Internal Report

A survey of the Freshwater Invertebrates of the North East Cape Rivers

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SUMMARY

A survey of the aquatic macroinvertebrates of the freshwater systems, concentrating on the rivers, of the Elliot, Ugie and Maclear districts in the North Eastern Cape was undertaken for Mondi Forests. Three surveys were undertaken in December 1990, March 1991 and March 1993 and 48 individual sites were visited at least once during this study. At each site, most identifiable aquatic biotopes were sampled to collect the greatest diversity of species possible. In addition light traps were set and aerial collecting of adult flying insects was conducted wherever this was possible. A photographic record was taken of collecting sites and together with specimens collected this forms a historical database of information which will be kept at the Albany Museum. The survey produced altogether 351 tentatively identified taxa for the region of which 33 are new to science. Identifications were carried out as far as possible with specimens sent away for expert identification where this could not be carried out by staff. A large number of these invertebrates are being further studied by various authorities for and will be described and named. Certain sites were particularly rich and diverse in species and deserve special conservation attention. The fauna shows elements of both tropical and cool temperate Cape groups indicating a transition zone.

INTRODUCTION

In 1989 Mondi Forests announced that the company had acquired a large number of farms in the Elliot, Ugie and Maclear Districts for the purpose of afforestation with exotic plantations. Because of the large scale of this operation conservationists and river ecologists expressed concern that the change in land use, from grasslands to exotic forests, would have a detrimental impact on the fauna and flora and on the rivers in the region.

As part of Mondi Forests commitment to conservation, the North East Cape Forest group agreed to fund scientists from various disciplines to survey, study and draw up inventories of all known animals found in the catchments and water bodies of the Elliot-Ugie-Maclear districts. Such studies should ideally be carried out before the start of any afforestation activities and unfortunately some afforestation had already been undertaken in December 1990 when the surveys were started. As a minimal amount of soil tilling had been done in planting activities and the trees were still very small it was considered that their impact on both land alteration and rainfall runoff was minimal. The Albany Museum's Freshwater Invertebrate Department was one of the research groups approached to investigate the fauna and our research concentrated on the occurrence of freshwater macroinvertebrates living in the various waterbodies in the area.

An inventory of the aquatic macroinvertebrates found in the streams and rivers and some standing water bodies was compiled from three separate surveys carried out between December 1990 and March 1993. Many species of aquatic macroinvertebrates are sensitive to changes in their environment, and these surveys, initiated during the early stages of tree planting, before the trees had started growing and using water, will provide a good baseline of pre-afforestation data. These collections can be used in future for comparative studies, when the trees have

started having an influence on the surrounding landscape, vegetation and river flow regime.

Our knowledge of the freshwater fauna of South Africa is scanty in many areas, and the North East Cape has proved to be no exception. Very little work was previously done on the rivers in this area, and we will never know what species have been lost due to man's earlier influence. At the turn of the century, rainbow and brown trout, *Oncorhynchus mykiss* (Walbaum) and *Salmo trutta* Linnaeus, were introduced into the rivers of the north east Cape (de Moor and Bruton, 1988). Rainbow trout established viable, self-perpetuating populations which undoubtedly have had some impact on the invertebrate fauna. The indigenous fish fauna was detrimentally affected by this introduction (Skelton and James, 1991). Farming practises have resulted in erosion and silting up of many of the rivers, which also negatively affects the invertebrate fauna (Chutter, 1969). However, despite these influences, the north east Cape has proved to have a diverse and interesting aquatic invertebrate fauna.

STUDY AREA AND METHODS

The rivers investigated flow into two main river systems, the Mbashe and the Mzimvubu (Fig. 1). The rivers all flow in a southerly to easterly direction, some rising from altitudes of over 2700m above sea level. All sites studied were at an altitude above 1000m. The Drakensberg escarpment forms the watershed between these rivers, all flowing into the Indian Ocean, and those flowing westwards into the Orange river and eventually into the Atlantic Ocean (Fig. 1). During the three surveys altogether 48 sites were selected for studying (Table 1). Not all of these are included in the report because they include rivers flowing off the western watershed and therefore were not within the Mondi afforestation region. A survey of dams, pans and temporary pools was undertaken in March 1993, but these are not covered further in this report. The collecting sites are indicated in Figure 2.

The region was visited from 3-7 December 1990, 21-27 March 1991 and 26 March - 2 April 1993. Sampling sites along rivers were selected to provide a broad spectrum of the prevailing conditions of the rivers in the region to become afforested. Sites were also selected to ensure the greatest possible coverage of aquatic biotopes present in a reach of stream enabling the collection of a wide diversity of aquatic invertebrates. Owing to time limitations, collecting sites were usually in close proximity to roads to ensure as great a coverage of sites as possible.

Ecological conditions such as plant cover, river bank conditions and flow regime of the rivers at the time of sampling are presented in a photographic record of all the sampling sites (Plates 1-50). The time of each visit during the three surveys and the physicochemical parameters such as pH, temperature and electrical conductivity were recorded at each site (Table 2).

Collecting of aquatic stages was done using a range of techniques. A variety of hand-nets, kickscreens and drift nets were used to sample aquatic biotopes. Mesh sizes of hand nets ranged from 80μm to 300μm and kickscreens with a 1mm mesh size were used. As many aquatic biotopes as possible were sampled at each site. See Table 3 for descriptions of all

aquatic biotopes sampled during the survey. Light traps, to collect the adult stages of many aquatic insects important for species identification, were set up wherever possible. In addition, where time permitted, general collecting with aerial nets to collect flying adult insects was also carried out. A synopsis of all biotopes sampled at each site is given in Table 4.

Unsorted samples as well as selected animals collected were given a catalogue number for each site, date and biotope type. Samples were labelled and preserved in either 80% ethanol or 4% neutrally buffered formaldehyde. Samples were sorted in the laboratory by first picking out large animals and then passing each sample through a series of different mesh sizes of net to separate large and small invertebrates. A final check of each sample with a dissecting microscope was conducted to remove any smaller animals that might have been missed in the coarse sorting.

Identification of animals was carried out using museum voucher material for comparison and where specimens of particular species were not available, the excellent library of taxonomic papers held by the Albany Museum was used. Certain groups were sent away to specialists for identification. All material collected is stored and curated in the Albany Museum under the Eastern Cape Rivers catalogue (ECR). There are about 2500 separate catalogue entries and the collection holds about 30 000 specimens. New species are being processed for description and publication.

RESULTS AND DISCUSSION

The physicochemical status of the waters in the rivers of the North East Cape was in all instances good. The streams appeared well buffered with pH around neutral (6.8 to 8.1) for all streams sampled. The electrical conductivity as an indicator of dissolved solids was also low to very low 37-323 μS/cm at 25°C. Nutrients were not measured but from the general appearance of the water, algal growth and smell the streams did not seem unduly enriched. Site 18 on the Kukowa stream and sites along the upper tributaries of the Mbashe River did show some organic enrichment of the water (Plates 43, 48, 49)

In a preliminary report (de Moor and Barber 1992) it was estimated that there were about 190 aquatic macroinvertebrate taxa for the region. The data presented in this report increase this estimate to 351 taxa. The identification and analysis of the fauna has been carried out separately for each group of invertebrates. Insects are presented as a separate table for each order except for the Diptera families Simuliidae and Chironomidae where a separate table is presented for each family. Non insect orders have been grouped together in a single table. See tables 5-14 for presentation of the faunal assemblages found in the various river systems.

1. Ephemeroptera

The Ephemeroptera (Mayflies) proved to be abundant and diverse in the North east Cape waterbodies. Except for the Ephemerellidae and the Prosopistomatidae all the known South African mayfly families were represented.

A list of the species collected is presented in Table 5. One of the most interesting Baetidae collected was the nymph of a new species of *Afroptilum (Afroptiloides)* sp. This was initially mistakenly identified as *Acanthiops* sp. (Barber-James, in press), but it almost certainly falls into the *Afroptiloides* subgenus of *Afroptilum* erected by Gillies (1990). Unfortunately, no adult material on which the final placement of this species is dependent was collected.

Other baetids of interest are those in the genus *Acentrella*. Two of the three known species of *Acentella* were found in the area. There has been much debate over the validity of this generic status, but the name *Acentrella*, belonging to European species, is currently recognised for these species (McCafferty and de Moor, in press). *Acentrella* was at one stage included as a subgenus of *Baetis* (Demoulin, 1970).

Several well known baetids were collected, including *Afroptilum sudafricanum* and *A. excisum*, both of which are widespread. *Afroptilum tarsale* described from Tanzania (Gillies 1990), was also collected, representing the first record of this species in southern Africa. *Afroptilum parvum* was found only in the stream at the summit of the Prentjiesberg (site 44), at an altitude of 1900m. It has previously been recorded from several rivers in Natal, in mountain and foothill torrent zones, from altitudes of about 1200m to over 2000m (Oliff, 1960a, 1960b) and from the Great Usutu River in Swaziland (Demoulin 1970). In addition to these known species, another seven unknown species of *Afroptilum* were identified.

The genus *Baetis* was also well represented, with the pan-African *B. harrisoni* being dominant. *B. latus* and *B. glaucus* were also represented, and a species identified as being "near" *B. quintus*. In addition, another six undescribed species of *Baetis* were found. *Cloeon virgiliae* was present in all standing water bodies with marginal vegetation. A second unrecognised species was also found, though never in association with *C. virgiliae*. *Demoulinia crassi* was collected from slow flowing stretches of the Little Pot River (site 6) and the Upper Wildebees River (site 14), similar biotopes to the site in Natal from where the species was originally described (Crass, 1947). *Pseudocloeon vinosum* was found as nymphs at several sites (Table 5), and *P.* near *magae* was collected as an adult from the Mooi River (site 1). The latter two species are both known from the western Cape (Barnard, 1932) showing a merging of faunas in the north east Cape.

The Caenidae were the second most abundant group. Two known species, *Caenis capensis* and *C. basuto* were collected, along with another seven species which did not fit the descriptions of any known species. Two of these were represented by adults, and may turn out to be associated with nymphs represented in the other five species, but since they were not reared through from nymph to adult, it is not possible at this stage to link them.

Two genera of Heptageniidae were present, *Afronurus* and *Composoneuria*. Both *Afronurus* and *Compsoneuria* are genera with Oriental links. *Compsoneuria* tends to inhabit quieter water bodies, while *Afronurus* can tolerate stronger current flow. Four species of *Afronurus* were recognised, *A. barnardi*, *A. harrisoni*, *A. peringueyi* and *A.* near *oliffi*, with little overlap in their distribution (Table 5). *C. njalensis* was found only twice, as an adult near a bank of marginal vegetation along the Mooi River, and as a nymph in the Municipal dam

near Maclear, also associated with marginal vegetation.

The Leptophlebiidae were represented by five genera and six species (Table 5). The family is well represented worldwide, especially in the southern hemisphere. Several of the genera, such as *Aprionyx* and *Castanophlebia* are considered to be old-element palaeo-endemic forms, having affinities with the South American and Australian fauna (Harrison, 1965). Such species are usually cool-adapted temperate forms, and they are confined to the cooler waters of higher altitude streams. In the north east Cape, *Castanophlebia albicauda* was collected only from a spring-fed stream on the summit of the Prentjiesberg, at an altitude of 1900m. The second species of *Castanophlebia* was more widepsread and occurred down to an altitude of 1300m. *Aprionyx tricuspidatus* was only found in the headwaters of the Little Mooi River at 1280m. The other leptophlebiid species were more widespread in their distribution, *Adenophlebia* sp. tending to be more common in the Mbashe system, while *Choroterpes* sp. was concentrated in the Tsitsa and Pot Rivers, and are probably more Afroptropical in their origin.

The oligoneuriid mayfly, *Oligoneuriopsis lawrencei*, was found only in larger swift flowing rivers, such as the Tsista and Nqancule Rivers, at sites where rejuvenation occurred, ie. the river course was reduced to bedrock. It was also found in the gut of a trout caught in the Pot River (site 19).

Tricorythid mayflies of the genus *Tricorythus* were widespread, though again the species is undescribed. The wing venation resembles that of *T. discolor*, but the male penal lobe is much longer, similar to *T. reticulatus*, but more pointed apically. The nymphs showed clear sexual dimorphism from early instars. *Tricorythus reticulatus* s.l. was only collected from the Antelope Park Spruit.

The Antelope Park Spruit and Pot River at Oakleigh each produced more than mayfly 20 species, while the Tsista River at the Falls, and the Nqancule River at Waterval produced respectively 19 and 17 species. The substrate of all these sites was largely bedrock and boulders, with some smaller stones, though it was possible to sample marginal vegetation at all four sites. Baetidae were dominant, though the actual species complement varied from site to site. For example, *Afroptilum tarsale* was only found in the slightly warmer waters of the Tsitsa River, while *Afroptilum (Afroptiloides)* sp. was found in the Tsitsa and Pot rivers but not in the Antelope Park Spruit. Many of the undescribed Caeindae were collected from the Antelope Park Spruit, with few caenids from the Tsitsa and Pot Rivers. No light trapping was done at the Tsitsa or Nqancule Rivers, and it is likely that the diversity at these sites would have been higher if this had been possible.

The actual species diversity at any site depends to a large extent on the availability and variety of suitable biotopes. Light trapping over-night will attract adults of the aquatic stages collected during the day, and will often uncover species that were not found in the stream using standard collecting procedures. It is not possible during a survey to set up light traps at every site due to large distances between sites and for other logistical reasons.

Several other sites had a fairly diverse mayfly fauna (10-20 species). In some cases, mayfly diversity was not as high as might have been expected. For example, even though the stream at the summit of the Prentjiesberg (site 44) was clean and undisturbed, it had few mayfly species. However, it was the only site at which *Afroptilum parvum* and *Castanophlebia albicauda* were collected. This is probably because it is a high elevation stream (1900m) with very pure water (EC = 37μS/cm) and lower water temperatures (15°C at midday in March).

The effect of silting from bad land-use practises can severely affect the biodiversity along a stretch of river. If one compares site 32 on the Tsitsa River with site 33 (Table 5), the first site was considerably silted and the banks of the river were destabilised by exotic vegetation. The second site, above the falls, was faster flowing, and the effect of siltation was reduced. The diversity of species present at site 32 was therefore much lower than at site 33.

2. Odonata

The order Odonata (Dragonflies) are represented in South Africa by 162 species (Pinhey 1984). The present survey was not specifically directed at collecting dragonflies. It is well known that adult Odonata are most active on hot days and during the warmer part of the day. General collecting for all aquatic groups was carried out throughout the day and it was only where time and opportunities presented themselves that adult dragonflies were collected. Incidental collecting of aquatic nymphal Odonata was conducted at selected sites. Hence the representation of species should not be considered as complete and undoubtedly many more species will be added to the list produced (Table 6). Pinhey (1984, 1985) provides detailed check-lists of species found in South Africa and these publications should be consulted to get an estimation of what additional species are to be expected.

In the suborder Zygoptera five of the seven families were represented. The family Chlorolestidae was represented by *Chlorolestes fasciatus* which was encountered in both major river systems. The nymphs collected identified only as *Chlorolestes* sp. could belong to either the above-mentioned species or to *C. tessellatus* which has been collected in the region.

Only adults of *Lestes plagiatus* (Lestidae) were collected although there are a further two species reported from the region. The nymphs of unidentifiable *Lestes* species were collected at several sites.

As *Mesocnemis singularis* is the only known species in the genus, nymphs collected undoubtedly belonged to this species. Another species of Platycnemididae that should be found, but was not, was *Allocnemis leucosticta*. Ecological conditions in many rivers seemed ideal for this species.

The family Coenagrionidae is the largest in the Zygoptera with several genera. *Enallagma glaucum* was widespread and a second species of *Enallagma* was collected at site 39. *Ischnura senegalensis*, one of the most widespread species in Africa, was only collected at site 39. *Pseudagrion kersteni* and the nymphs of several *Pseudagrion* spp. were collected at many sites. From known distribution records it is to be expected that at least another seven species in

this genus should be found in the region.

