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Hydrobiological Studies on the Tugela River System
Part IV
The Mooi River

by

W. D. OLIFF, M. Sc.

&

J. L. KING, B. Sc.

(National Inst. for Water Res., South African Council for Scient. and Ind. Res., Pretoria)

(with 4 figs.)

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I. Introduction

The hydrobiological surveys of the tributaries in the Tugela river basin continued, in 1961, with work on the Mooi river, the fourth largest tributary, comprising the southern and south-western margin of the basin. The work was designed as a comparative study against the background of three previous surveys, viz. those of the Tugela river itself (Part I), and its tributaries, the Bushmans (Part II) and the Buffalo (Part III) rivers respectively. The whole series was undertaken by the National Institute for Water Research of the South African Council for Scientific and Industrial Research, for the Town and Regional Planning Commision of the Natal Provincial Administration.

II. Description of the basin

a. General

Figure 1 is a map showing the sampling stations on the Mooi river. the main features of the topography, geology, rainfall and vegetation in the basin have been described in Part I of the series. For easy reference, maps of the main physical characteristics are given in Figure 2 (a)—(d), which are reproduced by kind permission of the Town and Regional Planning Commission.

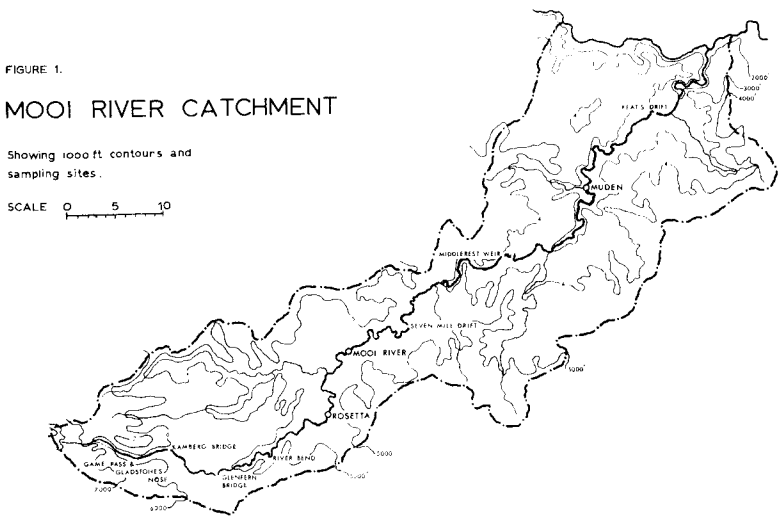
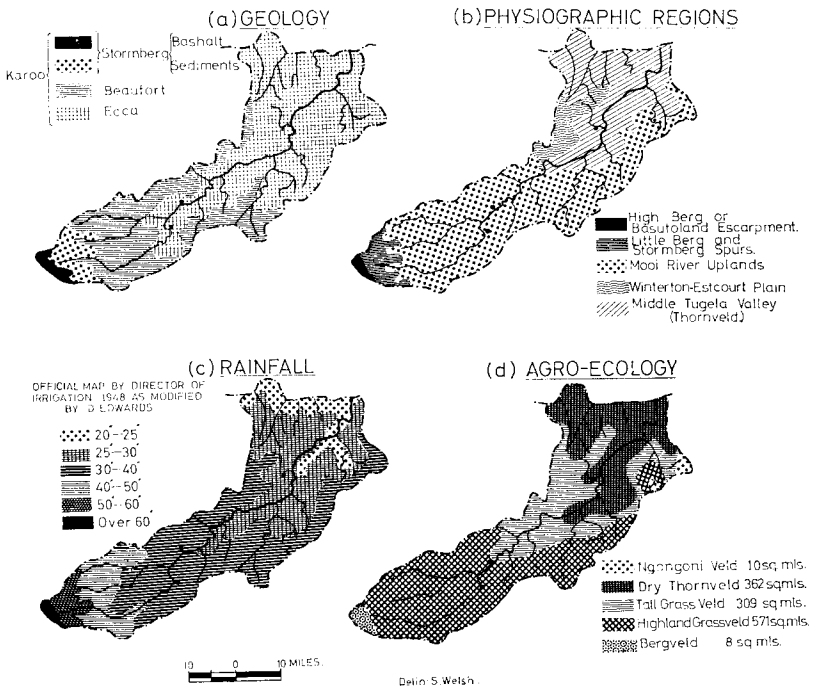


FIG 2

MOOI RIVER CATCHMENT (AREA 1260 sq mls)
PRINCIPLE CHARACTERISTICS

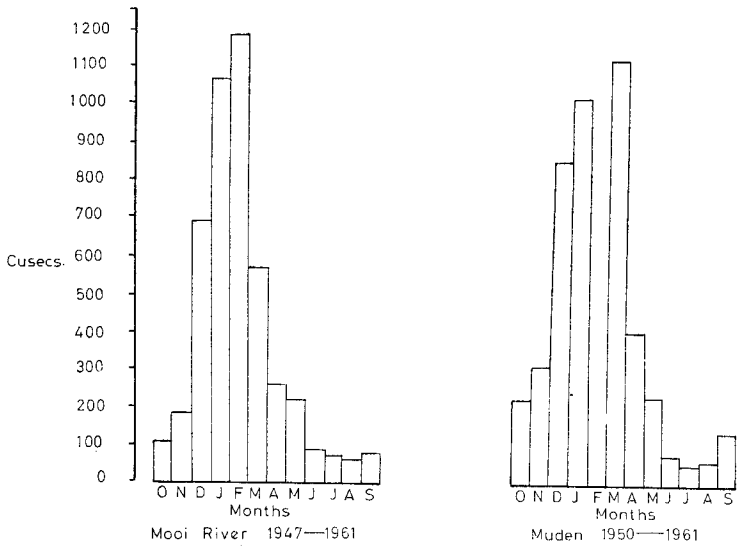


b. Flows

Average flows for the only completely gauged stations on the river, those at Mooi river pump station and Muden have been plotted in Figure 3. The data are available for the last fourteen years and the averages do not yet form a reliable gauge of the variations in river flow. In particular the averages for the months of September and October have been unduly influenced by high and unusual floods in September and October 1957. Maximum flows occur in Summer (January and February).

