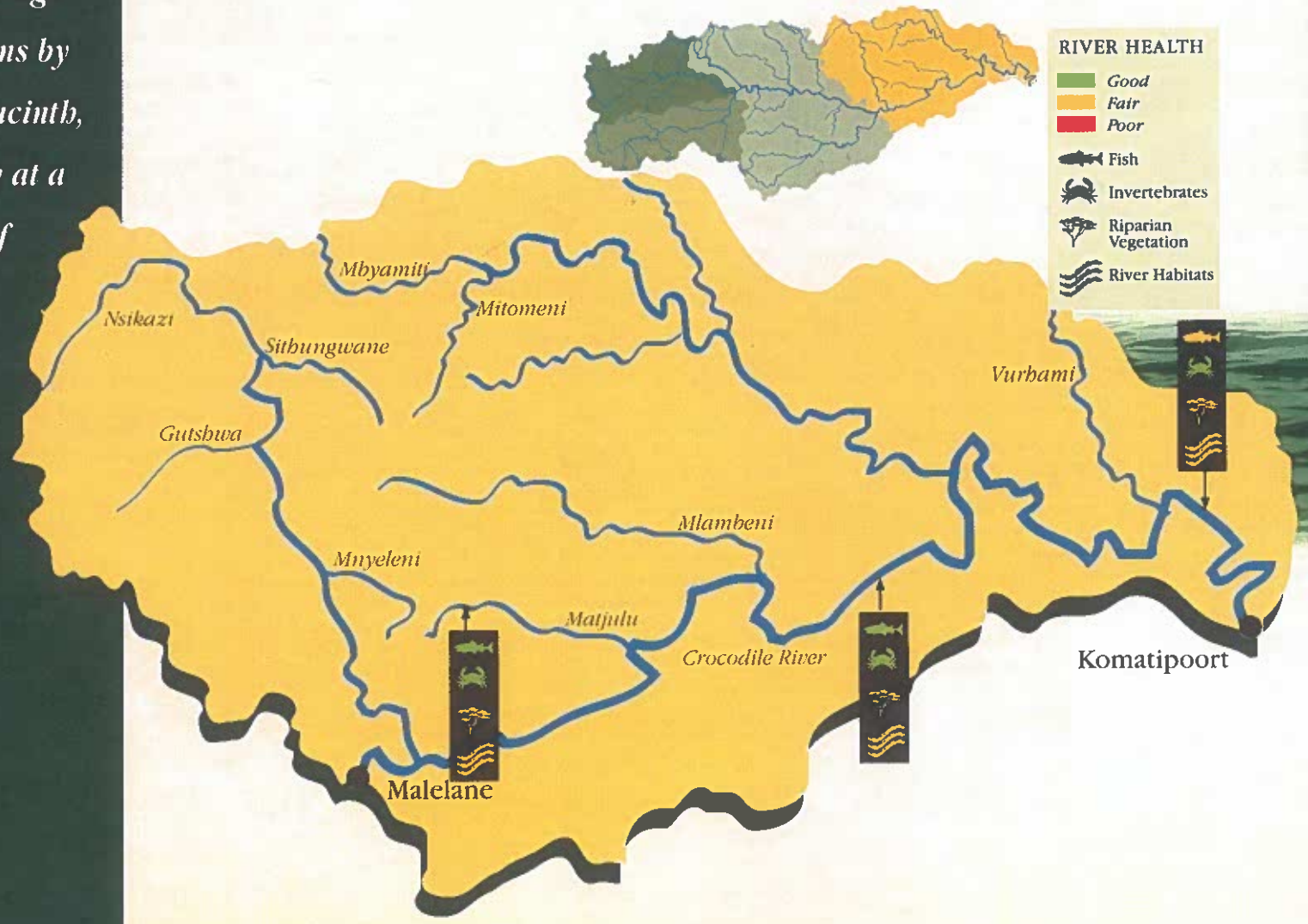
The middle Crocodile River catchment is characterised by intensive agricultural, industrial and urban land uses. Large areas are used for irrigation agriculture, ranging from fruit and nut orchards to vegetables and tobacco, with sugar cane a relatively recent introduction. Nelspruit has a relatively large industrial area, with metal processing forming a key part of the economic activities. Together with fruit processing in the vicinity of Nelspruit, urban runoff from Nelspruit and domestic wastes from Kanyamazani, the activities in this reach have a significant impact on the health of the Crocodile River. As an example, the incomati suckermouth is absent around and immediately upstream of Nelspruit, most likely because of the inundation caused by Mataffin Weir as well as urban and industrial pollution originating from Nelspruit.