In the family Chlorocyphidae both *Platycypha caligata* and *P. fitzsimonsi* are known from the region but only the nymphs of an unidentifiable *Platycypha* sp. were collected.

The suborder Anisoptera is represented by three of the four known South African families. The family Gomphidae is represented by ten genera and 16 species in South Africa. In the present survey three genera of Gomphidae which may represent several species were collected. Adult Gomphidae are often shy and difficult to catch and to get a complete regional record would take several years of dedicated collecting. The larva of a species of *Crenigomphus* which was collected is most likely *C. hartmanni*, as the other known species is more tropical in distribution. Only one adult *Paragomphus cognatus* was collected and all the other specimens designated to that genus were nymphs. As there is one other species of *Paragomphus* recorded from the region these nymphs were not designated specific names. The discovery of a *Phylogomphus* nymph is an interesting find. *Phylogomphus brunneus*, the only known South African species, has thus far only been recorded in the eastern Transvaal or further North.

The family Aeshnidae is represented by three identifiable genera in the present survey. *Aeshna* sp. nymphs belonging to two species were collected and were identifiable as *A. miniscula* or *A. subpupillata*, both previously recorded in the eastern Cape. The nymphs of these two species were restricted respectively to either standing water or running water biotopes as proposed by Samways et al. (1993). The *Anax* sp. is either a nymph of *A. imperator* or *A. speratus* both species having been found in the eastern Cape. As only a single species of *Hemianax* is known from the region, the species collected is almost certainly *H. ephippiger*.

The Libellulidae are represented by five genera in the present survey. Two species of *Brachythemis* (*B. lacustris* and *B. natalensis*) have been recorded from the region, and nymphs collected at sites 29 and 30 could belong to either of these. Although only *Orthetrum caffrum* was collected, it is to be expected that at least another five species in this genus should be found in this region. *Pantala flavescens*, one of the most widespread species in Africa, was collected at only one site. It is to be expected that this species will be found at many localities as it is an opportunistic species and will use any temporary pool of water to breed in. Two species of *Trithemis* (*T. dorsalis* and *T.furva*) were collected the latter of the two was more widespread and common. Nymphs of *Trithemis* spp. were collected at many sites and it is expected that of the 12 known South African species at least another three will be found in the region. Other genera not collected but expected to be found include *Notiothemis*, *Palpopleura* and *Crocothemis*.

3. Plecoptera

The Plecoptera (Stoneflies) are represented by two families in South Africa. The Notonemouridae with 21 species, and a complex of several species in what was previously believed to be a single widespread species, *Neoperla spio*, in the family Perlidae (Picker

1985). Species belonging to the *Neoperla spio* complex are considered to be more tolerant of warmer water and are found throughout Africa. In the present survey they were recorded in tributaries of both the Mbashe and Mzimvubu Rivers (Table 7.). The Notonemouridae are more cold-adapted and are restricted to the southern and south western Cape or in headwater streams in the montane eastern regions of South Africa. Only one species, *Aphanicercella cassida*, was found in tributaries of both the Mbashe and Mzimvubu Rivers.

4. Hemiptera

The Hemiptera (Bugs) are predominantly a terrestrial group, although some families have adapted to living in or on the water. The Cicadellidae and Aphididae have no true aquatic stage, but may suck sap from emergent water plants and may thus be associated with water. Most of the aquatic Hemiptera are associated with still to slow-flowing water, and are seldom found in association with the stones-in-current biotope. Little work has been done on aquatic Hemiptera in southern Africa, and most of the identifications of the Gerromorpha have been based on the work of Andersen (1982). The Hebridae were found at only one site, a hygropetric ooze on the margin of the Antelope Park Spruit. Hydrometridae were also not commonly collected, being found in marginal vegetation at two sites only (Table 8). Veliidae were more widespread and several genera were identified. However, it was not possible to identify species. The pond skaters, or Gerridae, were also found at scattered sites and like the Veliidae, are surface dwellers.

The South African Notonectidae have been examined in some detail by Hutchinson (1929) and the genus *Anisops* by Truxal (1990). *Anisops poweri* is widespread in South Africa. *Enithares chinai*, collected from still water in the Danville Vlei, is known from pools and backwaters in streams from Zimbabwe, Uganda and Sudan (Hutchinson, 1929). *Enithares sobria*, collected from a small pool adjacent to the Pot River at Site 19, occurs throughout the Cape Province, and is known from Kwazulu-Natal, the Transvaal, and from Zimbabwe, Botswana and Mozambique (Hutchinson, 1929). A further two species of *Anisops* and one species of *Enithares* could not be identified.

The family Pleidae was represented by one of the two known species, *Plea pullula*. Both *P. pullula* and the other species, *P. piccanini*, are widespread in water bodies in southern Africa. Both genera of the Nepidae were collected. However, since most collecting was done in rivers rather than pools, the abundance and diversity of the aquatic Hemiptera groups in the region will be under-represented in this study. The Naucoridae, represented by the genus *Laccocoris*, were frequently encountered during this study amongst marginal vegetation and gravel sediments in still to slow-flowing reaches.

The Corixidae were the most diverse of the hemipteran families. Several species of the subfamily Micronectinae were represented and one species of the subfamily Corixinae, *Sigara sjöstedi*. The last revision of the group was by Hutchinson (1929). These creatures are good fliers and it is expected that they will be found in any suitable water body in the area. *Micronecta* near *bleekiana* has not previously been recorded in the Cape Province, and *M. bleekiana* sl., a usually a more tropical species, is known from the Northern Transvaal,

Zimbabwe and the Caprivi strip. *M. dorothea* has previously only been recorded in the Transvaal. *M. gorogaiqua* is known from the Western Cape and Orange Free State. *M. monomatapae* is only known from Zimbabwe. *M. piccanin* is widely distibuted throughout the Cape Province, Transvaal, Kwazulu-Natal and Zimbabwe, as is *M. scutellaris*, which has also been recorded in Namibia. *M. uvarovi* is known from Kwazulu-Natal and Zimbabwe, while *M. winifreda* is only known from the western Cape. It is not surprising that many of the species have not previously been recorded in the eastern Cape, since no detailed work on Corixidae has been done since Hutchinson (1929), and it is likely that many of these species will be found in other parts of the country when further studies are carried out. This also applies to the other hemipteran groups.

5. Coleoptera

The Coleoptera (beetles) form the largest single group of organisms in the animal kingdom, comprising around 350 000 described species. Although the vast majority of species are terrestrial there are many species that have secondarily adapted to an aquatic existence. During the present survey 69 possible species belonging to three of the four known suborders were collected (Table 9). As larvae and adults of many species could not be correlated each identification was given independent species status. Some of these are, however, likely to be the associated larvae and adults of a single species.

The suborder Myxophaga was represented by what appears to be the larva of a hydroscaphid beetle collected at Antelope Park Spruit. There are many records of this family from Natal in the Albany Museum confirming Endrody-Younga's (1985) expectations. A larva of a Torridincolidae beetle was collected in trickling water into the Kukowa Stream and represents an interesting distribution extension of this family. The larvae and pupae of all Myxophaga are aquatic and apparently feed on algae or plant matter.

The suborder Adephaga was represented by four families and 26 species. Carabidae are usually terrestrial beetles although many species are encountered on moist mud along banks of streams and pond shores. Species of carabid were recorded at three sites in the present survey. The other three families collected have been conveniently placed in the section Hydradephaga hence "associated with water". The Dytiscidae with more than 250 South African species were represented by 18 species in the present survey. The adults and larvae of this family are all predators and most frequently encountered in slow flowing or standing water amongst aquatic vegetation. Certain species appeared widespread whereas others were rare. Because further identification was not attempted, comments regarding species distribution are reserved. The Gyrinidae, with about 45 species recorded for South Africa, were represented by six species in the present survey. Adult gyrinids are encountered on the surface of pools in streams where they swim rapidly in circles and feed on insects that get caught in the surface tension on the water surface. Larvae, depending on the species, are found in standing to swift flowing water. They are also predators. Haliplidae were represented by a single species recorded at two sites. There are ten species recorded for South Africa.

The suborder Polyphaga was represented by 13 families in the present survey. The superfamily Hydrophiloidea with all known species aquatic in both larval and adult stages were represented by Hydraenidae (ten species), Hydrochidae (one species), Spercheidae (one species), Hydrophilidae (eleven species) and Elophoridae = Helophoridae (considered by some researchers to be only a subfamily) with one species. Hydraenidae are small to minute beetles that have been recently studied (Perkins in press). The present survey recorded four previously undescribed species of hydraenids. As the descriptions of these new species are still in press (although they have been named and manuscript names are known), it is best not to mention them since this may result in some taxonomic confusion. Hydraenidae were common and one species of *Hydraena* was the most widespread and found in most river systems in a range of biotopes. Only a single species of Hydrochidae, *Hydrochus capensis*, is known from South Africa. In the family Spercheidae so far only three species of *Spercheus* have been described from South Africa. A single specimen was collected at a dam on the KuNtwanazana River (site 47). The Hydrophilidae form a large family with relatively few South African species described. One species of *Elophorus* (Elophoridae) was recorded in the Wildebees River (site 13).

Helodidae are small to medium sized beetles and adults are found in vegetation or on damp soil near water. The larvae are dorso-ventrally flattened, found in shallow water and are easily recognisable by their remarkably long antennae. Larvae were found only at four sites, where they were abundant. They will, however, undoubtedly prove to be more widely distributed in the region. The superfamily Dryopoidea which consists of small mostly aquatic or semi-aquatic beetles, was represented by three families in the present survey. Larvae of Psephenidae were collected in swift flowing waters at three sites and adult Dryopidae were collected at four sites. The Elmidae were represented by six different species of adults and five of larvae collected mostly in swift to moderate current either on stones or amongst submerged vegetation. It is probable that some of these will prove to be the same species when adult and larval correlations can made.

The family Mycteridae has not previously been recorded from South Africa. A single adult specimen collected from marginal vegetation in the Wildebees River (Site 13) thus produces an interesting find. Dr S Endrody-Younga (personal communication) informed us that there were, however, several undescribed species in the collections of the Transvaal Museum. Chrysomelidae, mostly a terrestrial family of phytophagous beetles, has a few species that have adapted to an aquatic environment. Larvae of a single species not further identifiable were collected from stones in flowing water at site 2. Adult Curculionidae were collected from marginal vegetation along the banks of streams at several sites. The weevil family, Curculionidae, is richer in species than any other family of plants or animals and it is estimated that some 45 000 species, mostly terrestrial, have been described (Oberprieler and Louw 1985). Both adults and larvae of this family are phytophagous, feeding internally or externally mainly on flowering plants. Larvae are legless grubs that bore into plant tissues and often form galls.

6. Trichoptera

The order Trichoptera is represented in South Africa by 150 described species in 18 families and 51 genera (de Moor 1993). During the present survey 30 species in nine families and 16 genera were collected (Table 10). Four undescribed species were also found and the distribution record of most species was extended.

Philopotamidae were represented by a single species of *Chimarra* of which larvae were collected in the spring fed stream on the summit of the Prentjiesberg. It is to be expected that Philopotamidae should be more common in the streams and rivers of the North East Cape as at least 10 species have been recorded from this hydrobiologically categorised region (de Moor 1993).

The psychomyiid *Tinodes pollicaris* was collected in a small seep over bedrock running into the Antelope Park Spruit. Larvae and adults were collected and biological observations were made. This represents a very valuable correlation of the larval and adult stage of this little known species.

The family Polycentropodidae, represented by larvae of a species of *Pseudoneureclipsis*, were collected from the Antelope Park Spruit and tributary of the Kukowa Stream. Although previously recorded from the region a species description has not been made because only larvae have thus far been collected.

The family Ecnomidae were rather underepresented. The two species of *Ecnomus* found were collected amongst marginal vegetation next to a man-made lake on the Gatberg River. One unidentified species of *Ecnomus* will most likely turn out to be undescribed. Unfortunately only females were collected. Although females are identifiable to species level, many have not been described and correlated with named males. More collecting, especially light-trapping, will undoubtedly extend the distribution range of all three species collected and probably add several more *Ecnomus* species to the list. It should be noted that most Ecnomidae are found in quieter backwaters and pools in rivers and limited collecting in these regions will have underestimated the family.

All members of the family Hydropsychidae are adapted to life in flowing water (Scott 1978). They rely on the water current to carry food in the form of small invertebrates and plant matter to them. Food is gathered in silken spun nets which face the current. Three species of *Cheumatopsyche* which are widespread in South Africa were collected. *Cheumatopsyche afra*, the most widespread, was found in streams and large rivers in both the Mzimvubu and Mbashe catchments. *Cheumatopsyche maculata* and *C. thomasseti* were restricted to rivers in the Mzimvubu system. It was notable that with one exception the larvae of *C. maculata* were found in swift-flowing streams in erosional headwater or rejuvenation sections of rivers, closely tying in with the ecological categories proposed by Scott, de Moor and Kohly (1988). During surveys of the rivers of Natal, Dr Mark Chutter formerly of the CSIR (NIWR) collected a large number of *Cheumatopsyche* larvae that were unnamed and not correlated with adults. They were tentatively designated as FMC types 1-8. The larvae of two

species, identifiable as *Cheumatopsyche* type 5 FMC and type 7 FMC, were collected in tributaries of the Inxu River. *Cheumatopsyche* sp. (table 10) refers to small larvae that could not be further identified. *Hydropsyche longifurca* and *Macrostemum capense* were found in both major river systems.

The micro-caddis family Hydroptilidae was represented by four species in three separate genera. The species recorded as *Hydroptila* sp. were small larvae either planktonic or else not further identifiable. It is to be expected that the distribution of all these species should be wider than revealed by the survey.

The lepidostomatid *Goerodes caffrariae* was collected at two sites. Barnard (1934) described this species from near Grahamstown and mentioned that it was a remarkable southward distribution of a tropical species. Ecologically this species is a leaf shredder often found in forest streams. Although encountered in the grassy verged Antelope Park Stream, it was found amongst leaf litter in shallow water. It is apparent that the presence of this species is dependent on leaf litter in the stream.

Only empty pupal and larval cases of what are almost certainly remains of Sericostomatidae, which closely resemble those of *Aclosma bispinosum*, were collected in the upper reaches of two streams. The other known species, *Aclosma anomala*, has also been recorded in the eastern Cape. As its larvae and pupae are unknown it may well have been either one of these species or else a third unknown species. Collection of more material and adults in particular is needed to confirm this identification.

The family Leptoceridae has the largest number of known species of all the Trichoptera families in South Africa. Of the 10 species found in the survey, five are undescribed. In the genus *Athripsodes* the most widespread species was *A. harrisoni* found in both major river systems. There were two undescribed species of *Athripsodes*, one found in the Antelope Park Spruit, and a second found in a tributary of the Bell River, thus not included in the survey. Some small larvae which were not further identifiable were also collected and labelled as *Athripsodes* sp. (Table 10). There were three species of *Oecetis* of which the most widespread proved to be an undescribed species. A new species of *Triaenodes* was found coexisting with *Triaenodes elegantulus* in the Mooi River. Adults of a new species of *Trichosetodes* were collected along the Pot River at Oakleigh and a single larva of possibly the same species was found in the spring stream on the summit of the Prentjiesberg.

The river site with the most diverse caddisfly fauna proved to be the Antelope Park Spruit (site 2) followed by the Mooi River at Riverside (site 1). Undoubtedly additional light-trap collecting at these sites, as well as follow-up collecting during each of three separate surveys, considerably enhanced the overall species counts for these sites. The river systems with the most diverse fauna were the Mooi and Inxu with their tributaries each having 17 species. To get a complete picture of the entire fauna would require more intensive collecting at each site together with light trap collecting to cover several seasons. The stream at the summit of the Prentjiesberg contained some interesting rare species and warrants further collecting.