c. Zonation

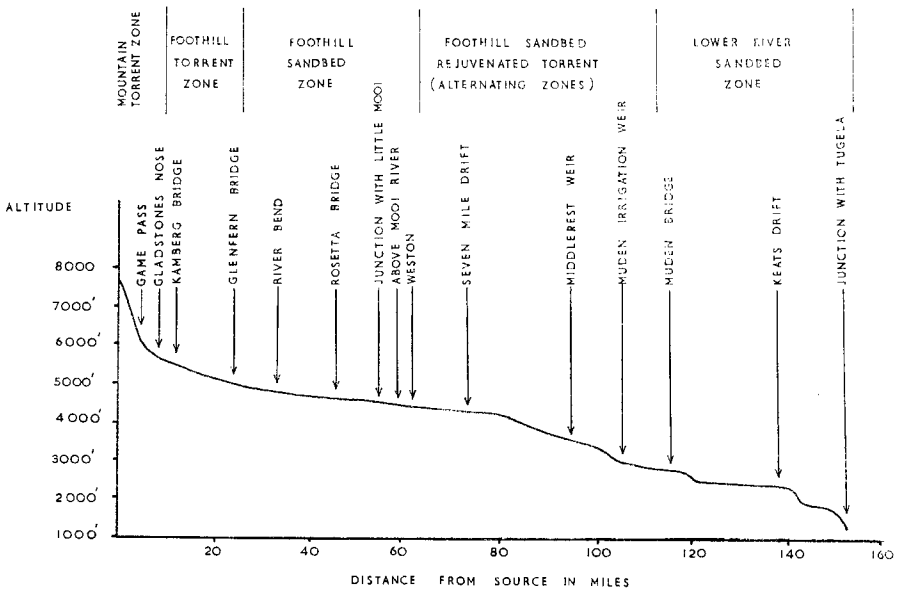
Figure 4 presents a profile diagram of the river. In length the Mooi is one quarter that of the Tugela (OLIFF 1960), and its zonation is similar to that recognised and described for the Tugela, with the zones following the topographical features to a greater or lesser degree.



MONTHLY AVERAGE RATES OF FLOW ON TWO STATIONS ON THE MOOI RIVER

Fig. 3

FIGURE 4. PROFILE DIAGRAM OF THE MOOI RIVER



The two uppermost zones of the Tugela, viz. the source and waterfall zones, however, are lacking in the Mooi as in the Buffalo (vide OLIFF 1962, Part III), and the river rises in a mountain torrent zone at an altitude of 7750 feet. This zone soon grades at Gladstone's Nose into a foothill torrent zone which extends for about nine miles to the Glenfern Bridge.

From Glenfern Bridge to Mooi River township the river flows through a foothill sandbed zone for about eighteen miles. Here the gradient of the river is gentle, and pool-like conditions are found, particularly in the lower reaches where the river begins to meander.

Below Mooi River township the gradient of the river steepens and Foothill sandbed and rejuvenated torrent zones alternate for some twenty seven miles as far as Muden. From Muden the river grades into a lower river Sandbed zone, and finally flows into the Tugela at the very end of a rejuvenated zone.

III. METHODS AND LIMITATIONS

The methods of sampling and analysis were the same as those used in the survey of pollution in the Bushmans river, described in Part II of the series and were subject to the same limitations. Two sets of samples were taken – one set in March to show summer conditions and one set in August showing winter conditions.

IV. CONDITIONS IN THE RIVER

Analyses of water samples taken from the Mooi river during the survey are shown in Table I.

As in the Tugela, the water was alkaline and the concentration of dissolved solids was comparatively low, with a considerable increase downstream largely in calcium and sodium salts. Judged by the 5 day B.O.D. test there was little organic matter except below Mooi River town where pollution occurred.

Below Muden a considerable increase in T.D.S. was observed – in fact the concentration of dissolved solids practically doubled in the five miles below Muden. This was probably due to the seepage of irrigation water back to the river. Some sulphates were present throughout the course of the river. These sulphates are expected in waters flowing over both the Stormberg and Ecca series of rocks which the river traverses.