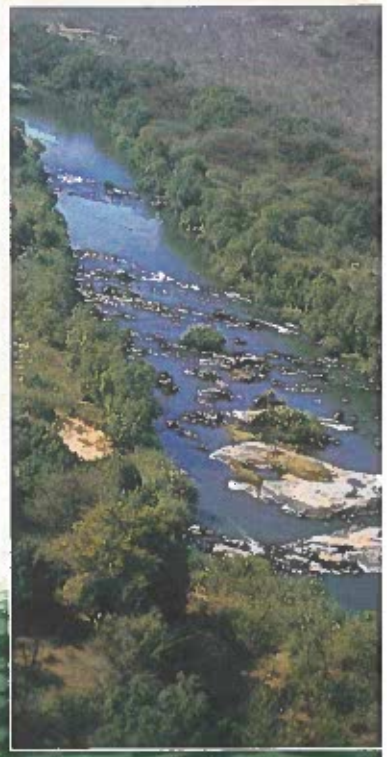
Lower Crocodile River

This slow flowing reach of the Crocodile River is prone to large infestations by water hyacinth, especially at a number of weirs.

Overview

Downstream of its confluence with the Kaap River, the gradient of the Crocodile River flattens out until its confluence with the Komati River at the town of Komatipoort. In this zone the Crocodile River forms meanders, incised into a wide sandy river bed. In other sections the river flows through multiple bedrock channels.

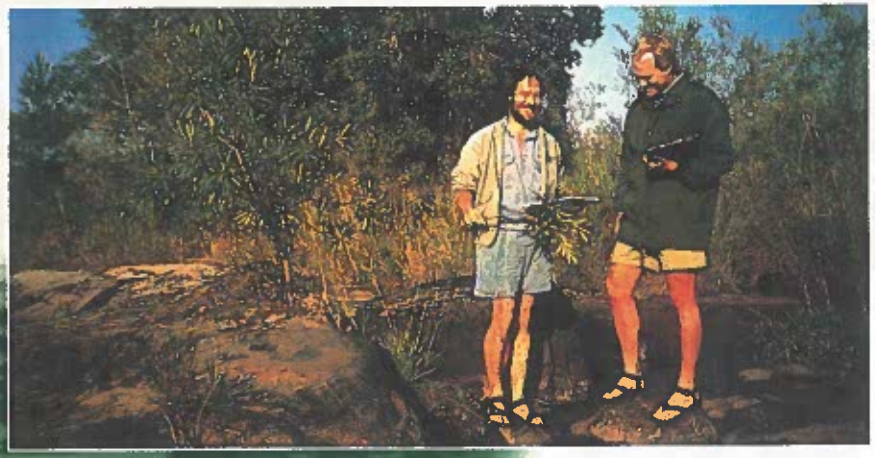




Above: Lower Crocodile River.

Dead tigerfish on dense mat of water hyacinth.

Non-lethal electro-fishing is one of the techniques used for fish collection.



Assessing riparian vegetation.

River habitats

This slow flowing reach is prone to large infestations by water hyacinth, especially at a number of weirs. Nutrient enrichment originating from human settlements exacerbate these infestations. In the lower parts the severity of drought conditions increases because riverside farmers and residents withdraw large amounts of water, posing a serious threat to the availability of aquatic habitats.

Invertebrate organisms

The Lower Crocodile River yielded 35 different families of aquatic invertebrates. Two Mollusc families, namely the orb snail (Planorbidae) and the freshwater mussel (Unionidae) were found only in this lower section of the river. This is a result of the more sandy bottom and slower flow in this part of the river, which provide a suitable habitat for these organisms.

Fish communities

This reach is inhabited by typical Lowveld species, most of which prefer slow flowing habitats. Fish specialists found 26 different species here, including three species of the tigerfish family, namely the tigerfish (*Hydrocynus vittatus*), the silver robber (*Micralestes acutidens*) and the imberi (*Brycinus imberi*).

Riparian vegetation

The riparian vegetation is in good condition on the northern bank within the Kruger National Park. Vegetation on the south bank has been impacted by sugar cane and citrus farming. Vegetation removal for a number of reasons, including tourist lodges and resorts, has also modified large tracts on the southern bank. Extensive reed encroachment of the river bed is evident.

Summary

Dense mats of water hyacinth may cause fish mortalities by depleting oxygen in the water.

The Kaap River, which flows into the Crocodile River at the beginning of this reach, may have a negative impact on the water quality of this reach. This suspected impact is linked to pollution associated with mining activities in the catchment of this tributary. As the past survey did not include the Kaap River, this potential impact could not be assessed.

Silver robber (*Micralestes acutidens*)

Future activities

More fish species occur in the Crocodile River System than in any other system in South Africa.

The Crocodile River system is not only one of the most economically productive catchments in South Africa, it is also one of the most biologically diverse. Forty-nine fish species occur in this river system, more than in any other system in South Africa. One reason for this diversity is the broad range of available habitats - from cold mountain streams in the Drakensberg to the slow flowing warm waters where the river meanders through the Lowveld.

Use of the information in this brochure

In the strive to optimise the balance between the conservation of natural resources and the development of the country's economy and people, we need to monitor key ecological, economic and social indicators. The River Health Programme aims at providing early warning where development takes place at the expense of our rivers, in a manner that is not sustainable. This programme will highlight problem areas so that the appropriate authorities can take action before the deterioration becomes irreversible. Once the River Health Programme has become established in a certain catchment, the observation of longer term health trends will inform resource managers whether their actions achieve the desired result.