7. Simuliidae

The nematoceran family Simuliidae is represented by 39 species in South Africa (Palmer 1991a). During the present survey 15 species all belonging to the genus *Simulium*, were collected and all of these were found in the Mzimvubu River catchment. Only seven species were found in the Mbashe River catchment (Table 11).

The torrenticolous *Simulium (Anasolen) dentulosum* was recorded only from the upper reaches of the Tsitsa River. It is a species that is confined to waterfalls and swift flowing cascades of mountain streams. In the rivers sampled it appears to be restricted to altitudes of 1680 m or higher. Crosskey (1969) notes that this species is the only blackfly found at very high altitudes upto 4500 m in central Africa. It is found in southern African rivers down to 760 m above sea level, although its ecological requirements restrict it to cascades and waterfalls. It will probably be found in the upper reaches of some of the streams not sampled in this survey.

Simulium (Edwardsellum) damnosum s.l. is recognised as a species complex with more than 40 described Afrotropical species, of which most are distinguishable only on cytological characters. Species of this complex were all found in moderately swift flowing waters in large streams in both the Mzimvubu and Mbashe River systems.

One of the most widespread species in South Africa, *S. (Meilloniellum) adersi*, was only found in the Mooi River. It is a pollution and saline tolerant species usually found in slow flowing medium sized rivers with a stable flow regime. This species may be more common than revealed by this survey. It has been recorded biting man. A closely related species, *S. (Meilloniellum) hirsutum*, was collected at two sites. Larvae of these two species are very similar and difficult to distinguish.

The subgenus *Metomphallus* contains several species which usually form the dominant simuliid component in swift-flowing, turbulent streams throughout the Afrotropical region. *Simulium chutteri* was found in large numbers in the Tsitsa Rivers upstream of the Falls, and a few specimens were also collected at site 19 on the Pot River. Where man has interfered with the flow regime of large rivers in South Africa *S. chutteri* has become a serious pest species, attacking livestock near river sites where the fly breeds. A note of caution should be added, as this species may in future pose a serious ecological threat if damming or regulation of the flow regime associated with interbasin transfers are implimented. Two other species in the subgenus, *S. medusaeforme* and *S. vorax*, were encountered in several swift flowing streams in both river systems. Several larvae could not be identified and they are tentatively placed as *Simulium* sp. near to *medusaeforme*.

The most widespread species in the survey *S. (Nevermannia) nigritarse* was found in all kinds of streams from swift cascades to small trickles. Larvae and pupae of this species closely resemble *S. (Nevermannia) brachium*, and Palmer (1991b) records these two species as occurring sympatrically in the Buffalo River. *Simulium nigritarse* appears to be commonly found in slow-flowing reaches of rivers and is often found downstream of impoundments. It is

therefore possible that two species may be represented in this survey. To further complicate the issue, Fain and Dujardin (1983) revised the systematics of a number of closely-related species and came to the conclusion that *S. nigritarse* forms a species complex. Keys for 19 species of this complex, mostly from the mountainous regions of central Africa have been devised by Fain and Dujardin (1983). A single larva of what appears to be *S. (Nevermannia) rutherfoordi* was collected in a spring fed stream at the summit of the Prentjiesberg.

Pomeroyellum is the largest endemic Afrotropical subgenus contributing about 30% of the species and forms of Simuliidae for the region (Crosskey 1969). Most members of the subgenus are restricted to slower flowing reaches of small to large streams. Two species identifiable in this subgenus could not be placed in any presently known species. *Simulium (Pomeroyellum)* sp.1 was found at only two sites and was represented by three larvae. Although *Simulium (Pomeroyellum)* sp. 2 was found at several sites, it was also very scarce and represented only by larvae. Both species, from the limited sampling carried out, appear to be restricted to small upper tributaries of the Mzimvubu River. Three other species in the subgenus were found in both river systems and *S. (Pomeroyellum) rotundum* was the most widespread.

The river with the most diverse simuliid fauna was the Inxu and its tributaries (10 species), followed by the Pot and tributaries (with 9 species). Along the Tsitsa River and its tributaries, the dominant species at site 2 was *S. dentulosum*. At the Tsitsa Falls (site 33) *S. vorax*, *S. chutteri* and *S. damnosum* s.l. were all fairly abundant with no species completely dominating the population. In the Pot River at site 19, *S. medusaeforme* was the dominant species whereas at site 7, *S. vorax* was the dominant species. Sites along the Mooi or Inxu Rivers and their tributaries supported several species of Simuliidae and *S nigritarse*, *S. medusaeforme* and *S. (Pomeroyellum)* spp. were common but not abundant. At the Nqancule River (sites 30 and 31) Simuliidae were abundant and *S. damnosum* s.l. and *S. vorax* were the dominant species. A change in species composition is to be expected if there are going to be any marked changes in the flow regime of these rivers.

8. Chironomidae

The nematoceran Diptera family Chironomidae is represented by 86 genera and 223 species in southern Africa (Harrison personal communication). During the present survey 57 species were collected (Table 12). Many larvae collected were not identifiable to species level and only a special collecting and rearing survey would reveal the full diversity of this fauna. The majority of Chironomidae are inhabitants of fresh water and practically all aquatic ecological niches in this environment are inhabited by larvae of numerous species in this family (Freeman and Cranston 1980). Because of the vast numbers of individuals encountered in all kinds of fresh water they play an extremely important role in the functioning of aquatic ecosystems. Most of the larvae of Tanypodinae are free living predators feeding on other aquatic invertebrates. Most species in the other subfamilies construct silk-lined tubes and they feed on plant matter, algae and detritus. Some species are leaf miners and feed on leaf litter. Most species in the subfamily Orthocladiinae prefer cool, swift-flowing waters and are numerically the dominant subfamily in mountain streams. The Chironominae prefer slower-

flowing, warmer waters and are often found in stagnant pools and temporary waters.

The subfamily Tanypodinae was represented by eight of the 15 recorded southern African genera. The genera *Clinotanypus* and *Tanypus* are each represented by a single known species in southern Africa (*C. claripennis* and *T. guttatipennis*). As only larvae were collected it can not be determined whether these belong to the known species or represent new undescribed species. The larvae of the two known species are inhabitants of standing or slow flowing water. There are four species of *Procladius* recorded for South Africa, so the species collected in the present survey can not be determined. The tribe Pentaneurini is represented by five of the ten known genera for South Africa. Many of these were formerly placed collectively in the genus *Pentaneura*. The species in all of the recorded genera of Pentaneurini are recorded as inhabitants of running water.

The subfamilies Podonominae, Aphroteniinae and Diamesinae were not represented in the present survey. The subfamily Orthocladiinae had 12 of 26 recorded southern African genera, as well as one genus that could not be placed, represented in the survey. The genera *Cricotopus* and *Thienemanniella* were each represented by several species, whereas the remaining genera were each apparently represented by only a single species. *Cricotopus unizonatus*, described from the Ethiopian highlands, was an interesting find for the region.

Chironominae were represented by 17 out of 36 recorded southern African genera. Some species of the genus *Chironomus* are extremely tolerant to pollution and many species in this genus are widespread. The larvae of *Polypedilum* spp. were found predominantly in stones-in-current and other running water biotopes. The filter feeding larvae of *Rheotanytarsus fuscus* were common wherever a moderate flow of water was discernible.

The river site with the most diverse chironomid fauna was the Antelope Park Spruit with 35 species. Sites 16 and 35 on the Inxu River each produced 16 species. The Inxu and the Tsitsa Rivers and their tributaries each produced 37 species. The Mzimvubu system had a total of 55 chironomid species and the Mbashe 25. Clearly from a the point of view of Chironomidae the Antelope Park Spruit was the site with the highest conservation rating.

Because of similarities in species composition, a comparison of the present survey to one conducted on the Great Berg River during the 1950's (Scott 1958) was made. The Berg River survey was a very intensive one extending over all seasons and incorporating 21 sites along the course of the river. Some sampling sites were visited at monthly intervals for more than a year. Altogether 83 species were collected in the Berg River survey. The present survey collected 57 species. In the Tanypodinae all genera except *Apsectrotanypus* and *Cantopelopia* found in the Berg River were also found in the North East Cape rivers. Once further identified the species may prove to be different, although some have already been identified as the same species for both surveys. The Orthocladiinae had six species of *Cricotopus* collected in both surveys. Similarly, the genus *Thienemanniella* was represented by four species in the present and three in the Berg River survey. Only one species of *Corynoneura* was recorded in the present survey whereas there were three for the Berg River survey. Eight genera of Orthocladiinae were found only in the Berg River whereas *Eukiefferiella* was the only genus

found in the present survey but not in the Great Berg River survey.

Twelve genera of Chironominae were common to both surveys and each survey produced five genera not found in the other river system. *Cladopelma*, *Nilodorum*, *Paratendipes*, *Stempellinella* and *Virgatanytarsus* were found only in the North East Cape Rivers while *Parachironomus*, *Paracladopelma*, *Pentapedilum*, *Stictochironomus* and *Stempellina* were found only in the Berg River survey. *Polypedilum dewulfi* and *P. alticola* were common in both the Berg and the North East Cape Rivers. It is also noted by Harrison and Hynes (1988) that the latter species was common in Ethiopia.

Even though the species may differ it was remarkable to see so many genera shared between the two river systems. The present survey also revealed that a fairly good estimate of the chironomid faunal composition has been obtained. Undoubtedly more genera and species will be uncovered with further collecting.

Some of the chironomid species are good indicators of water quality and, although this survey was not undertaken to elucidate this aspect, it was interesting to note relatively high numbers of individuals of *Rheocricotopus capensis* larvae in the upper reaches of the Wildebees River. Berhe and Harrison (1989) report that mild pollution leads to an increase of this species and some others, as well as a loss of certain species from the system. The database of Chironomidae built up during this survey will serve as a valuable source of historical information for future surveys and will enable monitoring of changing conditions to be recorded and verified. Many adult chironomids collected during the last of the three separate surveys have not yet been identified and will further contribute to the database.

9. Diptera

The Simuliidae and Chironomidae have been separately analysed in sections 7 and 8. All the remaining Diptera with aquatic stages in the life cycle collected during the present survey are discussed here. The Diptera are divided primarily into two suborders with several major divisions. The Nematocera, including Simuliidae and Chironomidae, are represented by ten families and the Brachycera, subdivided into the Orthorrapha (five families) and Cyclorrapha (two families). A total of 37 additional species are recorded (Table 13). As no specialist identification of material was carried out some of the names may prove to incorrect and a specialist will have to be consulted to confirm identifications.

The nematoceran family Tipulidae is represented by 357 species in South Africa (Alexander 1964). The larval and pupal stages of most species of Tipulidae require some form of moisture. Species are found in swift-flowing waters, sediments and leaf litter in pools, damp moss or humus and even in damp forest litter. In the present survey ten genera were collected. Species identification was confined to adults and these were taken mostly with light traps, hence the high number of species at sites 1 and 2.

Generic identifications were determined on adults collected. There is very little information on the ecology and biology of the immature stages of Tipulidae available and what

is reported is mostly gleaned from the paper by Wood (1952). Larvae of two western Cape species of *Dolichopeza* are recorded from wet to saturated mats of moss or liverworts in the splash zone of waterfalls. *Dolichopeza chaka* is so far only known from the Natal Drakensberg. Larvae of species of *Nephrotoma* have been recorded in the western Cape from damp soil. They are therefore not aquatic but are probably dependent on the moist shoreline of streams. *N. edwardsi* was previously recorded from the Kwa-Zulu-Natal Midlands region. Larvae of *Tipula pomposa* have been found associated with wet sand and gravel on the edges of small trickles of water. They are widespread and among the largest of the crane flies encountered. *Tipula draconis* described from Natal National Park it presents an interesting extension of a group of species previously recorded only from the east African highlands. Species of the genus *Antocha* were the most commonly encountered tipulid in the present survey. There are six species known from southern Africa. The larvae of this genus are found inhabiting silk tubes in swift flowing water clinging to the underside of stones. Only one species of *Limonia* was collected. It is a large genus with about 64 known species and larvae of the various species are found under a variety of ecological conditions. An adult of a species of *Erioptera* was collected at a light trap and a larva was collected from marginal vegetation. Wood (1952) reports that larvae of species in this genus were collected from muddy sand pits along the margins of streams. Species in this genus are found all over the world. Larvae of *Limnophilomyia* were collected from the stones-in-current biotope. Wood (1952) records larvae from rotting logs of wood or amongst the roots of aquatic reeds. It is a small genus with 11 species of which four are restricted to South Africa. Wood (1952) records that larvae of *Rhabdomastix* were collected from gravelly sand pits under small rocks, sheltered from the main current of cascading streams in the western Cape. *Rhabdomastyx* is a large genus with a cosmopolitan distribution, Alexander (1964) records four species for South Africa.

Larvae of the family Dixidae were found in slow-flowing reaches of small streams at a number of sites in both river systems. The discovery of Thaumaleidae is very interesting as only a single species, considered to be palaeondemic, is known in Africa (Stuckenberg 1961). The identity of the single specimen collected at a light trap at Riverside will have to be confirmed by an expert. The family Culicidae or mosquitoes was represented by both culicine and anopheline mosquitoes which were not further identified. Ceratopogonidae were represented by at least four different species. The larvae of *Bezzia* sp. were found at many sites, usually in running water. They are predators of other aquatic invertebrates. The family Blephariceridae have remarkable larvae that adhere by means of suckers to stones. They are found only in cool, well- oxygenated, swift-flowing, unpolluted mountain streams (Stuckenberg 1980). Any significant reduction in the flow regime will be detrimental to the members of this family. Some species of Cecidomyiidae larvae live in the tissues of aquatic plants and often form plant galls.

In the Orthorrapha the family Athericidae were only found at two sites in the present survey. The larvae are predatory and found in flowing water. Many species of Tabanidae larvae live in shallow standing or slow flowing-water. They need access to the air to obtain atmospheric oxygen through a posterior siphon. Only one species of *Haematopota*, biting one of the authors FCdM, was collected on this survey. Tabanidae are however common and several species were seen although not collected. Larvae of Stratiomyidae were collected in

marginal vegetation at only one site. It is suspected that they are much more common than revealed by the present survey. Empididae were represented by four genera in the present survey. Larvae of one species collected in a small seep halfway up the Prentjiesberg (a site not recorded in the table) were keyed out to the genus *Chelifera* using Smith (1969). This genus is not recorded from South Africa and identification needs confirmation by a specialist. *Clinocera* is represented by two known species in South Africa and, on its known distribution, larvae and adults collected along the Gatberg and Mooi Rivers were most likely *C. tripunctata*. Larvae keyed out as belonging to the genus *Hemerodromia* were collected from stones in the Antelope Park Spruit. The genus has a cosmopolitan distribution and there are nine species recorded from South Africa. The larvae of a genus keyed out as *Rhamphomyia* were collected in a stream on the west side of Naude's Neck. The genus is recorded by Smith (1969) in leaf litter from Zimbabwe. The identification of this genus needs confirmation. Adults and larvae of the family Dolichopodidae were collected at three sites. Adults are usually found in moist places although the larvae of only a few species are aquatic. There is no recent revision of this family and very little is known about the distribution of the known species. Numerous species of this family are recorded in southern Africa, many of which are also known from Europe. A revision of the family is needed to resolve these anomalies.

Larvae of the cyclorraphan family Ephydridae were collected at five sites. The majority of the species known have aquatic larvae and there are 72 species recorded from southern Africa (Cogan 1980). Aquatic Muscidae larvae, probably belonging to the Limnophorinae, were collected at five sites. They are difficult to identify and have not been further named.

Because of the limited collecting done it is not feasible to carry out a comparison of the various river systems. It is again apparent that most species were collected at the localities where light trapping was carried out.