TABLE 1

ANALYSES OF MOOI RIVER WATER

STATION	pH	Conductivity in micromhos cm	T.D.S. ppm.	B.O.D. ppm.	Nitrate-ppm. N	Phosphate ppm. PO_4	Total Alkalinity ppm. $CaCO_3$	Total Hardness ppm. $CaCO_3$	Ca ppm.	Mg ppm.	Na ppm.	K ppm.	SO_4 ppm.	Cl ppm.	SiO_2 ppm	pH_s	Stability index
MARCH 1961																	
Game Pass Stream	7.3	30	27	0.1	0.01	0.1	22.4	10.8	2.9	0.8	1.7	0.3	3.1	2.0	8.0	9.5	11.7
Kamberg Bridge	7.3	39	26	0.1	0.01	0.1	24.8	15.4	2.6	2.2	1.7	0.3	2.5	1.2	6.7	9.5	11.6
Rosetta Weir	7.2	40	32	0.6	0.01	0.1	26.2	15.8	3.7	1.6	2.5	0.4	4.3	0.4	6.7	9.3	11.4
Above Mooi River	7.1	41	33	0.6	0.01	0.1	26.2	20.0	5.0	1.8	2.8	0.7	8.2	0.9	6.7	9.2	11.3
Below Mooi River	7.1	42	39	0.9	0.01	0.1	23.6	14.0	3.6	2.4	3.0	0.6	5.4	2.0	6.7	9.4	11.7
Seven Mile Drift	7.2	44	35	0.6	0.01	0.1	27.6	14.8	4.0	1.2	3.3	0.7	5.4	0.9	8.0	9.2	11.6
Middlerest	7.4	47	38	0.8	0.01	0.1	30.0	18.2	4.4	1.8	3.1	0.6	3.1	1.3	8.0	9.2	11.0
Muden	7.5	65	50	0.5	0.01	0.1	39.4	24.4	6.0	2.3	4.1	0.7	6.4	2.7	8.0	8.9	10.4
Keates Drift	7.8	98	76	0.6	0.01	0.1	53.8	36.2	9.2	3.2	6.5	1.0	7.8	3.2	9.3	8.6	9.5
AUGUST 1961																	
Game Pass Stream	8.2	46	26	0.3	0.02	0.10	41.4	18.6	5.4	1.3	2.4	0.3	Nil	4.0	12.0	9.0	9.7
Kamberg Bridge	8.1	51	35	0.5	0.01	0.14	35.6	24.6	5.9	2.4	2.3	0.2	Nil	4.5	13.0	9.0	9.9
Rosetta Weir	8.0	59	41	0.7	0.01	0.15	28.2	24.8	6.1	2.3	3.6	0.5	Nil	3.9	11.7	9.1	10.2
Above Mooi River	8.0	59	33	0.7	0.01	0.10	33.8	22.0	5.9	1.7	4.1	0.6	4.3	4.9	10.1	9.1	10.1
Below Mooi River	9.0	86	51	2.3	0.01	0.11	42.4	23.0	6.0	1.9	10.3	0.8	5.4	6.5	8.0	8.9	8.9
Seven Mile Drift	8.0	77	49	0.9	0.01	0.07	40.6	23.0	5.9	2.0	8.0	1.0	5.4	7.0	5.3	9.0	10.0
Middlerest	8.0	109	67	1.4	0.02	0.11	54.8	37.2	8.5	3.9	8.9	1.3	6.5	7.9	8.5	8.7	9.4
Above Muden	8.2	136	75	1.4	0.02	0.10	67.2	50.6	11.2	5.5	9.5	1.1	4.3	8.0	9.1	8.5	8.8
Muden	8.2	218	121	1.1	0.10	0.13	100.0	78.6	16.8	8.3	16.0	1.0	8.2	12.2	11.3	8.2	8.1
Keates Drift	8.6	429	239	1.5	0.16	0.25	199.2	145.4	26.6	19.1	41.3	1.8	12.2	17.9	14.7	7.7	6.8

V. Pollution

The survey revealed some interesting forms of pollution. A feature encountered for the first time was what might be called natural pollution. As mentioned above, the river gradient is gentle in the foothill sandbed zone below Glenfern Bridge, the flow is correspondingly slow, and falling forest leaves, dry grasses and other plant litter accumulate in the river in autumn and rot, leading to conditions of mild pollution. Faunal characteristics indicating these conditions are high numbers of *Nais* sp. (56 %), and *Simulium* spp. larvae (24 %), and a restricted Mayfly fauna (3 species only). Such conditions are mentioned by Hynes (1960) as occurring in Scotland and it is of interest to find them occurring in Natal.

Below the township of Mooi River effluents from town drains and a milk and a meat processing factory resulted in a considerable increase in the level of the 5 day B.O.D. in the dry season when the river was low. The fauna was made up of large numbers of *Nais* sp. (86 %) and Chironomidae, features indicative of maintained organic pollution (cf.Bushmans river results).

The fauna at Seven Mile Drift, about 7 miles below the township, was nearer normal, though a considerable algal and diatom growth and a rather high percentage of Elmidae which are algal browsers, indicated that the environment was probably still somewhat enriched.

There was a considerable growth of diatoms and algae, *Spirogyra* spp. and some increase in the numbers of Chironomidae below the irrigation settlement of Muden. These conditions, indicative of enrichment, may have arisen in three ways. Firstly, from enrichment with salts leached from the irrigated lands, for surplus water is often returned to the river from the lands. Secondly, the diminished water in the river in winter is used for watering quite large numbers of stock, and is also used for domestic purposes by the natives in the reserves, and this use may lead to some enrichment. Thirdly, nutrients probably also come at least partly from ground water in the lower part of the valley, for the concentration of solids in the water in the lower in the river rises sharply in the dry season as the river flow drops (vide Oliff 1960). Nitrates have been detected in crystals deposited on the river banks from seepage which has dried up.

