A re-evaluation of the occurrence of freshwater molluscs in the Kruger National Park

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De Kock, K.N. and C.T. Wolmarans. 1998. A re-evaluation of the occurrence of freshwater molluscs in the Kruger National Park. *Koedoe* 41(1): 1–8. Pretoria. ISSN 0075–6458.

Most of the previous records of the freshwater molluscs from the Kruger National Park date back prior to and up to 1966. On account of several droughts between 1966 and 1995 it was decided to do a survey of the freshwater mollusc population in 1995 to evaluate the effect of these droughts. The traditional mollusc intermediate hosts were also screened for trematode parasites to establish whether or not they were infected. No infected molluscs were found. Eight of the 19 species reported up to 1966 were not found during the 1995 survey. Three new mollusc species were collected in 1995. The consequences of the drought are clearly visible when the species diversity found in the dams in the 1995 survey, is compared to what was previously recorded.

Key words: Mollusca, freshwater molluscs, rivers, dams, rainfall, Kruger National Park, South Africa.

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Introduction

The largest diversity of freshwater mollusc species worldwide are usually present in tropical and sub-tropical areas. Many of these species act as intermediate hosts for trematode parasites that often have a detrimental effect on the health of man and animal which act as the final hosts for these parasites. In South Africa this is especially true for the Mpumalanga, Northern and KwaZulu-Natal provinces which represent the tropical and sub-tropical regions of this country. In accordance with this, a large variety of freshwater molluscs of which some act as intermediate hosts for trematode parasites of man and animal was reported by Oberholzer & Van Eeden (1967) for the Kruger National Park, which is mainly located in the Northern Province. The distribution of freshwater molluscs is a dynamic process which is mainly influenced by the availability of suitable water habitats. The most recent records of the diversity of freshwater molluscs present in the Kruger National Park date back to 1966 and are kept as part of the National Snail Collection at the Zoology Department of the Potchefstroom University. Since then, no other freshwater mollusc collections were made in the park. In the period between 1966 and 1995, the park was struck by several droughts, namely those of 1986/87 and 1982/83 — the latter also being the severest, prior to the third drought which occurred in the 1991/92 period (Zambatis & Biggs 1995). This situation prompted the idea to do a survey to evaluate the effect of this drought on the freshwater mollusc population of the park. It is especially the drought of 1991/92 that could have had a negative influence on distribution, species diversity and numbers of molluscs present in the park during the survey discussed in this paper.

Methods and materials

During the recent collection, we have concentrated mainly on permanent water bodies, water bodies fed by boreholes and others, not necessarily permanent but suitable for supporting molluscs. During each survey, all the habitat types were screened for molluscs by using aluminium mollusc scoops. The established intermediate hosts for trematode parasites like *Bulinus globosus* (Morelet, 1866), *Biomphalaria pfeifferi* (Krauss, 1848), *Lymnaea columella* Say, 1817, *L. natalensis* Krauss, 1848, *Bulinus tropicus* (Krauss, 1848) and *Bulinus forskalii* (Ehrenberg, 1831), which act respectively as intermediate hosts for *Schistosoma haematobium*, *S. mansoni*, *Fasciola hepatica*, *F. gigantica*, *Calicophoron microbothrium* and *Gastrodiscus* sp. were screened for parasites in the following way: The representatives of each of the species were placed together in a glass vial filled with filtered habitat water to allow them to shed cercariae. The snails were then removed and the water was filtered through a 0.22 µm millipore filter. The filter was fixed and stored in Todd's fixative (Todd 1986) for electron microscopical investigations. The preparations for this investigation corresponded with that of Wolmarans &Yssel (1988). The removed snails were then fixed in 4 % formalin as was the case with all

Table 1
Mollusc species found in selected rivers prior and up to 1966 and during the 1995 collection

Collection site	Species found prior and up to 1966	Species found during 1995
Olifants River	*Melanoides tuberculata*	
	Spathopsis wahlbergi	
	Corbicula fluminalis	
Sabie River	*Bulinus globosus*	*Bulinus globosus*
	Biomphalaria pfeifferi	*Biomphalaria pfeifferi*
		Lymnaea natalensis
		Lymnaea collumella
		Physa acuta
		Aplexa marmorata
	Gyraulus costulatus	
	Melanoides tuberculata	*Melanoides tuberculata*
		Unio caffer
	Unio sp.	
	Coelathura framesi	
	Corbicula fluminalis	
	Eupera ferruginea	*Eupera ferruginea*
	Pisidium langleyanum	
	Pisidium pirothi	
		Oxyloma patentissima
Nwaswitsontso River	*Bulinus globosus*	*Bulinus globosus*
	Bulinus tropicus	
	Biomphalaria pfeifferi	
	Lymnaea natalensis	
	Ceratophallus natalensis	
	Ferrissia sp.	
	Cleopatra ferruginea	*Cleopatra ferruginea*
	Spathopsis petersi	*Spathopsis petersi*
	Eupera ferruginea	
Mbyamiti River		*Bulinus globosus*
	Spathopsis wahlbergi	*Spathopsis wahlbergi*
	Unio sp.	

the other molluscs that were collected during this survey. The molluscs were identified by the senior author who was also mainly responsible for the identification of the molluscs in the National Snail Collection since 1973. The molluscs were subsequently incorporated into the National Snail Collection.