10. Non-insect groups.

All remaining taxa are presented in Table 14. Annelida were not identified beyond class. They were fairly common, the class Oligochaeta being found in at least some rivers in each main river system.

The Ostracoda will be covered separately in detail by Dr Koen Martens of the Royal Belgian Institute for Natural Sciences in Brussels. The Cladocera and Copepoda were widely occurring, though the names and number of species of each has not yet been determined.

It is interesting that both *Potamonautes perlatus*, the Cape river crab, and *P. sidneyi*, the Natal river crab, were found in the North East Cape. As has been seen with several of the insect groups, this region seems to be the meeting place of the cold-adapted Cape fauna, and the more Tropical fauna. The Potamonidae are currently being revised.

Water mites or Hydracarina were abundant, but again expertise was lacking for detailed analysis. They are a diverse group and are good indicators of environmental conditions.

Freshwater snails can be divided into two groups, the Gastropoda or univalve molluscs, and the Pelecypoda or bivalve molluscs. The family Neritidae was represented at one site only, the Danville Vlei. Most neritids are marine, although five non-marine genera are known from the Afrotropical region. *Burnupia* sp., representing the Ancylidae, were frequently found, and the genus is widespread in the highlands of Ethiopia and East Africa, south eastern Zaire, northern Angola and Zimbabwe and in the non-arid areas of South Africa (Brown, 1980).

The genus *Bulinus* is represented by about 30 species in Africa and associated islands in the Indian Ocean, and also occurs in the southern Mediterranean and South West Asia (Brown, 1980). It is responsible for the transmission of the Bilharzia parasite, *Schistosoma haematobium* in Africa. *B. natalensis* occurs through East Africa from Ethiopia to South Africa, where it is most common in Natal. The identity of a second *Bulinus* species remains uncertain at present, and other planorbid snails were unidentified.

Physa acuta (Physidae) was found only in vlei conditions in the upper reaches of the KuNtwananzana River. This is the only known species of Physidae in Africa, and is thought to have been introduced from North America (Brown, 1980).

Pelecypodan snails were represented by the families Corbiculidae and Sphaeriidae, as well as some very immature individuals that could not be accurately placed in a family.

GENERAL DISCUSSION

It was fortunate that we were able to see the rivers of this region in both dry and wet periods. Soon after heavy rainfall some of the rivers appeared very turbid and muddy (Plate 11). Yet within a short period, when little or no rainfall occurred, they appeared clear once more. This indicates that the beds of rivers in this region are naturally well eroded with very little fine material remaining and that turbidity is caused by secondary input of silt into the system from road cuttings and farming activities. Some of the slower-flowing, lower reaches of rivers, where sediments would settle out showed heavy siltation (Plates 8, 42). Exotic trees such as poplars and wattle growing too close to river banks did not sufficiently bind the soil and also excluded the growth of secondary vegetation such as grass, which would have helped prevent erosion. In many of these rivers there was serious erosion showing undercutting of river banks at a number of sites (Plates 19, 42). Ploughing of land too close to river banks also prevented the development of a sufficiently wide corridor of riparian vegetation which would also have stabilised the river banks (Plate 17).

Erosion scars caused by livestock tracks were evident on steep slopes in the upper catchment of several rivers (Plate 7). Where such conditions prevail excessive runoff will occur after heavy rains and we were again fortunate to experience two contrasting events. On December 5 1990 heavy rains caused the Mooi River at Riverside to rise about 2m within 24 hours. During this period the water changed from clear to turbid (Plates 19-21). In contrast, the Gatberg River flowing through the extensive Danville Vlei system showed little change in flow volume or turbidity during the same period (Plate 36). This demonstrates the importance of the "sponge" influence of wetlands which helps to maintain a steady release of water

and prevents flash floods after heavy rains.

Most of the non-insect groups have been identified in less detail than the insects. Some of these are still out on loan to specialists and once these have been studied species numbers are expected to increase considerably.

The aquatic macroinvertebrate fauna showed a mixture of tropical and Cape cool-temperate elements which is borne out by many of the aquatic insect groups discussed above. Ichthyologists have noted a marked decline in the number of fish species from the more diverse northern tropical rivers such as the Limpopo and Phongolo southwards to the eastern Cape. This reduction of species reaches its lowest diversity between the Keiskamma and Mtwavuma Rivers (Bowmaker et al 1978). The compliment of macroinvertebrate species shows a similar reduction of both tropical and temperate species in this region leaving remnants of the more hardy species of both groups. A total of 351 species of aquatic macroinvertebrates have so far been identified in the survey. The Mzimvubu system produced 322 species and the Mbashe system 136. The Inxu River and its tributaries was the richest sub-system with 212 species followed by the Tsitsa River with its tributaries with 171 species. The Inxu River system was remarkably rich in its diversity of Coleoptera species. This is because it encompassed both swift-flowing rivers such as the Wildebees River and slow, meandering rivers with adjacent marsh and wetland such as the Gatberg River. The Tsitsa, and Inxu Rivers showed similar diversities for Ephemeroptera, Hemiptera, Trichoptera and Chironomidae. Of the insects identified, 20 Ephemeroptera, one Odonata, five Coleoptera, six Trichoptera and two Diptera are undescribed and new to science. A cluster and ordination analysis of the data may show some interesting relationships, but this is outside the scope of this report.

Species diversity along the Antelope Park Spruit (site 2) was quite markedly the highest (with 133 species). Compared to all other sites sampled it appears that this section of river is in an extremely good ecological state. Other rivers which require special mention are the Pot River (site 19) with 88 species, the Mooi River (site 1) with 61 species, the Inxu River (site 35) with 59 species, the Tsitsa River (site 33) with 50 species, and the Nqancule River (site 30) with 57 species. It is noticeable from Table 4 that the sites with the highest diversity had the greatest number of biotopes sampled. Although this may appear to be a reflection of the collecting effort, it also indicates that the most heterogenous sites were naturally the most diverse in species as a greater variety of ecological conditions would be present. Light-trap collecting also considerably enhanced the number of species collected and certain sites such as the Tsitsa River Falls would have a much higher species diversity if light trapping had been carried out.

It is apparent that bank erosion and siltation of a number of rivers have severely reduced the abundance of species and even eliminated certain aquatic invertebrate taxa. The enlargement of the riparian zone and the removal of exotic vegetation, ensuring an increase in the percentage of indigenous riparian flora, will most certainly enhance the quality of the rivers and lead to a greater diversity of aquatic biotopes with a subsequent increase in the diversity of aquatic invertebrate species.

The rehabilitation of the riparian zone, allowing natural indigenous vegetation to grow along the banks of rivers, is one of the most effective ways of improving the quality of the rivers. The riparian zone provides a refuge for adults of many aquatic insects, it allows them to feed, reproduce and maintain healthy populations (Jackson and Resh 1989). Aquatic insects form a very important functional component of the ecosystem. They provide an important food source for fish and terrestrial vertebrates (birds and bats) and play a fundamental role in purifying the water. The more diverse the assemblage of aquatic invertebrates in a river system, the less likely the development of population explosions of pest species. Adult aquatic insects have not been considered in the management of the riparian zones of rivers before. We would strongly recommend that these small but numerically important creatures found in and along the rivers of the North East Cape are seriously considered in developing an overall stream rehabilitation policy.

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Mondi sites to revisit

Antelope Park Spruit (site 2)

Hawes Spruit (site 4)

Tsitsa R. at Niagara (site 32)

Tsitsa R at The Falls (site 33)

Pot R 5

Pot R at Dinosaur Footpr. 19

Pot R 7

Little Pot R 6

Mooi R at Oakhurst 8

Little Mooi 9

Mooi R tribs 10 & 12 assess
(both v. poor previously)

Mooi R (Riverside) 1

Wildebees R at Morven 14

" Mt Challanger. 13

Mountain stream, Prentjieberg 44

Wildebees, midreaches 45

KuNtombizininzi R 34 or 11 (assess)

Wildebees (Inxu) 35

Gatberg R 17, 37. (assess between 16 & 37)

Gatberg trib 25

KuNtwonazana 36

River	Site
Kukowa	18
Trib of Xuka	27
ku Didwayo.	28

EAST LONDON REGIONAL WASTE DISPOSAL SITE
SUB-CONSULTANTS AGREEMENT

THIS AGREEMENT is made on the ... June , 2003

BETWEEN:-

ARCUS GIBB (PROPRIETARY) LIMITED whose registered office is situate at 14 Kloof Street, Cape Town, South Africa ("GIBB") of the first part, and

Department of Freshwater Invert berates, Albany Museum, represented by Dr. F.C. de Moor and Mrs Helen James ("the Sub-Consultants"), whose office is situated at Somerset Street, Grahamstown, 6139.

WHEREAS:

A. ARCUS GIBB has entered into an agreement dated 01 March 1998 ("the Principal Agreement") between the Buffalo City Municipality of P.O. Box 984, East London ("the Client") and ARCUS GIBB whereby ARCUS GIBB has agreed on the terms and conditions therein contained to perform the services in connection with the East London Regional Waste Disposal Site detailed in Schedule 1 ("the Principal Services")

B. GIBB wishes to sub-contract part of the Principal Services as set out in Schedule 2 ("the Sub-Contracted Services") to the Sub-Consultant and the Sub-Consultant has agreed to undertake the Sub-Contracted Services on the terms and conditions herein contained.

NOW THIS AGREEMENT WITNESSETH as follows:-

1. The Sub-Consultant undertakes to perform the Sub-Contracted Services set out in Schedule 2 in accordance with the terms and conditions of this Agreement including any Supplementary Conditions set out in Schedule 2.

2. In consideration of the proper provision of the Sub-Contracted Services ARCUS GIBB shall pay to the Sub-Consultant the sums set out in Schedule 3.

3. Within seven days after the Consultant receives monies from the Client in respect of and following an application for payment which the Sub-Consultant was entitled to make ARCUS GIBB shall (subject as hereafter provided) pay the same to the Sub-Consultant. If payment is not made by such date, subject to any deduction which ARCUS GIBB was entitled to make, ARCUS GIBB shall also pay interest compounded monthly at the rate of 2% per annum above the base lending rate of Nedbank Limited.

4. If ARCUS GIBB intends to withhold any payment, it shall notify the Sub-Consultant.

5. If the Sub-Consultant intends to claim any additional payment, it shall promptly notify ARCUS GIBB accordingly. The Sub-Consultant shall not be entitled to additional payment to the extent that ARCUS GIBB is unable to seek compensation from the Client therefor.

6. Any payments due under this Agreement will be paid without deduction of income tax on receipt of a Tax Exemption Certificate or tax directive. In the absence of such documents ARCUS GIBB will deduct income tax in accordance with the South African Revenue Services requirements. Should the tax deduction not be processed the Sub-Consultant is solely responsible for its own tax payments.

7. The Sub-Consultant shall be deemed to have knowledge of all necessary provisions of the Principal Agreement (including any subsequent variations thereto which variations will be notified by ARCUS GIBB to the Sub-Consultant as soon as reasonably practicable) and accepts these stipulations of the Principal Agreement as binding on it. Provided that if any variation of the provisions of the Principal Agreement results in an increase or decrease in the amount of work to be performed by the Sub-Consultant hereunder, the sums payable to the Sub-Consultant under Clause 2 above will be adjusted upwards or downwards (as appropriate) to such sums as in the opinion of ARCUS GIBB is fair and reasonable.

The Services Contracted Out

Aquatic Invertebrate Fauna Monitoring

a) This aquatic invertebrate fauna monitoring programme will constitute a revision of the construction monitoring programme that has been running to date

b) A total of 10 sites are to be sampled. These sites to include two on the Rwantsa tributary of the Nahoon River (NR1 and NR6), five on the Xolo tributary of the Nahoon River (NX2, NX4, NX4a, NX6, NX7), two on the Nahoon River itself (N0 and N2) and one site on the Mncotsho tributary of the Buffalo River (BM1).

c) These sites be sampled twice a year, namely once in mid summer (November - February) and once in late Winter (August-September). This will give data on breeding success in summer and survival over the low-flow period in winter. The exact timing of the mid-summer sampling will have to be adjusted to avoid high river flows, which impact on sampling effectiveness.

d) Required activities include:

- Field work: Routine survey techniques have been developed during previous monitoring surveys conducted at the ELRWDS and are to be retained for this revised programme. The SASS4/SASS5 evaluation methods to assess water quality have been used to date. All efforts must be made to keep survey techniques constant with baseline techniques, so as to make generated data comparable to existing baseline data. In addition material collected will be continue to be maintained and curated in the Department of Freshwater Invertebrates, National Collection of Freshwater Organisms held in the Albany Museum. This material can be used for future reference and is a direct comeback for any claims against the contractor.

- Data capture and interpretation
- Reports]
  - Reporting will be undertaken following each monitoring survey.
  - A short summary report will be submitted to the ARCUS GIBB office within 1 week of the completion of each field survey. This report will serve to communicate any crucial issues from the sub-consultant, to ARCUS GIBB with minimal delay.
  - Full Report: A full report will be submitted to reach ARCUS GIBB within 1 month after each survey trip, outlining the methods used, the results of each trip, and providing appropriate, conclusions drawn and recommendations.
  - The final monitoring report for each year will include comments summarising the findings for the year

Table 1. List of collecting sites, with grid reference coordinates and altitudes for each site.

Site No.	Locality	Grid Reference	Alt./m.
1	Mooi River at Riverside	31°05'00"S 28°18'00"E	1280
2	Antelope Park Spruit	30°49'02"S 28°12'30"E	1780
3	Rush Spruit	30°50'30"S 28°12'15"E	1760
4	Hawerspruit at Falstaff Glen	30°51'50"S 28°12'16"E	1680
5	Pot River at Fairview	30°56'58"S 28°14'00"E	1440
6	Little Pot River at bridge	30°58'58"S 28°15'40"E	1320
7	Lower Pot River at Ho/Hoha	31°02'01"S 28°24'55"E	1180
8	Upper Mooi River at Oakhurst	31°04'50"S 28°09'30"E	1240
9	Upper Little Mooi River at Fairvalley	31°07'50"S 28°05'10"E	1280
10	Trib. of Mooi River at Preston Park	31°06'15"S 28°12'45"E	1340
11	KuNtombizininzi River	30°07'30"S 28°14'00"E	1340
12	Unnamed tributary of Mooi River	31°06'00"S 28°18'50"E	1300
13	Wildebees River at Mt. Challenger	31°10'25"S 28°07'20"E	1340
14	Upper Wildebees River at Morven	31°12'00"S 28°04'50"E	1360
15	Wildebees River headwaters at Glenelg	31°13'30"S 28°03'50"E	1380
16	Danville Vlei	31°14'50"S 28°05'15"E	1380
17	Gatberg River below vlei at Greendale	31°14'00"S 28°11'30"E	1320
18	KuKowa stream, trib. of Slang-Mbashe R.	31°28'50"S 27°49'00"E	1300
19	Pot River at Oakleigh (Dinosaur Footpr.)	30°58'40"S 28°16'30"E	1300
25	Upper Gatberg River at Madun	31°16'20"S 28°10'00"E	1340
26	Ntsubu River at Borva	31°25'10"S 28°02'15"E	1480
27	Unnamed trib. of Xuka R. at Rondavel	31°27'10"S 28°01'00"E	1280
28	KuDidwayo River at Marinus	31°25'05"S 28°06'30"E	1300
29	KuNtwanazana River at Two Streams	31°20'10"S 28°11'45"E	1240
30	Nqancule River at Waterval	31°22'20"S 28°13'00"E	1220
31	Nqancule River at Albany	31°20'55"S 28°12'55"E	1240
32	Tsitsa River at Niagara	30°56'55"S 28°26'20"E	1220
33	Tsitsa River at "The Falls"	31°00'55"S 28°29'20"E	1140
34	KuNtombizininzi River at Weatherstone	31°08'40"S 28°17'30"E	1300
35	Inxu River at Brione	31°09'10"S 28°20'05"E	1260
36	KuNtwanazana River at Ronan	31°20'05"S 28°04'00"E	1420
37	Gatberg River at Chantry	31°14'58"S 28°07'09"E	1260
38	Wildebees River at Beverin	31°10'45"S 28°08'15"E	1340
39	Maclear Municipal Dam	31°03'30"S 28°19'08"E	1380
40	Dammed trib. Little Pot R. at Killarney	30°59'25"S 28°15'58"E	1280
41	Rush Valley Pan	30°51'02"S 28°12'56"E	1740
42	Glen Avice Pan	30°47'22"S 28°12'02"E	1960
43	Unnamed tributary of Wildebees River	30°09'39"S 28°10'55"E	1360
44	Mountain stream, Prentjiesberg SW Peak	31°08'48"S 28°08'18"E	1900
45	Wildebees River on Lanark Farm	31°09'55"S 28°12'50"E	1300
46	Dam on Gatberg River	31°14'39"S 28°06'24"E	1360
47	Dam on KuNtwanazana River	31°20'00"S 28°03'55"E	1420
48	Small seep flowing into pools, below pine plantation.	31°04'00"S 28°19'02"E	1400

Table 4. List of biotopes sampled at each collecting site.