VI. The fauna

a. General

Collections were made with the same fine meshed net as was used in the Bushmans and Buffalo river surveys. The collections were made

TABLE 2a

PERCENTAGE COMPOSITION OF ANIMALS CONSTITUTING OVER 5% OF POPULATION

STONES IN CURRENT AUGUST COLLECTION	Oats Pass Cataract	Game Pass below Cataract	Gladstone's Nose	Kamberg Bridge	Glenfern Bridge	River Bend	Rosetta Weir	Above Mooi River	Below Mooi River Weston	Seven Mile Drift	Middlerest Weir	Above Muden	Mooi at Muden	Keate's Drift
Nais sp.	-	5	2	-	1	56	21	4	86	52	-	-	-	-
Chydorus sphaericus (Müller)	-	-	-	-	-	-	-	79	-	-	-	-	-	-
Baetis harrisoni Brnrd.	-	3	52	3	26	9	2	1	1	6	9	42	57	2
B. glaucus var 3 Brnrd.	-	-	-	-	-	-	-	-	-	-	-	16	8	12
Acentrella monticola Crass.	-	11	16	-	13	-	-	-	-	-	-	-	-	-
Centroptilum sudafricanum Lest.	-	41	5	59	10	-	-	1	-	-	-	-	-	-
Centroptilum excisum Brnrd.	-	-	-	-	-	-	-	-	-	2	5	-	-	-
Neurocaenis discolor (Brnrd.)	-	11	2	5	33	-	-	-	-	-	-	-	-	-
Euthraulus elegans Brnrd.	-	-	-	1	3	-	-	-	-	-	-	-	-	10
Cheumatopsyche afra (Mosely)	-	1	-	5	-	-	-	-	-	-	-	-	-	-
Cheumatopsyche thomasseti (Ulmer)	-	-	1	3	-	-	-	-	-	-	1	12	5	8
Hydroptila capensis (Barnard)	-	-	-	1	-	-	-	-	-	-	-	-	-	9
Scirtes sp.?	-	-	1	5	-	-	-	-	-	-	-	-	-	-
Simulium larvae	-	8	11	-	-	24	58	7	1	17	73	-	13	2
Chironomidae							10							
Orthocladinae sp.3	-	-	-	-	-	-	-	1	2	3	-	3	-	11
Rheotanytarsus sp.1	-	2	3	-	-	1	-	1	-	-	2	-	3	11
Chironominae sp.	-	-	-	-	-	-	-	-	-	3	-	3	-	11
Ceratopogonidae sp.1	-	-	-	-	-	-	-	-	-	-	-	-	-	11

once in March at the end of the wet season and again in August late in the dry season when the river was low.

b. The Biology

Tables 2 (a) and (b), 3 (a) and (b), and 4 (a) and (b), list the animals constituting over 5 % of the total population. This level was used in conformity with previous work. Tables 5 (a) and (b) show the percentage composition and the number of species in each collection.

TABLE 2b

PERCENTAGE COMPOSITION OF ANIMALS COMPOSING OVER 5% OF POPULATION

STONES IN CURRENT MARCH COLLECTION	Game Pass Cataract	Game Pass below Cataract	Gladstone's Nose	Kamberg Bridge	Glenfern Bridge	River Bend	Rosetta Weir	Above Mooi River	Below Mooi River Weston	Seven Mile Drift	Hillcrest Weir	Mooi at Muden	Keate's Drift
Planariidae	-	-	2	-	-	6	2	13	1	5	-	-	-
Nais sp.a	18	7	-	1	-	-	2	1	8	-	-	-	-
Neoperla spio.(Neuman)	3	1	11	2	-	-	-	-	-	3	1	1	-
Pseudocloeon inzingae Crass.	-	-	-	-	-	-	4	3	7	16	-	3	-
Baetis harrisoni Brnrd.	2	10	21	14	15	29	3	-	6	-	3	1	1
B. glaucus var 3 Crass.										3	24	54	34
B. latus Agnew	-	-	-	-	-	-	-	9	-	-	-	-	-
Acentrella monticola Crass.	17	3	-	1	4	-	-	-	-	-	-	-	-
Centroptilum sudafricanum Lest.	7	11	9	3	5	-	-	-	1	-	-	-	-
C. indusii Crass.	-	-	-	-	-	-	-	4	-	1	49	3	-
C. medium Crass.	-	-	-	-	-	-	-	-	-	-	8	-	-
Caenis sp.2	-	-	6	6	-	1	-	-	-	-	-	2	-
Caenis sp.3	-	7	-	-	-	-	-	-	-	3	-	3	3
Neurocaenis discolor (Brnrd.)	7	12	11	11	26	21	1	-	1	-	1	6	18
Adenophlebia auriculata Eaton	1	4	8	2	-	-	-	-	-	-	-	-	-
Castonophlebia calida Brnrd.	13	9	-	-	-	-	-	-	-	-	-	-	-
Euthraulus elegans Brnrd.	-	-	7	17	6	-	2	9	1	19	1	8	7
Afronurus harrisoni Brnrd.	9	4	1	4	-	-	-	-	-	-	-	-	-
Afronurus sp.2	-	-	-	-	3	-	-	6	-	8	-	3	-
Cheumatopsyche thomasseti (Ulmer)	-	-	4	3	5	1	2	-	6	3	1	10	10
Dryopidae larvae sp.1	-	-	-	-	7	-	2	3	-	-	-	-	-
Elmidae sp.1	-	-	1	-	-	-	-	-	-	6	-	1	-
Elmidae sp.8	-	-	-	1	3	2	-	5	-	16	-	1	1
Elmidae sp.17	-	-	-	-	1	-	-	5	-	-	-	-	-
Simulium larvae	-	-	1	8	1	6	19	-	-	-	-	1	13
Orthocladinae sp.3	-	-	-	1	-	2	32	14	14	-	-	-	1
Orthocladinae sp.5	-	5	-	1	1	-	6	-	-	-	-	1	-
Tanytarsus sp.1	-	1	-	-	-	-	-	-	6	-	-	-	-
Chironominae sp.1	-	-	2	1	-	1	-	-	5	-	2	-	-
Chironominae sp.2	-	1	1	4	-	-	8	2	4	-	-	1	2
Hydracarina spp.	-	-	1	-	1	12	4	-	8	2	-	-	-
Burmupia ponsonbyi Walker	-	-	-	-	-	-	-	-	-	13	-	-	-