Future activities in Mpumalanga

The Mpumalanga river monitoring team have continued their work with a survey of the Sabie River, and are assessing and interpreting their data. At the same time, they are planning a survey of the Olifants River system for 1998. This river crosses three provinces and the study will involve agencies from each of these provinces.

The monitoring team members plan to return to the Crocodile river in about the year 2000, and to establish a three yearly sampling frequency for each of the three main rivers that flow through Mpumalanga.

Dynamic nature of monitoring programmes

Monitoring programmes should always be dynamic, to change with the needs of people that make use of the information as well as to incorporate the latest findings of researchers. We can expect the River Health Programme to also adapt with the times. On the Crocodile River, for example, we may introduce additional monitoring sites to provide information on important tributaries such as the Kaap, Ngodwana and Nels Rivers. We may also use further indicators of river health (e.g. the geomorphology of the river and water chemistry) in future surveys. Such information will provide valuable additional insight into the present condition of the Crocodile River, and future trends in its state of health.

More Information

For more information regarding the River Health Programme in the Province of Mpumalanga, please contact one of the following people:

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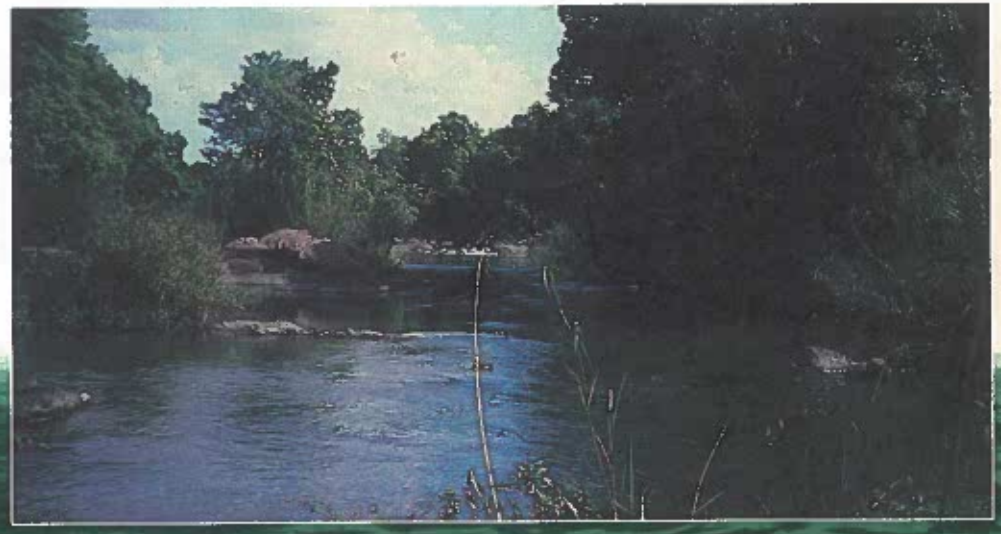
Information on the national River Health Programme is available at:
http://iwqs.pwv.gov.za/michael/biomon/index.htm



The River Health Programme aims at providing early warning where development takes place at the expense of our rivers, in a manner that is not sustainable.

DW 66

DEPARTEMENT VAN WATERWESE EN BOSBOU
DEPARTMENT OF WATER AFFAIRS AND FORESTRY

NAVRAE ENQUIRIES	Ms L. Hill
TELEFOON TELEPHONE	808 0374
VERWYSING REFERENCE	4/12/2/1 CSIR

SUWY / Neem asb en skakel met dekdirek. Vra dat verdere kopieë met elektroniese kopie aan Geo Streekhoofde gaan. 29/4

INSTITUTE FOR WATER QUALITY STUDIES

DIRECTOR: GEOHYDROLOGY

NATIONAL AQUATIC ECOSYSTEM BIOMONITORING PROGRAMME (NAEBP): STATE OF THE CROCODILE RIVER - MPUMALANGA REPORT

The specific purpose of the National Aquatic Ecosystem Biomonitoring Programme (or River Health Programme as it is referred to now) will be to directly monitor, assess and report on the health status and trends of aquatic environments, including rivers, dams, wetlands and estuaries in South Africa. The current focus is on rivers as one component of aquatic ecosystems and it is envisaged that all South Africa's major river systems will ultimately be included in the biomonitoring programme. Considerable progress has already been made at national and provincial level since the launch of the NAEBP in 1996.

Each of the provinces has been encouraged to set up a Provincial Implementation Team consisting of various stakeholders. This resulted in programmes of action that were identified for each of the provinces. In Mpumalanga, the Crocodile and Elands river survey was undertaken in September and October 1996.

Copies of the above report are included for your information and use. Further copies for distribution can be obtained from Ms Liesl Hill at the above telephone number or e-mail address: eee@dwaf-hri.pwv.gov.za.

L. Hill

DIRECTOR: INSTITUTE FOR WATER QUALITY STUDIES
DATE: 20-04-98