Site No.	Biotopes
1.	SIC, DRIFT, SNAG, LIGHT
2.	SIC, BRIC, MVIC, SOC, SED, HYG, DRIFT, FNW, LIGHT
3.	SIC
4.	SIC
5.	SIC
6.	BRIC, FA, SAND
7.	BRIC, FAIC, MVIC, MVOC, HYG
8.	SIC, MVIC, SOC, MVOC
9.	SIC, SOC, MVIC, TVIC, SED
10.	SIC, MVIC, SOC
11.	SIC, FAIC
12.	MVIC
13.	SIC, MVIC, RIC, SOC
14.	SIC, BRIC, MVIC, SAND, FNW
15.	SIC, MVIC
16.	SOC, MVOC, POOL
17.	SIC, MVIC
18.	SIC, BRIC
19.	SIC, BRIC, MVIC, SOC, FNW, LIGHT
25.	MVOC, SOC
26.	SOP, SED
27.	SIC, SOC, SED
28.	SIC, MVIC
29.	SED
30.	SIC, BRIC, MVIC
31.	SIC, BRIC
32.	MVIC, SED
33.	BRIC, MVIC, MVOC, GRAVOC, FNW
34.	SIC, MVIC, SED
35.	SIC, BRIC, MVIC, FAM, MUD, LIGHT
36.	MARSH, SED, POOL
37.	MVOC
38.	SIC, MVIC, INT, LIGHT
39.	MVOC, FNW
40.	MVOC, SED, FNW
41.	MVOC, BENTH, FNW
42.	MVOC
43.	SIC
44.	SIC, MVIC, SOP, FNW
45.	SED
46.	MVOC, SED, FNW
47.	MVOC, SED, FNW
48.	SOP, SEEP, FNW

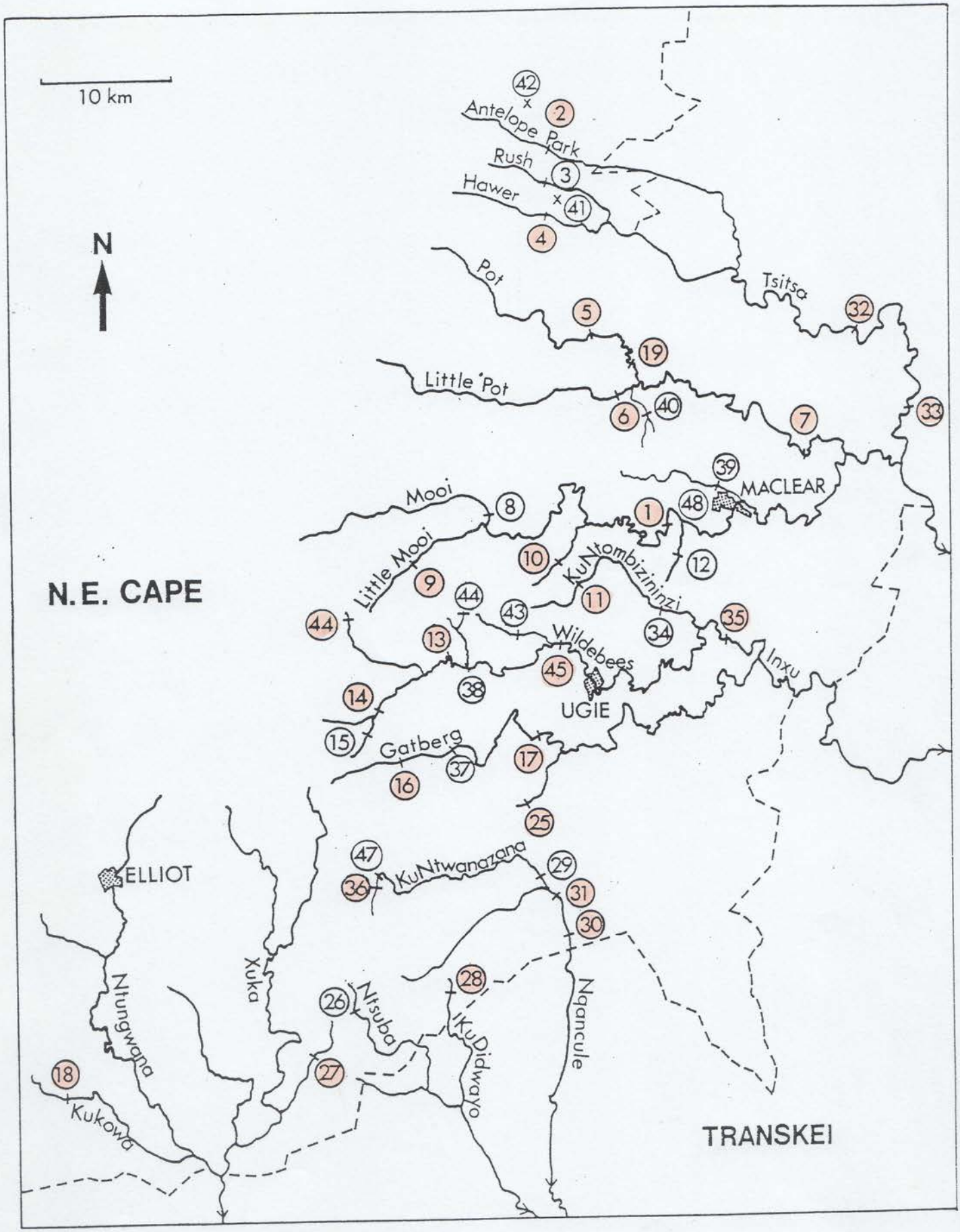

Figure 2. Collecting sites on the North East Cape rivers. For site numbers refer to Table 1.

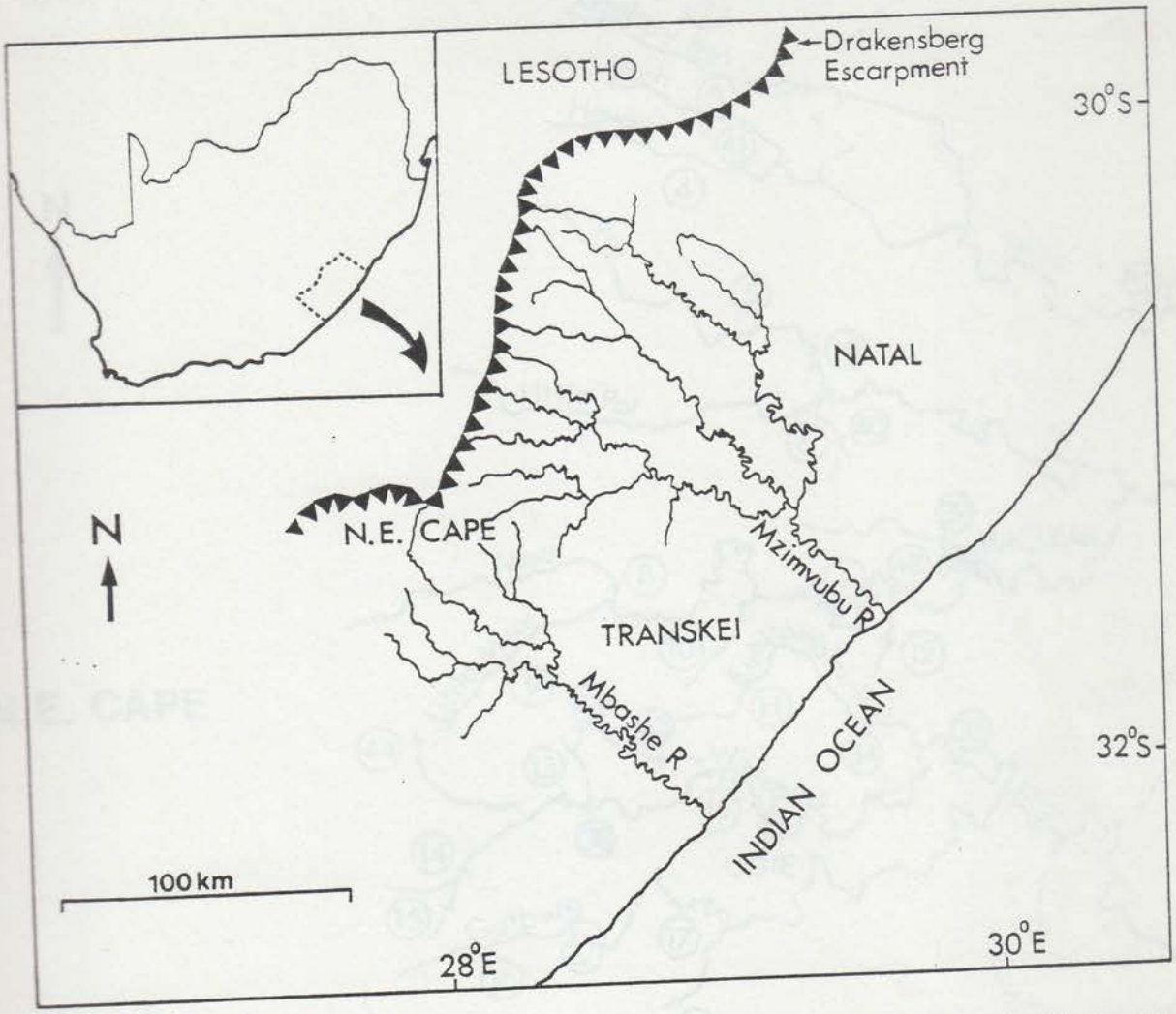

Figure 1. The main river systems of the North East Cape, showing the Drakensberg escarpment which forms the watershed between the east and west flowing rivers.

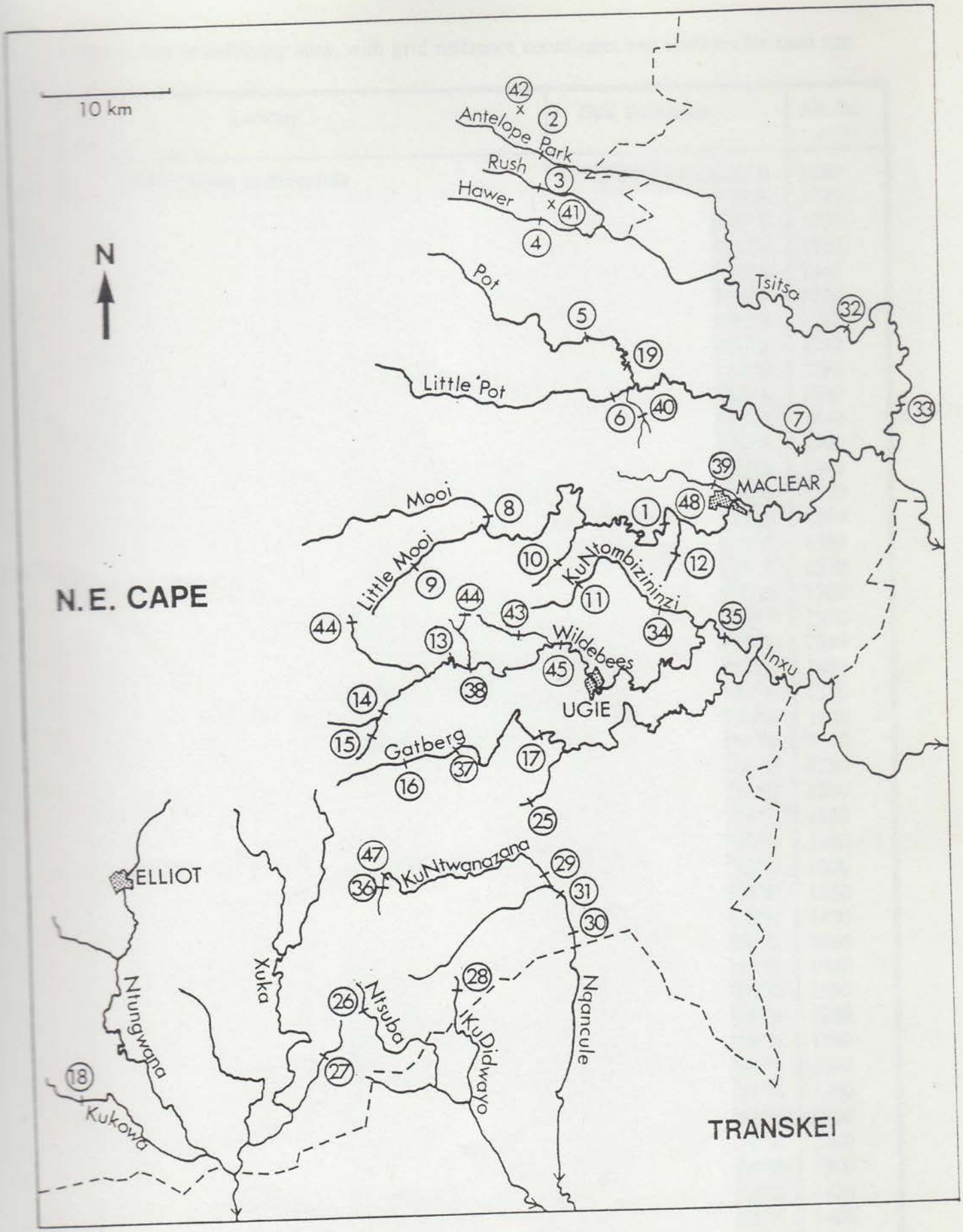

Figure 2. Collecting sites on the North East Cape rivers. For site numbers refer to Table 1.