The distribution, composition, and zonation of the fauna of the Mooi was very similar to that of the Tugela. Mayflies formed over 50 % of the total population, Caddis-flies were present in low numbers, and Simulium larvae and Chironomids formed approximately 1—30 % of the total population, except at stations where pollution occurred. In the stones in current there was an increase in the number of species found during the dry season, and the reverse was true in the marginal vegetation.

The effects of pollution, which was largely organic, upon the river fauna were remarkably similar to those described in the study of the Bushmans river (1960) and require no further comment.

TABLE 3a

PERCENTAGE COMPOSITION OF ANIMALS CONSTITUTING 5% OR OVER OF TOTAL POPULATION

MARGINAL VEGETATION AUGUST COLLECTION 1961	Gladstone's Nose Camp	Kamberg Bridge	[illegible] Bridge	River Bend	Rosetta	Mooi River Weir above Town	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nais sp.	–	–	2	10	–	–	–	–	1	–	9
Simocephalus vetuloides (Sars)	–	–	–	–	–	12	–	–	–	–	–
Alona rectangula	–	–	–	–	–	6	–	–	–	–	–
Chydorus sphaericus (O.F.M.)	–	–	–	–	–	24	93	4	–	–	–
Macrocyclops albidus (Jurine)	–	–	–	13	10	–	–	1	–	–	–
Tropocyclops confinis Kieffer	–	5	–	13	10	7	–	–	–	11	–
Eucyclops euacanthus (Sars)	9	5	–	13	–	–	–	–	–	–	–
E. hadjebenis	–	–	–	13	–	–	–	–	–	–	–
Paracyclops finitinius cf. Kieffer	–	–	–	–	–	–	–	–	9	–	2
Microcyclops varicans Sars	–	–	–	–	–	7	–	–	–	–	–
Cypridopsis hirsuta Sars	–	–	–	–	1	–	3	1	11	–	–
Stenocypris sp.1	–	9	–	–	–	–	–	1	10	–	–
Collembola	6	–	–	–	–	–	–	–	–	–	–
Austrocloeon africanum Barnard	17	–	–	–	3	–	–	–	–	–	–
Pseudocloeon vinosum Barnard	39	42	39	–	3	13	–	18	7	2	–
Baetis latus Agnew	–	–	–	3	–	–	–	–	15	16	18
Centroptilum sudafricanum Lest.	–	9	31	–	–	–	–	2	2	–	–
C. excisum Barnard	–	–	–	–	2	1	–	8	15	–	–
Centroptilum sp.2	–	–	–	–	–	–	–	–	–	–	26
Caenis sp.2	–	–	–	–	–	–	–	21	9	–	1
Caenis sp.3	7	–	–	–	–	1	–	–	–	1	–
Velidae	5	–	–	–	–	–	–	–	–	–	–
Micronecta piccanin Hutch	–	–	–	–	14	3	–	–	–	–	–
Hydroptila capensis (Barnard)	–	–	–	–	–	–	–	–	1	21	–
Culex sp.	–	–	–	–	–	–	–	–	–	6	–
Chironomidae spp.	–	–	–	–	–	–	–	5	–	6	–
Pentaneura sp.	–	11	–	–	–	–	–	6	–	3	4
Corynoneura sp.	1	2	2	27	3	2	–	7	2	3	2
Orthocladinae spp.	–	11	4	2	21	–	5	–	–	–	–
Tanytarsus sp.1	–	–	–	–	–	2	–	5	11	–	–
Rheotanytarsus sp.1	–	–	–	–	–	–	–	5	–	–	–
Tanytarsus sp.5	–	–	–	–	–	–	–	–	–	6	–
Chironominae spp.	–	–	4	–	–	–	–	–	–	12	–
Lymnaea natalensis Krauss	–	–	–	–	25	–	–	–	–	–	–

Perhaps the greatest individual feature about the fauna of the Mooi, in contrast to other rivers examined in the basin, is the comparative richness of the Entomostraca and Chironomidae in the marginal vegetation, particularly in the dry season. This arises naturally both from the nature of the slow flowing, rather lentic Foothill Sandbed zone above Mooi River, and from the natural enrichment of the river in this region. Such conditions have previously been described by HARRISON (1958) in the Berg, and Allanson in the Juskei rivers (1961).

One other important feature was the almost complete absence of the mayfly *Neurocaenis discolor*, between Rosetta and Middlerest. The significance of this is not understood. HARRISON (1958) noted that *Neurocaenis* was not abundant in silted parts of the Great Berg river, and silt may restrict the distribution of the species above Mooi River township, but the river below Mooi River contains many rapids and reaches with comparatively swift flows, and such conditions should support the species, which is not greatly sensitive to pollution, (vide Bushmans river, OLIFF 1960).