CATALOGUE	SPECIES	COLLECTOR	SITE	DATE	GRID	HABITAT	AGE
					31 0052 28 2918		
ECR 134A	*lawrencei*	F.C.de Moor, H.M.Barber-James, K. Martens	Tsitsa River, at "The Falls" 1140m	1993/03/28	310117S 282855E	BR/SIC	6 n
ECR 86A	*lawrencei*	F.C. de Moor, H.M. Barber	Nqancule River, at Waterval	1991/03/25	312220S 281300E	BR/SIC	12 n
ECR 88A	*lawrencei*	F.C. de Moor, H.M. Barber	Nqancule River, at Albany	1991/03/25	312055S 281255E	SIC	1 n
ECR 92AE	*lawrencei*	F. de Moor, H.M. Barber	Tsitsa River, at "The Falls"	1991/03/26	310055S 282920E	MVIC	1 n
GEN 1097A	*lawrencei*	F.C. de Moor	Stream below Tor Doone, Hogsback	1992/02/29	323440S 265605E	SIC	6 n
GEN 1845A	*lawrencei*	N. Phaliso	Kettle Spout waterfall, Thyme River tributary, Hogsback	2007/05/19	3233S 2657E	BR/SIC	1 n
MOI 29BS	*lawrencei*	C. Dickens	Klein Mooi River, at Durleigh Farm	1995/03/15	291342S 295359E	SIC	1 n immature
MOI 35B	*lawrencei*	F.C. de Moor	Klein Mooi River, at Durleigh Farm	1995/04/03	291342S 295359E	Surface of rock	3♀, 4♂ imagoes, 1 slide (wings)
GEN 1733G	*lawrencei*	R. Bills	Malolotja stream, Nkomati River system	2003/03/03	260700S 310652E		2 n
LES 38U	*lawrencei*	Kelly Meyer	Tsoelikana River	1986/01/21	295512S 290533E	Pebble and gravel substrate	4 n
GEN 1978C	*lawrencei*	T. Bellingan	Umkomozana River, Sani Pass	2011/01/14	293503S 291718E	Cobble and gravel substrate	4 n
GEN 1733E	*jessicae*	R. Bills	Malolotja stream, Nkomati River system	2003/03/03	260700S 310652E		14 n immature
GEN 1734B	*jessicae*	R. Bills	Jubukweni stream near Mbuluzi. Nkomati River system	2003/03/29	261210S 311140E		7 n
GEN 1738B	*jessicae*	R. Bills	Lubuyane stream near Mnyokane. Nkomati River system.	2003/04/06	260926S 311229E		4 n

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The message was checked by ESET NOD32 Antivirus.

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40	Dammed trib. Little Pot R. at Killarney	30°59'25"S 28°15'58"E	1280
41	Rush Valley Pan	30°51'02"S 28°12'56"E	1740
42	Glen Avice Pan	30°47'22"S 28°12'02"E	1960
43	Unnamed tributary of Wildebees River	30°09'39"S 28°10'55"E	1360
44	Mountain stream, Prentjiesberg SW Peak	31°08'48"S 28°08'18"E	1900
45	Wildebees River on Lanark Farm	31°09'55"S 28°12'50"E	1300
46	Dam on Gatberg River	31°14'39"S 28°06'24"E	1360
47	Dam on KuNtwanazana River	31°20'00"S 28°03'55"E	1420
48	Small seep flowing into pools, below pine plantation.	31°04'00"S 28°19'02"E	1400

Table 2. The time, pH, temperature and electrical conductivity (*u* S/cm. @ 25°C) recorded for each site during each of the three surveys December 1990, March 1991 and March 1993.

Site No	Time Sampled			pH			Temp (°C)			EC K_{25} (*u*S/cm)		
	Dec/ 90	Mar/ 91	Mar/ 93	Dec/ 90	Mar/ 91	Mar/ 93	Dec/ 90	Mar/ 91	Mar/ 93	Dec/ 90	Mar/ 91	Mar/ 93
1	09.00			6.9		8.1	19.9			85.1		
2	11.30	12.00	13.00	7.8	7.6		17.9	15.9	20.1	130.0	98.8	102.0
3												
4							19.5			99.9		
5	15.00			7.9			19.2			58.5		
6	16.30						21.0			75.6		
7	09.30			7.8								
8	11.00			7.6			20.0			71.3		
9	12.45			7.7			26.0			59.2		
10	14.30			7.1			22.5			37.5		
11	16.30			6.8			23.0			20.8		
12												
13	11.15		17.50	7.8		7.1	18.5		23.0	88.8		144.0
14	12.30			7.4			18.0			86.8		
15												
16	13.45			7.1			17.0			64.1		
17	16.00			7.0			17.5			66.1		
18								20.0				
19		12.30	14.50		7.6	7.5		17.4	18.4		74.8	57.0
25		18.00			7.1			20.1			57.2	
26		10.20			6.8			15.4			148.8	
27		11.30			7.7			17.9			270.2	
28		13.15			7.3			18.6			87.9	
29		15.00			7.8			23.1			221.5	
30		16.00			7.9			23.7			143.8	
31		17.00			7.4			18.0			159.6	
32		10.30			7.6			19.6			87.7	
33		12.30	11.30		7.9	7.7		20.9	20.9		73.6	67.0
34		15.30			7.0			22.4			37.8	
35		17.30			7.3			19.4			72.2	
36			09.30			6.8			18.4			323.0
37			11.05			6.7			18.3			277.0
38			13.15			7.7			22.0			141.0
39			12.50			7.3			21.4			57.0
40			09.30			6.6			19.8			75.0
41			11.00			6.6			15.0			127.0
42			13.00			7.6			19.0			
43			16.45			7.6			22.2			
44			12.50			5.6			15.0			37.0

Table 3. Key to abbreviations of biotopes sampled in this study.

Biotope	Description
BENTH	General benthic sample
BRIC	Bedrock in current
DRIFT	Drift sample
FA	Filamentous algae
FAIC	Filamentous algae in current
FAM	Floating aquatic macrophyte
FNW	Flying near water
GRAVOC	Gravel sample out of current
HYG	Hygropetric splash zone of waterfall
INT	Interstitial sample
LIGHT	Light trap sample
MARSH	Water-logged area without peat (with macrophytes)
MUD	Mud sample
MVIC	Marginal vegetation in current
MVOC	Marginal vegetation out of current
POOL	Pools
RIC	Roots in current
SAND	Sand sample
SED	Sediment sample
SEEP	Permanent seepage of groundwater
SIC	Stones in current
SNAG	Log jam
SOC	Stones out of current
SOP	Surface of pool/pond
TVIC	Trailing vegetation in current

Table 4. List of biotopes sampled at each collecting site.

Site No.	Biotopes
1.	SIC, DRIFT, SNAG, LIGHT
2.	SIC, BRIC, MVIC, SOC, SED, HYG, DRIFT, FNW, LIGHT
3.	SIC
4.	SIC
5.	SIC
6.	BRIC, FA, SAND
7.	BRIC, FAIC, MVIC, MVOC, HYG
8.	SIC, MVIC, SOC, MVOC
9.	SIC, SOC, MVIC, TVIC, SED
10.	SIC, MVIC, SOC
11.	SIC, FAIC
12.	MVIC
13.	SIC, MVIC, RIC, SOC
14.	SIC, BRIC, MVIC, SAND, FNW
15.	SIC, MVIC
16.	SOC, MVOC, POOL
17.	SIC, MVIC
18.	SIC, BRIC
19.	SIC, BRIC, MVIC, SOC, FNW, LIGHT
25.	MVOC, SOC
26.	SOP, SED
27.	SIC, SOC, SED
28.	SIC, MVIC
29.	SED
30.	SIC, BRIC, MVIC
31.	SIC, BRIC
32.	MVIC, SED
33.	BRIC, MVIC, MVOC, GRAVOC, FNW
34.	SIC, MVIC, SED
35.	SIC, BRIC, MVIC, FAM, MUD, LIGHT
36.	MARSH, SED, POOL
37.	MVOC
38.	SIC, MVIC, INT, LIGHT
39.	MVOC, FNW
40.	MVOC, SED, FNW
41.	MVOC, BENTH, FNW
42.	MVOC
43.	SIC
44.	SIC, MVIC, SOP, FNW
45.	SED
46.	MVOC, SED, FNW
47.	MVOC, SED, FNW
48.	SOP, SEEP, FNW

Table 5. Ephemeroptera species collected in the rivers of the North East C
refer to Figure 2.

	RIVER SYSTEM															
	MAIN RIVERS	Tsitsa					Pot					Mooi				
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12
BAETIDAE																
Acentrella monticola Crass		*						*							*	
Acentrella natalensis Crass		*						*	*	*		*				
Afroptilum (Afroptiloides) sp.						*		*								
Afroptilum excisum (Barnard)		*							*	*		*				
Afroptilum parvum (Crass)																
Afroptilum sudafricanum (Lestage)		*						*								
Afroptilum tarsale Gillies						*										
Afroptilum sp. 1		*				*		*								
Afroptilum sp. 2		*														
Afroptilum sp. 3		*														
Afroptilum sp. 4		*				*										
Afroptilum sp. 5		*				*										
Afroptilum sp. 6						*										
Afroptilum (small nymphs)			*		*		*	*						*	*	
Baetis glaucus Agnew		*			*	*		*								
Baetis harrisoni Barnard		*	*	*	*	*	*	*	*	*		*	*	*	*	
Baetis latus Agnew			*	*	*		*	*	*	*						
Baetis sp. 1		*				*		*								
Baetis sp. 2		*														
Baetis sp. 3		*				*		*								
Baetis sp. 4						*										
Baetis sp. 5		*			*											
Baetis sp. 6						*		*								
Baetis (small nymphs)			*		*	*		*		*			*		*	*
Centroptiloides bifasciata (E-P.)						*		*								
Cloeon virgiliae (Barnard)																
Cloeon sp.					*											
Demoulinia crassi (Demoulin)									*							
Pseudocloeon near *magae* Barnard													*			
Pseudocloeon vinosum Barnard						*		*								
OLIGONEURIIDAE																
Oligoneuriopsis lawrencei Crass						*										
HEPTAGENIIDAE																
Afronurus barnardi Schoonbee								*						*		
Afronurus harrisoni Barnard								*								
Afronurus oliffi Schoonbee		*					*									
Afronurus peringueyi (Esben-Petersen)		*														
Afronurus sp.				*		*										
Compsoneuria njalensis (Kimmins)													*			
LEPTOPHLEBIIDAE																
Adenophlebia auriculata (Eaton)								*								
Adenophlebia sylvatica Crass							*	*								
Adenophlebia sp.		*						*								
Aprionyx tricuspidatus Crass													*			
Castanophlebia albicauda Barnard																
Castanophlebia sp.								*							*	
Choroterpes sp.		*	*	*		*	*	*								
Euthraulus elegans Barnard								*								
POLYMITARCYIDAE																
Afroplocia sampsoni (Barnard)																
EPHEMERIDAE																
Afromera natalensis (Barnard)																
TRICORYTHIDAE																
Tricorythus reticulatus Barnard		*														
Tricorythus sp.		*		*			*	*					*	*	*	*
CAENIDAE																
Caenis basuto Demoulin		*														
Caenis capensis (Barnard)													*			
Caenis sp. 1													*			
Caenis sp. 2																
Caenis sp. 3		*		*					*	*		*	*	*	*	*
Caenis sp. 4		*								*		*	*			
Caenis sp. 5		*			*	*	*	*		*		*		*		
Caenis sp. 6		*							*				*	*		
Caenis sp. 7		*		*												
TOTAL NO. SPECIES: 58		27	5	7	8	19	8	25	7	8	0	6	11	7	7	3

f the North East Cape, arranged according to sampling sites within river catchments. Site numbers

MZIMVUBU																						MBASHE								
	Mooi						Inxu															Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	45	16	46	37	17	25	36	47	29	30	31	28	26	27	18
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	*		*	*				*													*			*	*	*		*	*	
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*	*	*	*	*			*		*	*		*					*			*	*				*	*			*	
*	*																*								*		*			
*		*					*	*	*	*	*	*					*			*				*	*				*	*
	*	*																			*									
6	11	7	7	3	2	0	7	11	9	4	13	5	6	4	3	2	3	1	0	2	5	1	1	11	17	9	9	5	7	5

Table 6. Odonata species collected in the rivers of the North East Cape, arra
Figure 2.

	RIVER SYSTEM																
	MAIN RIVERS	Tsitsa					Pot					Mooi					
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12	
ZYGOPTERA																	
PLATYCNEMIDIDAE																	
Mesocnemis singularis Karsch																	
COENAGRIONIDAE																	
Enallagma glaucum Burmeister			*								*						
Enallagma sp.																	
Ischnura senegalensis (Rambur)					*	*		*									
Pseudagrion kersteni Gerstaecker					*			*	*	*		*	*	*	*		
Pseudagrion sp.		*															
LESTIDAE																	
Lestes plagiatus Burmeister																	
Lestes spp. (nymphs)																	
CHLOROLESTIDAE																	
Chlorolestes fasciata Burmeister		*			*			*									
Chlorolestes spp. (nymphs)									*					*			
CHLOROCYPHIDAE																	
Platycypha sp.												*					
ANISOPTERA																	
GOMPHIDAE																	
Crenigomphus sp. (nymphs)		*															
Paragomphus cognatus Rambur								*									
Paragomphus sp. (nymphs)		*			*	*			*				*	*			
Phyllogomphus sp. (nymphs)																	
Gen. sp. indet. (nymphs)																	
AESHNIDAE																	
Aeshna miniscula McLachlan																*	
Aeshna subpupillata McLachlan							*					*					
Anax sp. (nymphs)															*		
Hemianax sp. (nymphs)		*															
Gen. sp. indet. (nymphs)																	
LIBELLULIDAE																	
Brachythemis sp.																	
Orthetrum caffrum (Burmeister)																	
Pantala flavescens (Fabricius)					*												
Trithemis dorsalis (Rambur)																	
Trithemis furva Karsch					*			*									
Trithemis sp. (nymphs)		*				*				*				*	*		
Zygonyx sp.								*									
Gen. sp. indet.									*								
TOTAL NO. SPECIES: 29		6	1	0	6	3	1	6	4	2	1	2	4	4	3	0	

h East Cape, arranged according to sampling sites within river catchments. Site numbers refer to

MZIMVUBU																				MBASHE								
Mooi							Inxu													Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
*	*	*	*		*	*				*	*	*	*			*	*	*		*	*	*	*			*	*	*	*
		*			*	*					*			*				*		*									
*					*																								
	*	*						*				*												*				*	
*				*					*							*				*			*						
			*		*					*	*													*					
						*																							
						*												*											
		*	*		*																								
											*																		
											*																		
2	4	4	3	0	9	4	0	1	2	3	6	2	1	1	0	2	2	5	1	3	2	2	3	4	0	1	2	2	1

Table 7. Plecoptera species collected in the rivers of the North East Cape, arra
Figure 2.

	RIVER SYSTEM																
	MAIN RIVERS	Tsitsa					Pot					Mooi					
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12	34
PERLIDAE *Neoperla spio* (Neuman) complex NOTONEMOURIDAE *Aphanicercella cassida* Barnard		*		*				*				*					
TOTAL NO. SPECIES: 2		1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	

rth East Cape, arranged according to sampling sites within river catchments. Site numbers refer to

MZIMVUBU																					MBASHE								
Mooi							Inxu														Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
*											*													*	*	*		*	
1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0

Table 8. Hemiptera species collected in the rivers of the North East Cape, a
Figure 2.

	RIVER SYSTEM															
	MAIN RIVERS	Tsitsa					Pot					Mooi				
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12
CICADELLIDAE																
Gen. sp. indet.			*													
APHIDIDAE																
Gen. sp. indet.																
HEBRIDAE																
Hebrus sp.		*														
HYDROMETRIDAE																
Hydrometra sp.														*		
VELIIDAE																
Microvelia sp.		*			*	*										
Ocellovelia sp.														*		
Rhagovelia sp.					*	*		*								
Tenagovelia sp.								*								
Gen. sp. indet.																
GERRIDAE																
Gerrinae																
Tenagogonus sp.														*		
Gen. sp. indet.			*													
Halobatinae																
Eurymetra sp.						*										
NOTONECTIDAE																
Anisops ?poweri Hutchinson																
Anisops sp. 1								*								
Anisops sp. 2																
Enithares chinai Jaczewski																
Enithares sobria Stål																
Enithares sp.																*
Gen sp. indet.																
PLEIDAE																
Plea pullula Stål		*	*													
NEPIDAE																
Laccotrephes sp.					*											
Ranatra sp.																*
NAUCORIDAE																
Laccocoris sp.			*			*		*								
Gen sp. indet.					*	*										
CORIXIDAE																
Micronecta near *bleekiana* Hutchinson																
Micronecta ?dorothea Hutchinson													*			
Micronecta gorogaiqua Hutchinson		*						*								
Micronecta monomatapae Hutchinson																
Micronecta ?piccanin Hutchinson																
Micronecta scutellaris Stål																
Micronecta uvarovi Jaczewski					*											
Micronecta winifreda Hutchinson										*						
Micronecta sp.		*	*													
Sigara sjostedti (Kirkaldy)			*							*			*			*
Gen. sp. indet.																
TOTAL NO. SPECIES: 35		6	6	0	5	5	0	5	0	2	0	0	2	3	0	3

North East Cape, arranged according sampling sites within river catchments. Site numbers refer to

MZIMVUBU																				MBASHE								
Mooi							Inxu													Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
																					*		*					*	
		*									*	*	*			*													
		*						*	*		*	*	*						*		*		*	*			*		
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									*												*								
0	2	3	0	3	6	0	0	2	4	3	4	3	3	0	0	5	6	0	2	1	8	3	3	4	0	1	4	4	0

Table 9. Coleoptera species collected in the rivers of the North East Cape, S
Figure 2. Where morphotypes have been distinguished, letters of the alphabe

	RIVER SYSTEM														
	MAIN RIVERS	Tsitsa					Pot					Mooi			
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12
MYXOPHAGA																
HYDROSCAPHIDAE																
Gen. sp. indet.		*														
TORRIDINCOLIDAE																
Torridincola sp.																
ADEPHAGA																
CARABIDAE																
Gen. sp. indet.													*			
HALIPLIDAE																
Gen. sp. indet.																
DYTISCIDAE																
Type 1 = *Hyphydrus* sp.																
Type 2 = *Agabus* sp.																*
Type 3																
Type A								*								
Type B																
Type C				*												
Type D																
Type E																
Type F																
Type G														*		*
Type H																
Type I																
Type J		*														*
Type K																
Type L																
Type M																
Type N		*														
Type O																
GYRINIDAE																
Type 1 = *Aulonogyrus* sp.																
Type A					*	*		*								
Type B																
Type C						*										
Type D																
Type E = *Dineutus punctatus* Aubé																

North East Cape, arranged according to sampling sites within river catchments. Site numbers refer to
tters of the alphabet refer to adults, while numbers refer to larvae.

MZIMVUBU																					MBASHE								
Mooi							Inxu														Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
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																*				*									
									*		*								*										
																							*						
																								*					

Table 9 continued over page...

Table 9 (continued). Coleoptera species collected in the rivers of the North Eas

	RIVER SYSTEM																	
	MAIN RIVERS	Tsitsa					Pot					Mooi						
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12	39	
POLYPHAGA																		
HYDRAENIDAE																		
Hydraena sp.		*			*													
Mesoceration sp. 1		*			*													
Mesoceration sp. 2		*			*													
Mesoceration sp.																		
Ochthebius sp.																		
Parahydraena sp.		*			*		*		*									
Parasthetops sp. 1					*													
Parasthetops sp. 2				*														
Parasthetops sp.																		
Gen. sp. indet.																		
ELOPHORIDAE																		
Elophorus sp.																		
HYDROCHIDAE																		
Hydrochus ?capensis Peringuey																		
SPERCHEIDAE																		
Spercheus sp.																		
HYDROPHILIDAE																		
Derallus sp.																		
Type 1		*																
Type 2																		
Type 3 = *Berosus* sp.																		
Type 4																		
Type A																		
Type B																		
Type C													*					
Type D													*					
Type E																		
Type F																		
HELODIDAE																		
Gen. sp. indet.		*		*			*					*						
PSEPHENIDAE																		
Gen. sp. indet.		*						*					*					
DRYOPIDAE																		
Gen. sp. indet.		*											*					
ELMIDAE																		
Potamodytes sp.								*										
Stenelmis sp.						*												
Type 1		*				*		*		*								
Type 2								*										
Type 3													*					
Type 4								*	*	*								
Type 5								*										
Type A															*			
Type B																		
Type C		*				*				*								
Type D																		
MYCTERIDAE																		
Gen. sp. indet.																		
CHRYSOMELIDAE								*										
Gen. sp. indet.																		
CURCULIONIDAE																		
Gen. sp. indet.		*																
TOTAL NO. SPECIES: 69		15	0	3	6	5	3	8	2	3	0	1	6	1	1	3	2	

ers of the North East Cape.

	MZIMVUBU																				MBASHE								
	Mooi						Inxu														Mbashe							Xuka	
[illegible]	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
					*					*	*	*				*							*					*	*
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											*	*				*													
1	6	1	1	3	2	0	1	4	6	4	16	12	1	1	0	7	4	10	3	7	6	3	6	6	2	2	0	3	6

Table 10. Trichoptera species collected in the rivers of the North East Cape, a
to Figure 2. Species marked ## were collected outside the designated area.

	RIVER SYSTEM															
	MAIN RIVERS	Tsitsa					Pot					Mooi				
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12
PHILOPOTAMIDAE																
Chimarra sp.																
PSYCHOMYIIDAE																
Tinodes pollicaris Morse		*														
POLYCENTROPODIDAE																
Pseudoneureclipsis sp.		*														
ECNOMIDAE																
Ecnomus oppidanus Barnard																
Ecnomus sp.																
Psychomyiellodes dentatus Kimmins												*				
HYDROPSYCHIDAE																
Cheumatopsyche afra (Mosely)		*		*		*	*	*	*	*		*	*	*	*	
Cheumatopsyche maculata (Mosely)								*		*						*
Cheumatopsyche thomasseti (Ulmer)		*	*					*				*	*			
Cheumatopsyche Type 5 (FMC)																
Cheumatopsyche Type 7 (FMC)																
Cheumatopsyche spp. (small larvae)																
Hydropsyche longifurca Kimmins						*	*									
Macrostemum capense (Walker)								*					*			
HYDROPTILIDAE																
Hydroptila capensis Barnard		*							*							
Hydroptila cruciata Ulmer		*						*	*	*		*	*	*		
Hydroptila sp.		*											*			
Orthotrichia sp.		*												*		
Oxyethira sp.													*			
LEPIDOSTOMATIDAE																
Goerodes caffrariae (Barnard)		*										*				
SERICOSTOMATIDAE																
Aclosma sp.		*												*		
LEPTOCERIDAE																
Athripsodes fissus (Ulmer)													*			
Athripsodes harrisoni (Barnard)		*						*		*		*	*			
Athripsodes sp. 1		*														
Athripsodes sp. 2 ##														*		
Athripsodes spp. (small larvae)																
Oecetis lucipetens Barnard								*					*			
Oecetis modesta (Barnard)		*														
Oecetis sp.		*	*		*			*				*	*	*		
Triaenodes elegantulus Ulmer								*					*			
Triaenodes sp.													*			
Trichosetodes sp.								*								
TOTAL NO. SPECIES: 30		14	2	1	1	2	2	10	3	4	0	7	12	6	1	1

North East Cape, arranged according to sampling sites within river catchments. Site numbers refer designated area.

	MZIMVUBU																					MBASHE								
	Mooi							Inxu														Mbashe							Xuka	
40	8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
	*														*			*												*
	*	*	*	*				*		*		*	*	*				*							*	*			*	*
	*	*			*					*			*	*			*													
			*						*	*		*		*	*															
		*								*				*							*			*	*	*				
	*	*	*						*	*		*	*			*								*			*			*
		*	*								*	*	*				*		*									*			*
			*																												
	*																														
		*	*						*	*	*	*	*	*	*				*						*						
										*																					
	*	*	*											*		*															
		*												*	*																
		*													*																
		*																													
		*																													
0	7	12	6	1	1	0	0	1	3	7	2	6	5	7	4	2	2	3	0	0	2	0	0	1	4	3	2	0	1	4

Table 11. *Simulium* (Diptera, Simuliidae) species collected in the rivers of the N
Site numbers refer to Figure 2.

	RIVER SYSTEM														
	MAIN RIVERS	Tsitsa					Pot								
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10
Simulium (Anasolen) dentulosum Roubaud		*	*	*		*		*							
Simulium (Edwardsellum) damnosum s.l Theobald													*		
Simulium (Meilloniellum) adersi Pomeroy								*							
Simulium (Meilloniellum) hirsutum Pomeroy						*		*							
Simulium (Metomphalus) chutteri Lewis		*		*		*	*	*	*	*				*	
Simulium (Metomphallus) medusaeforme Pomeroy		*				*		*		*					
Simulium near *medusaeforme*		*	*				*		*			*		*	
Simulium (Metomphallus) vorax Pomeroy															
Simulium (Nevermannia) nigritarse Coquillet		*						*							
Simulium (Nevermannia) ?rutherfoordi de Meillon							*	*		*			*		
Simulium (Pomeroyellum) bequaerti Gibbins												*			
Simulium (Pomeroyellum) impukane de Meillon							*								
Simulium (Pomeroyellum) rotundum Gibbins								*		*					
Simulium (Pomeroyellum) sp. 1							*								
Simulium (Pomeroyellum) sp. 2		*		*	*	*		*	*			*	*	*	
Simulium sp.															
TOTAL NO. SPECIES: 16		6	2	3	1	5	4	8	3	3	0	3	3	3	

n the rivers of the North East Cape, arranged according to sampling sites within river catchments.

MZIMVUBU																								MBASHE								
		Mooi							Inxu															Mbashe							Xuka	
7	40	8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
			*								*		*		*											*	*				
														*																	
*				*					*		*		*	*			*										*	*				
*																											*	*				
		*		*	*				*	*			*	*	*	*			*			*	*				*	*	*	*	*	*
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*			*								*		*	*	*		*					*						*	*			
		*											*																			
					*				*				*																			
		*	*	*						*	*			*								*	*			*	*	*	*	*	*	
3	0	3	3	3	2	0	0	0	3	2	4	0	6	6	4	1	3	1	0	0	3	2	0	0	1	7	7	4	0	2	1

Table 12. Chironomidae species collected in the rivers of the North East Cape, a
refer to Figure 2.

	RIVER SYSTEM																	
	MAIN RIVERS	Tsitsa					Pot					Mooi						
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12	39	
TANYPODINAE																		
Tanypodini																		
Clinotanypus sp.																		
Tanypus sp.																		
Macropelopini																		
Procladius sp.																		
Pentaneurini																		
Ablabesmyia dusoleili (Goetghebuer)		*	*	*	*		*		*	*		*	*	*				
Ablabesmyia sp.		*		*	*		*	*		*		*		*		*		
Conchapelopia sp.									*									
Larsia octomaculata (Freeman)																		
Larsia sp.																		
Nilotanypus sp.		*																
Paramerina sp.																		
Gen. sp. indet																		
ORTHOCLADIINAE																		
Cardocladius sp.		*		*		*		*	*									
Corynoneura sp.		*		*	*	*		*	*									
Cricotopus dibalteatus Freeman		*			*	*				*								
Cricotopus unizonatus Harrison		*						*										
Cricotopus larva B		*				*		*	*									
Cricotopus larva C		*								*								
Cricotopus larva D		*				*		*										
Cricotopus larva E								*										
Cricotopus sp.																		
Eukiefferiella sp.		*							*			*						
Limnophyes sp.												*	*					
Nanocladius sp.		*										*						
Parakiefferiella sp.										*								
Parametriocnemus sp.					*			*									*	
Paratrichocladius sp.		*		*				*										
Rheocricotopus capensis Freeman								*										
Rheocricotopus sp.		*	*	*	*			*	*	*		*		*				
Thienemanniella larva A																		
Thienemanniella larva B		*																
Thienemanniella larva C		*																
Thienemanniella larva D		*						*										
Tvetenia sp.		*						*		*								
Gen. sp. indet.																		
CHIRONOMINAE																		
Chironomini																		
Chironomus formosipennis Kieffer		*																
Chironomus sp.		*												*				
Cladopelma sp.																		
Cryptochironomus sp.		*	*	*														
Dicrotendipes peringueyanus Kieffer																		
Dicrotendipes sp.		*																
Harnischia sp.		*																
Microchironomus sp.		*								*	*							
Microtendipes sp.		*											*		*			
Nilodorum sp.																		
Paratendipes sp.		*																
Polypedilum alticola Freeman		*																
Polypedilum dewulfi Goetghebuer		*																
Polypedilum sp.		*			*	*	*	*	*	*	*		*	*				*
Stenochironomus harrisoni Freeman																		
Stenochironomus sp.		*																
Zavreliella ?marmorata (Wulp)		*																
Gen. sp. indet.																		
Tanytarsini																		
Cladotanytarsus sp.		*			*					*	*				*			
Rheotanytarsus fuscus Freeman		*			*	*		*	*	*	*		*		*			
Stempellinella sp.																		
Tanytarsus cf.*luctosus* Freeman										*								
Tanytarsus sp.		*	*	*									*	*				
Virgatanytarsus ardennensis (Goetg.)																		
Gen. sp. indet.																		
TOTAL NO. SPECIES: 59		34	4	11	8	7	4	15	13	11		0	9	5	6	0	3	

he North East Cape, arranged according to sampling sites within river catchments. Site numbers

MZIMVUBU																						MBASHE								
Mooi							Inxu															Mbashe							Xuka	
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
								*		*						*	*	*		*									
																				*									
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*	*								*	*																			*
					*	*				*			*				*				*								
9	5	6	0	3	1	2	7	12	16	9	15	8	1	1	1	16	5	1	4	14	0	1	6	8	5	13	9	3	5

Table 13. Diptera species collected in the rivers of the North East Cape, arrang
refer to Figure 2.

	RIVER SYSTEM																	
	MAIN RIVERS	Tsitsa					Pot					Mooi						
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12	39	
NEMATOCERA																		
TIPULIDAE																		
Gen. sp. indet.		*											*			*		
Tipulinae																		
Dolichopeza ?chaka Alexander													*					
Nephrotoma ?edwardsi Alexander													*					
Tipula draconis Alexander													*					
Tipula pomposa Bergroth		*																
Limoniinae													*					
Limoniini																		
Antocha sp.		*						*	*	*			*					
Antocha ?transvaalia (Alexander)																		
Limonia ?kraaiensis Alexander		*																
Hexatomini																		
Hexatoma sp.																		
Toxorhinini																		
Toxorhina? sp.													*					
Eriopterini																		
Erioptera? sp.		*											*					
Limnophilomyia? sp.							*											
Rhabdomastix sp.																		
DIXIDAE																		
Gen. sp. indet.								*				*						
CULICIDAE																		
Gen. sp. indet		*																
Anophelinae																*		
Gen. sp. indet																		
Culicinae																		
Gen. sp. indet.																		
CERATOPOGONIDAE																		
Gen. sp. indet.		*											*					
FORCIPOMYIINAE																		
Gen. sp. indet.		*				*		*										
CERATOPOGONINAE																		
Bezzia sp.		*	*		*				*	*			*					
Gen. sp. indet.																		
THAUMALEIDAE													*					
Gen. sp. indet.																		
BLEPHARICERIDAE																		
Gen. sp. indet.		*																
CECIOMYIIDAE																		
Gen. sp. indet.													*					
BRACHYCERA																		
ATHERICIDAE																		
Atherix sp.																		
Gen. sp. indet.																		
TABANIDAE																		
Haemotopota? sp.																		
Gen. sp. indet.																		
STRATIOMYIDAE																		
Gen. sp. indet.																		
EMPIDIDAE																		
Chelifera sp.													*					
Clinocera sp.																		
Hemerodromia sp.		*																
Rhamphomyia sp.																		
Gen. sp. indet.		*							*									
DOLICHOPODIDAE													*					
Gen. sp. indet.		*																
EPHYDRIDAE																		
Gen. sp. indet.								*				*		*				
MUSCIDAE																		
Gen. sp. indet.		*	*															
TOTAL NO. SPECIES: 37		15	2	0	1	1	1	4	3	2	0	2	14	1	0	2	0	

th East Cape, arranged according to regions where collected, from north to south. Site numbers

	MZIMVUBU																					MBASHE								
	Mooi						Inxu															Mbashe						Xuka		
8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	45	16	46	37	17	25	36	47	29	30	31	28	26	27	18
	*			*							*			*																
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2	14	1	0	2	0	1	2	0	3	2	7	8	4	1	0	2	4	1	0	2	3	2	2	1	1	0	4	3	3	2

Table 14. Non-insect species collected in the rivers of the North East Cape, ar
refer to Figure 2.