TABLE 3b

PERCENTAGE COMPOSITION OF ANIMALS CONSTITUTING 5% OR OVER OF TOTAL POPULATION

MARGINAL VEGETATION MARCH COLLECTION	Gladstones Nose	Kamberg Bridge	Glenfern Bridge	River Bend	Rosetta Weir	Above Mooi River	Below Mooi River	Seven Mile Drift	Middlerest Weir	Mooi at Baden	Keate's Drift
Microcyclops varicans Sars	-	-	-	-	2	-	12	-	-	-	-
Pseudocloeon vinosum Barnard	2	47	7	-	-	46	-	36	-	4	27
Baetis bellus Barnard	3	3	52	31	31	5	49	11	50	49	57
B. latus Agnew	19	3	-	-	-	-	-	33	-	19	-
B. glaucus Agnew	-	-	-	-	-	-	-	-	-	10	-
Centroptilum sudafricanum Lest.	24	9	2	-	-	-	-	-	-	-	-
C. excisum Barnard	-	-	-	-	-	5	-	-	-	-	-
C. indusii Crass	-	-	-	-	-	-	-	11	-	-	-
Caenis juveniles	8	-	6	-	-	-	-	6	-	-	-
Caenis sp.3	-	5	-	-	-	2	-	-	4	-	-
Mesovelia sp.	35	1	-	42	18	4	-	-	25	-	-
M. piccanin Hutch	-	-	-	-	-	32	6	-	12	-	-
Corynoneura sp.4	-	5	-	-	-	-	-	-	2	3	-
Chironominae sp.2	-	-	6	18	24	-	10	-	-	7	-
Hydracarina spp.	-	1	6	-	-	-	-	-	1	-	-

TABLE 4a

PERCENTAGE COMPOSITION OF ANIMALS CONSTITUTING 5% OR OVER OF THE TOTAL POPULATION

Bottom sediments August collection	Kamberg Bridge	Mooi River Weir above town	Middlerest Weir	Keates Drift
Tubifex sp.	1	-	5	-
Branchiura sowerbyi Bedd.	-	1	5	-
Limnodrilus sp.	70	-	-	-
Chydorus sphericus (O.F.M.)	-	8	-	-
Eucyclops euacantus (Sars)	1	11	-	-
Paracyclops poppei (Rehberg)	-	11	4	-
Cypris sp.	-	52	-	42
Cypridopsis gregaria (Sars)	-	-	8	-
C. hirsuta Sars	-	-	-	42
Cypretta sp.	-	-	9	-
Baetis harrisoni Brnrd.	-	-	9	-
Centroptilum excisum Brnrd.	2	-	10	-
Caenis sp. nov.	8	-	-	-
Caenis sp.3	-	2	12	-
Procladius spl.	-	2	9	-
Tanytarsus sp.1	4	-	8	-
Chironominae sp.4	4	-	8	5

VII. Discussion

The study of the Mooi river has served to confirm the general uniformity of the hydrobiology of the tributaries of the basin. The distinctive features which the river possesses arise from peculiarities inherent in the nature of the catchment and the gradient of the river.

The faunae of the stony-rapids in the rivers in the basin which are the most diverse of all, and which are the most sensitive to changes in river physiography, and those resulting from pollution, show a pattern of many species restricted to the head waters, and a few more widely distributed species in the middle and lower reaches of the rivers. It has been suggested previously (Oliff 1960), that temperature is possibly the most important factor controlling the distribution of species, but it is recognised that other factors such as the quantity

TABLE 4b

PERCENTAGE COMPOSITION OF ANIMALS CONSTITUTING 5% OR OVER OF THE TOTAL POPULATION

Bottom sediments March collection	Kamberg Bridge	Rosetta Bridge	Above Mooi River	Below Mooi River	Mooi at Muden *	Keates Drift
Nematoda	3	44	-	46	-	-
Tubifex sp.1	19	-	-	1	-	-
Limnodrilus sp.1	12	15	-	1		-
Branchiura sowerbyi Bedd.	-	8	-	3	40	-
Macrocyclops sp.	-	8	-	-	-	-
Cyprid juvenile	-	8	-	-	-	-
Cypridopsis sp.	-	-	-	20	-	-
Baetis harrisoni	-	-	6	-	-	-
Centroptilum excisum Brnrd.	-	-	14	-	-	-
Caenis sp.3	6	-	19	2	-	-
Micronecta piccanin Hutch	-	9	23	7	-	-
Procladius sp.	7	8	2	2	-	-
Tanytarsus sp.1	6	-	-	-	-	-
Rheotanytarsus sp.6	20	-	6	-	-	-
Chironominae sp.1	-	-	-	1	60	-
Chironominae sp.4	-	-	18	1	-	100
Ceratopogonid sp.1	23	-	-	1	-	-

* not quantitative

of silt, changes in current speed, and changes in the nature of the substratum, all play a part. High current speeds, low temperatures and a substratum of large stones etc., usually occur in the same places, at the heads of streams, usually at high altitudes. In support of the importance of temperature, it has been found that torrential parts of well forested, coastal streams, where water temperatures are as low as those in the head waters of the Tugela river, contain many typically head water species (SCHOONBEE, unpublished data, OLIFF, unpublished data).