	RIVER SYSTEM															
	MAIN RIVERS	Tsitsa					Pot					Mooi				
SPECIES	SITE NO.	2	3	4	32	33	5	19	6	7	40	8	1	9	10	12
ANNELIDA																
OLIGOCHAETA																
Gen. sp. indet.		*		*						*		*	*			*
CRUSTACEA																
CLADOCERA																
Gen. sp. indet.		*						*	*	*			*			
COPEPODA																
Gen. sp. indet.		*			*	*		*	*							
OSTRACODA																
Gen. sp. indet.		*			*	*		*		*						
DECAPODA																
POTAMONIDAE																
Potamonautes perlatus (Milne-Edwards)		*					*			*			*	*		
Potamonautes sidneyi Rathbun								*								
Potamonautes sp.																
HYDRACARINA																
Gen. sp. indet.		*		*	*	*	*		*	*		*				
MOLLUSCA																
GASTROPODA																
NERITIDAE																
Gen. sp. indet.																
ANCYLIDAE																
Burnupia sp.		*						*		*		*	*	*		
PLANORBIDAE																
Bulinus sp.																
Bulinus natalensis (Küster)								*		*		*				*
Gen. sp. indet.																
PHYSIDAE																
Physa actua Draparnaud																
Gen. sp. indet.																
PELECYPODA																
Gen. sp. indet.		*														
SPHAERIIDAE																
Gen. sp. indet.		*														
CORBICULIDADE																
Corbicula sp.																
TOTAL NO. TAXA: 18		9	0	2	3	3	2	6	3	7	0	4	4	2	0	2

North East Cape, arranged according to regions where collected, from north to south. Site numbers

	MZIMVUBU																						MBASHE								
	Mooi							Inxu															Mbashe							Xuka	
40	8	1	9	10	12	39	48	11	34	35	15	14	13	38	44	43	16	46	37	17	25	36	47	29	30	31	28	26	27	18
	*	*			*			*	*	*							*			*		*					*	*	*	
		*				*			*	*		*	*				*	*	*		*	*						*		
						*			*	*	*	*	*				*	*	*	*	*	*	*		*	*	*	*	*	
						*	*		*	*		*					*	*		*	*	*	*		*	*	*		*	
		*	*					*									*			*	*				*			*		
						*											*		*				*				*		*	
	*					*		*	*	*		*	*				*	*		*	*	*		*	*		*		*	
																	*													
	*	*	*						*	*		*	*								*				*	*	*	*	*	
						*												*						*						
	*				*				*	*	*	*	*	*							*		*							
								*				*									*									
										*							*													
0	4	4	2	0	2	6	1	4	7	8	2	7	5	1	0	0	8	5	3	5	8	6	3	2	5	3	6	4	6	1

Plate 1. Site 2. Antelope Park Spruit, upstream of road bridge, showing bedrock and a small riffle.

Plate 2. Site 2. Antelope Park Spruit, looking upstream from road bridge, showing riffle, bedrock, stones in current, and some marginal vegetation biotopes.

Plate 3. Site 2. Antelope Park Spruit, showing a reach where the grassland grows to the edge of the river, forming dense marginal vegetation.

Plate 4. Site 2. Antelope Park Spruit, showing small seep from banks of river, forming hygropectric zone. Shelters of *Tinodes pollicaris* (Psychomyiidae) can be clearly seen on the rock surface.

Plate 5. Site 3. Rush Valley Spruit, meandering through grassland.

Plate 6. Site 3. Rush Valley Spruit, showing stones in current in the background, and stones out of current, marginal vegetation and sediment in the foreground.

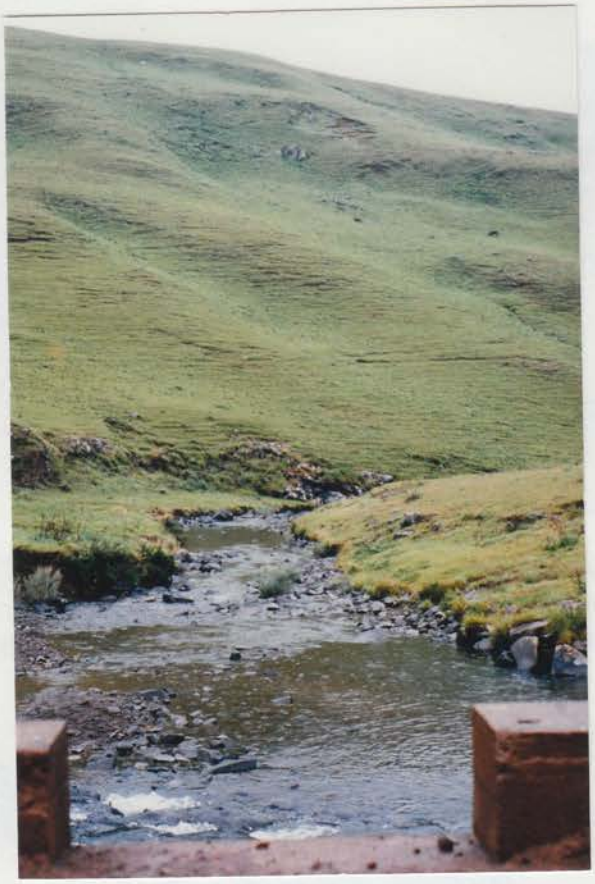

Plate 7. Site 4. The Hawerspruit, viewed from the road bridge.

Plate 8. Site 32. The Tsitsa River, at Niagara. Highly silted up section of river, with turbid water. The river was unexpectedly shallow, with the bed composed entirely of fine sand.

Plate 9. Site 33. The Tsitsa River, above the Falls. Although this site has suffered from sedimentation, many of the natural biotopes are still present. Since this is a rejuvenation zone of the river, bedrock and stones in current are the dominant biotopes.

Plate 10. Site 33. The Tsitsa River, at the Falls. Note the layers of bedrock, and encroaching exotic vegetation in the background.

Plate 11. Site 5. The Pot River at Fairview, near road bridge, taken just after a heavy rain storm. This site had been crystal clear a few hours previously, with cobble substrate clearly visible.

Plate 12. Site 19. Pot River at Oakleigh. Natural grassland, and some exotic vegetation along banks.

Plate 13. Site 6. Little Pot River, near road bridge. Slow flowing stream, with stones out of current, sediment and floating algae being the dominant biotopes sampled.

Plate 14. Site 7. Lower Pot River at Hoha. River flows over slabs of solid bedrock, eroded with many small potholes.

Plate 15. Site 7. Looking downstream at same site, where river flow is more broken and gradient slightly increased.

Plate 16. Site 40. Dam on tributary of Little Pot River, at Killarney.

Plate 17. Ploughing along the banks of the Pot River. Not enough riparian vegetation has been left to stabilise the banks.

Plate 18. Site 8. Upper Mooi River at Oakhurst. Finely cobbled stream, overhung with willows.

Plate 19. Site 1. Mooi River, near Riverside. Banks of river had dense groves of poplars and willows. Note undercut bank erosion.

Plate 20. Site 1. Mooi River, near Riverside. Log jam in river after it came down in spate following heavy rain.

Plate 21. Site 1. Mooi River, near Riverside. Sampling for invertebrates amongst willow roots.

Plate 22. Site 9. Upper Little Mooi River at Fairvalley. The water temperature was unusually high (26°C in December 1990) at this site when compared to other sites in this system, and an isolated population of *Barbus anoplus* was found here. The banks of the river had been disturbed by farming activities.

Plate 23. Site 10. Tributary of Mooi River at Preston Park. A superficially similar stream to the last, but water temperature only 22.5°C in December 1990. Note riffle, stones in and out of current, marginal vegetation and sediment biotopes all visible.

Plate 24. Site 12. Tributary of Mooi River near Riverside, flowing over bedrock.

Plate 25. Site 39. Maclear Municipal Dam on tributary of Mooi River.

Plate 26. Site 48. Small seep forming stream and pools on hillside below pine plantation.

Plate 27. Site 11. KuNtombizininzi River valley, showing recently planted pine trees.

Plate 28. Site 11. KuNtombizininzi River, showing old ox-bow cut-offs fringed with sedges in background. Pool and riffle biotopes visible in river.

Plate 29. Site 34. KuNtombizininzi River at Weatherstone.

Plate 30. Site 33. Inxu River at Brione Farm, below weir. Strongly flowing river, margins densely fringed with sedges.

Plate 31. Site 15. Wildebees River headwaters at Glenelg. Water turbid after heavy rain.

Plate 32. Site 14. Upper Wildebees River at Morven. Pioneer vegetation visible above left hand bank, in old farm fields.

Plate 33. Site 13. Wildebees River further downstream at Mount Challenger. Banks lined with willow trees.

Plate 34. Site 44. Spring-fed stream on south-west summit of Prentjiesberg.

Plate 35. Site 44. Pool on the above stream.

Plate 36. Site 16. Gatberg River at Danville Vlei.

Plate 37. Site 46. Dam on Gatberg River, at Chantry. Note shallow water with sedges.

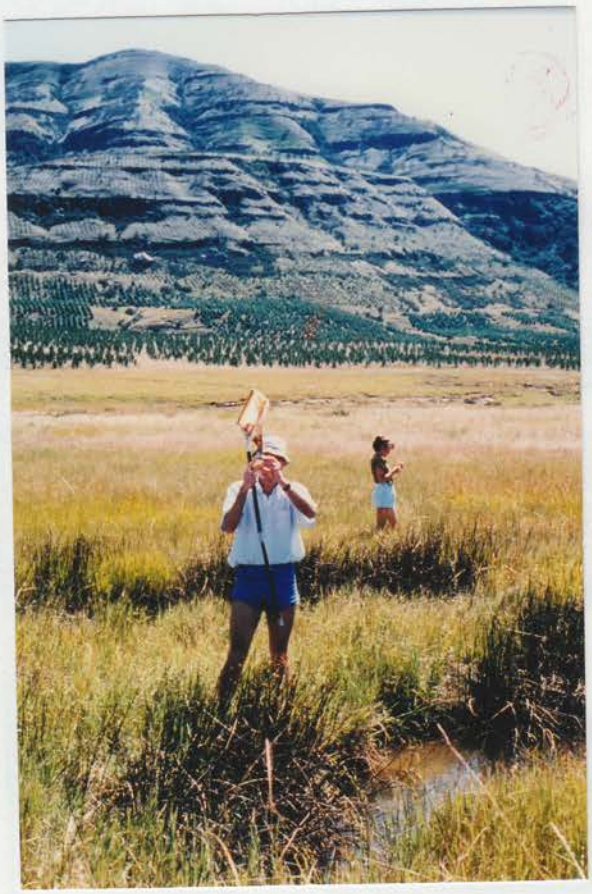

Plate 38. Site 37. Gatberg River at Chantry. Note plantation of young pines in background.

Plate 39. Site 17. Gatberg River at Greendale. Water turbid, forming shallow run over silt and clay with scattered cobbles and boulders.

Plate 40. Site 25. Tributary of Gatberg River at Madun. River forming pools, with dense *Cyperus* and grasses along margins.

Plate 41. Site 47. Marshy area below dam on KuNtwanazana River, at Ronan, with sedges along margins.

Plate 42. Site 29. Tributary of Nqancule River at Two Streams. Banks eroded and stream heavily silted.

Plate 43. Site 31. Nqancule River at Albany, near road bridge.

Plate 44. Site 30. Nqancule River at Waterfall. Substrate of bedrock, overlain with silt.

Plate 45. Site 30. Nqancule River at Waterfall. Bedrock and shallow grassy banks.

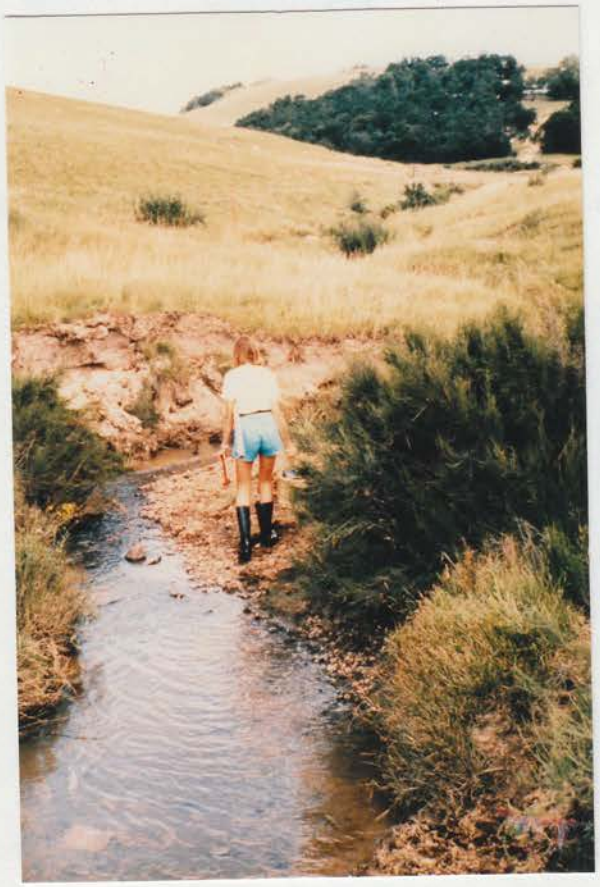

Plate 46. Site 28. KuDidwayo River at Marinus. Banks eroded, river bed of clay, mud and some pebbles and stones in slow current.

Plate 47. Site 26. Ntsuba River at Borva. Small inaccessible stream surrounded by rocky outcrop.

Plate 48. Site 27. Xuka River at Rondavel. A disturbed site, stream hardly flowing, very silted. Banks heavily invaded with exotic *Acacia*.

Plate 49. Site 18. Tributary of Kukowa River. Lower site near road disturbed and hardly flowing.

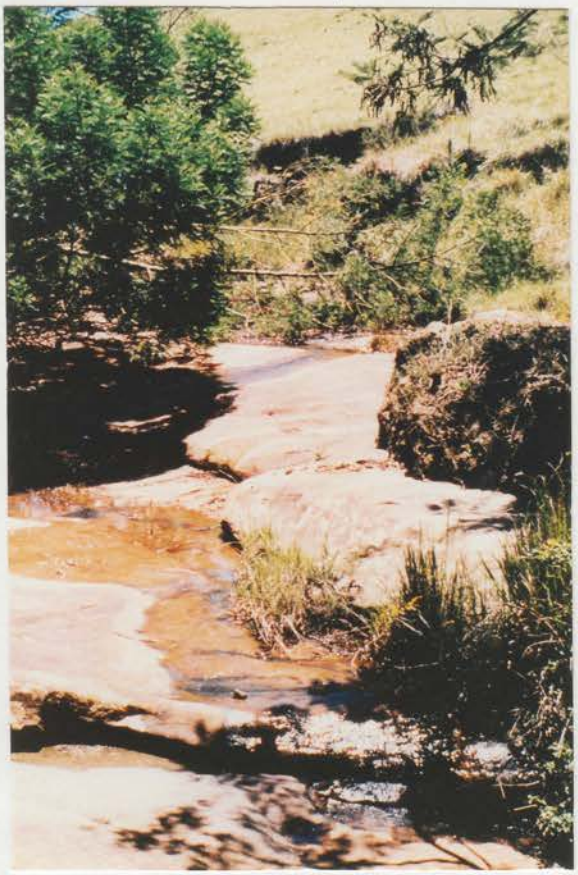

Plate 50. Site 18. Tributary of Kukowa River, upstream of last site. Clean water flowing over bedrock. Several organisms associated with temporary streams were collected at this site.