Thus, wherever low temperatures and torrential conditions occur with little silt, at least some species of the torrential zones will be found, and wherever temperatures are high and silt considerable, mid- and lower-rivers species will be found. The question of tracing

TABLE 5a SHOWING NUMBER OF SPECIES AND PERCENTAGE COMPOSITION (IN BRACKETS) IN EACH COLLECTION

SPECIES IN CURRENT

Collections	Game Pass Cataract 1*	Below Game Pass Cataract 1*	Below Game Pass Cataract 2*	Gladstone's Nose 1	Gladstone's Nose 2	Kamberg Bridge 1	Kamberg Bridge 2	Glenfern Bridge 1	Glenfern Bridge 2	River Bend 1	River Bend 2	Rosetta Weir 1	Rosetta Weir 2	Above Kooi River 1*	Above Kooi River 2	Below Kooi River 1	Below Kooi River 2	Seven Mile Drift 1	Seven Mile Drift 2	Middlerest Weir 1*	Middlerest Weir 2	Above Ladeln 2	Ladeln 1	Ladeln 2	Keate's Drift 1	Keate's Drift 2
Platyhelminthes	1		2	1 (2)	2	1		1	1 (1)	1 (6)	1 (1)	1 (1)	1 (1)	1 (13)	1	1 (1)	1	1 (5)	1 (1)		1	1				
Nematoda	1	1 (1)				1 (1)		1 (1)			1		1	1	1		1	1 (1)	1				1 (1)		1 (1)
Oligochaeta	1 (18)	2 (7)	2 (5)	1	1 (2)	3 (1)		1	2 (1)	1	2 (56)	1	6 (21)	1 (1)	1 (4)	2 (8)	2 (88)	1	1 (52)	2	1				1 (1)	3 (1)	2	1
Crustacea	1	2	1 (2)		1	1 (1)		1		2	1	1	2 (5)	6 (6)	4 (79)				5		2	1	1			1 (2)
Plecoptera	2 (3)	2 (3)	1 (1)	2 (13)	1	1 (2)	1 (3)											1 (3)		1 (1)	1				1 (2)	1 (2)
Ephemeroptera	10 (58)	9 (66)	9 (66)	7 (63)	10 (75)	14 (59)	12 (70)	7 (57)	10 (87)	7 (54)	8 (9)	13 (15)	8 (2)	9 (31)	8 (1)	13 (18)	2 (1)	10 (57)	7 (9)	11 (91)	4 (15)	4 (60)	11 (84)	6 (66)	10 (68)	8 (27)
Odonata				1		2										1			1		2	2	1	1	2 (2)	1
Hemiptera																		1 (1)	1				1			
Trichoptera	3 (5)	4 (3)	4 (1)	3 (6)	6 (1)	5 (6)	7 (11)	7 (10)	7 (1)	1 (3)	2	1 (2)	1	4 (5)	2	4 (9)	1	4 (3)	6	1	4 (1)	1 (12)	1 (10)	4 (5)	1 (10)	4 (17)
Coleoptera	7 (10)	6 (5)	5 (2)	7 (8)	4 (1)	10 (4)	10 (13)	12 (18)	7 (8)	13 (12)	9 (2)	6 (6)	9	10 (17)	11 (1)	8 (1)	5	11 (29)	8 (7)	2 (7)	7	2	5 (3)	6 (1)	6 (1)	4 (2)
Tendipedidae	2 (3)	6 (13)	5 (9)	3 (3)	4 (9)	10 (14)		3 (2)		8 (4)	4 (4)	5 (50)	2 (10)	7 (19)	7 (5)	12 (37)	3 (6)	3 (1)	5 (11)	6 (7)	6 (10)	8 (21)	4 (3)	3 (9)	6 (4)	4 (35)
Other Diptera	4	4	4 (8)	2 (2)	4 (11)	5 (9)		3 (1)		1 (6)	6 (24)	1 (19)	7 (58)	1 (1)	10 (7)	2	2 (1)	1	7 (17)	1	8 (74)		1 (1)	9 (14)	2 (13)	5 (1)
Hydracarina	1		1	1 (1)	1			1 (1)	1 (1)	1 (12)	1 (2)	1 (4)	1			1 (8)	1 (1)	1 (2)	1		1			1 (1)		
Mollusca	1 (1					1		2		1	1		1	1	2	2 (14)	1 (1)		1							
TOTAL NO. OF SPECIES	34	34	31	28	31	54	30	39	28	37	28	30	29	41	43	42	18	35	43	23	39	22	26	35	23	30
TOTAL NO. OF ANIMALS	507	633	1464	480	3467	1272	2119	1774	2576	801	1879	318	15141	233	23524	1194	45642	306	11342	486	9173	649	552	2652	516	3088
INCREASE IN AUG.		2 x		7 x		1.5 x		1.5 x		2 x		47 x		100 x		38 x		37 x					48 x		6 x	

* not quantitative
1 = March collection
2 = August collection

TABLE 5b SHOWING NUMBER OF SPECIES AND PERCENTAGE COMPOSITION (IN BRACKETS) IN EACH COLLECTION

MARGINAL VEGETATION

Collection	Game Pass Cata-ract 1	Below Game Pass Cataract 1	2	Gladstone's Nose 1	2	Kamberg Bridge 1	2	Glenfern Bridge 1	2	River Bend 1	2	Rosetta Weir 1	2	Above Mooi River 1	2	Below Mooi River 1	2	Seven Mile Drift 1	2	Middlerest Weir 1	2	Above Muden 2	Muden 1	2	Kente's Drift 1	2
Platyhelminthes						1						1	1	1	1 (4)		1		1 (1)					1		
Nematoda				1	1 (1)		1	1 (1)		1	1	1			1 (2)		1 (1)		1 (1)		1 (1)		1 (1)			
Annelida						1	1 (2)		1 (2)		1 (10)	1 (2)				1	2 (1)		1 (2)		1 (1)			1	1 (3)	1 (2)
Crustacea				1 (1)	1 (9)		3 (19)		1	1	9 (52)	6 (8)	4 (22)		6 (56)	4 (18)	6 (39)		8 (10)		3 (30)		2 (2)	1 (11)	1 (3)	3 (10)
Plecoptera						2 (1)																				
Ephemeroptera				7 (57)	4 (63)	11(75)	4 (52)	6 (69)	5 (70)	5 (32)	2 (3)	3 (32)	4 (8)	5 (59)	4 (15)	1 (49)	2	6 (97)	6 (48)	2 (54)	7 (52)		6 (84)	7 (85)	4 (87)	7 (45)
Odonata					1			1 (2)			1	2	1			1 (1)	1	1	1		2			2 (3)		1
Hemiptera				2 (35)	1 (5)	3 (1)	1	1 (3)		2 (42)	2	8 (18)	3 (16)	4 (36)	2 (3)	6 (9)	1	3	1	3 (12)					1 (1)	1
Trichoptera				2	1	2	2 (1)	2 (1)	3 (1)	1	1	3	1 (2)	1	1 (1)	2 (1)	2	1	2 (1)					3 (1)		1 (21)
Coleoptera				1	1	3	1	1 (1)	2	2	6 (1)	3 (3)	2		6 (1)	3 (1)	2	3	6 (1)	1 (1)	3			8 (1)		
Tendipelidae				2 (3)	5 (13)	7 (13)	4 (24)	5 (10)	6 (20)	3 (21)	3 (29)	5 (31)	2 (24)	3 (5)	5 (10)	7 (15)	1	3 (2)	6 (33)	3 (7)	2 (13)		2 (10)	7 (36)	2 (6)	5 (12)
Other Diptera				1	2	3 (6)	2 (2)	4 (7)	3 (2)	3 (3)	3	1	1	1	2 (1)	1 (1)			2 (1)	1 (1)	3 (2)			4 (12)		2 (1)
Hydracarina						1 (1)		1 (6)	1		1		1		1 (1)				1 (1)	1						
Gastropoda						1 (1)			1 (2)		1	2	2 (25)		2 (3)	1 (1)	5	1	1 (1)	1	1			2 (4)		
TOTAL NO. OF SPECIES				17	17	34	19	22	26	17	31	33	21	15	30	26	24	18	36	12	23		9	37	9	20
TOTAL NO. OF ANIMALS				496	363	573	587	288	512	506	6519	490	306		597	827	179194	679	2172	161	1052		69	638	398	854
INCREASE IN AUG.							2 x			13 x		3.5 x				217 x		1x		6.5 x			9 x		2 x	

which factors limit the distribution of any species is properly one for the physiological laboratory and cannot easily be solved from field studies where there is no control of the many variables.

The features of pollution in the Mooi river on analysis are not much different from those observed in detail elsewhere in the basin and serve only to confirm the general applicability of results gathered to date. The basic nature of the rivers in the catchment and the effects of pollution on the conditions in the rivers are now known and documented for future reference.

The findings of studies in polluted places have been completely in line with other workers and nothing can be added to the excellent statements of HAWKES in KLEIN (1957), and HYNES (1960), except to record as others have done (HARRISON 1958, ALLANSON 1961), that pollution has basically much the same effects in S.A. as it does elsewhere.

It is now generally accepted that the pollution community is the only reliable indicator in assessing pollution, and this is clearly true. Nevertheless, experience shows that few observers ever have difficulty in recognising major pollution from a few simple 'indicator' features. A massive growth of 'sewage fungus' type of algae, and the presence of tubificids is safely indicative of gross organic pollution without further detailed analysis. The presence of masses of Naididae and Chironomidae indicates considerable sustained organic pollution. A considerable growth of filamentous algae, especially *Spirogyra* sp., and diatoms with an otherwise normal fauna on the other hand, is indicative of nutritive pollution, i.e. the addition of plant nutrients including phosphates and nitrates to the water from some source or other. The total absence of life, algal and animal, is just as clearly indicative of pollution with toxic material.

However, when dealing with lesser grades of pollution, and with what HYNES has called problems of subtle pollution, full community analysis provides the only complete answer. Small shifts in the dominance of certain species, e.g. increases in the numbers of Simuliidae and Chironomidae with slight organic enrichment, then provide clues to the nature and source of the polluting material, and also become parameters for assessing the combined effects of pollutants on the environment as a whole.

Experience in the survey work in the whole Tugela river catchment thus has served to confirm the usefulness, and even more the necessity, firstly of having a reliable background of information on conditions in the water, both chemical and biological, and secondly the necessity of collecting detailed information on the flora and fauna of the riverine community wherever an attempt is made to assess the effects of pollution.

As a river type the Mooi river represents perhaps the best graded river of the Tugela system. It contains reaches with the least gradient in the basin. These regions of slight gradient give the river a slow flowing, almost lentic character in places. Muddy bottom sediments accumulate, and in places a rooted aquatic flora of *Potamogeton* spp. et al., and the alga *Nitella* sp. flourish in the low flow season. Such conditions are ideal for Entomostraca and Chironomidae, and the density of these animals is correspondingly high. Elsewhere, where rejuvenation is proceeding, and rapids and sandbed reaches alternate, the conditions and the fauna are similar to those previously described in the Tugela and Buffalo Rivers.

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