Habitats without water were screened for mollusc shells. Rainfall records of the monitoring stations nearest to the habitats surveyed, were obtained from researchers of the Kruger National Park and analysed.

Results

The results of this investigation are presented in Tables 1–4. When the species diversity recorded during previous surveys up to and including 1966 is compared to that of the 1995 survey, it is seen that eight species found prior and up to 1966, were not recollected in the 1995 survey. Four of these, namely *Gyraulus costulatus* (Krauss, 1848), *Pisidium langleyanum* Melvill & Ponsonby, 1891, *P. pirothi* Jickeli, 1881 and *Coelatura framesi* (Connolly, 1925) (*Coe. framesi*) were found in the Sabie River (Table 1), while *Ceratophallus natalensis* (Krauss, 1848) (*Cer. natalensis*), a *Ferrissia* species, *Bulinus natalensis* (Küster, 1841) (*Bu. natalensis*) and *Burnupia stenochorias* (Melvill & Ponsonby, 1903) (*Bur. stenochorias*) were respectively present in the Orpen Dam, Leeupan, Nwanetsi waterhole and Pioniers Dam (Table 2). Three species, *Lymnaea columella*, *Physa acuta* (Draparnaud, 1805) and *Aplexa marmorata* (Guilding, 1828) were found during the 1995 collection (all in the Sabie River) but were not found previously (Table 1). A fourth species, namely *Oxyloma patentissima* (Pfeiffer, 1853), which is terrestrial but lives in close association with water, was found in the Sabie River in 1995.

No molluscs were found at the collection sites in the Olifants River in 1995 (Table 1). Three species, namely *Corbicula fluminalis* (Müller, 1774) (*Cor. fluminalis*), *Melanoides tuberculata* (Müller, 1774) and *Spathopsis wahlbergi* (Krauss, 1848) were found in this river before 1966.

With regard to the Sabie River, ten species were found during the 1995 collection, while ten were present prior to and up to the 1966 collections. Species found prior to 1966 but not in 1995, include *Cor. fluminalis*, *G. costulatus*, *P. langleyanum*, *P. pirothi* and *Coe. framesi*. Species collected in 1995 but not found previously, are *L. columella*, *A. marmorata*, *Eupera ferruginea* (Krauss, 1848), *P. acuta* and *L. natalensis*. With regard to the Nwaswitsontso River, nine species were found previously but only three during the 1995 collection (Table 1). From a comparison of the species found in dams prior to and including 1966 and in 1995, it is clear that no molluscs were found in 1995 in the Orpen Dam, Leeupan, Mpanamana Dam and Ngotso Dam (Table 2). Only four species were found in the Nwanetsi waterhole in 1995 while 12 species were found previously. Of the six species found in the Gudzani Dam in 1995 two, namely *U. caffer* and *L. natalensis* were not found previously in this habitat. *Melanoides tuberculata*, *Cor. fluminalis* and *Spathopsis petersi* (Martens, 1860), not previously present in the Pioniers Dam, form part of the six species collected in 1995.

Table 3 shows the mean annual rainfall of all records available, as well as the mean annual rainfall recorded during the 1985–1987, 1988–1990 and the 1991–1994 periods at monitoring stations nearest to the mollusc collection sites (see Fig. 1 for the location of these monitoring stations). The mean rainfall figures recorded for these stations in 1991 and which were in several cases the lowest in history (Zambatis & Biggs 1994) are given separately. According to Zambatis & Biggs (1995) a generally accepted criterion for drought is when an area receives less than 75 % of its mean rainfall. When com-

Table 2
Mollusc species collected in selected dams prior to 1966 and during the 1995 collection

Monitoring station	Dam	Species found before 1966	Species found during 1995
Tshokwane	Orpen dam	*Bulinus globosus* *Bulinus tropicus* *Bulinus forskalii* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Cerathophallus natalensis* *Melanoides tuberculata* *Spathopsis wahlbergi* *Spathopsis petersi*	
Tshokwane	Leeupan	*Bulinus globosus* *Bulinus forskalii* *Ferrissia* sp.	
Crocodile Bridge	Mpanamana Dam	*Bulinus forskalii* *Cleopatra* sp.	
Houtboschrand	Ngotso Dam	*Bulinus globosus* *Bulinus forskalii* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Melanoides tuberculata* *Spathopsis wahlbergi*	
Nwanetsi	Nwanetsi water hole	*Bulinus globosus* *Bulinus natalensis* *Bulinus forskalii* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Burnupia sp.* *Melanoides tuberculata* *Cleopatra bulimoides* *Spathopsis wahlbergi* *Spathopsis petersi* *Corbicula fluminalis* *Eupera ferruginea*	*Biomphalaria pfeifferi* *Melanoides tuberculata* *Spathopsis petersi* *Corbicula fluminalis*
Nwanetsi	Gudzani Dam	*Bulinus globosus* *Bulinus tropicus* *Bulinus forskalii* *Biomphalaria pfeifferi* *Melanoides tuberculata* *Spathopsis petersi* *Corbicula fluminalis* *Eupera ferruginea*	*Bulinus globosus* *Bulinus forskalii* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Spathopsis petersi* *Unio caffer*
Mooiplaas	Pioniers Dam	*Bulinus globosus* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Burnupia stenonchorias* *Burnupia* sp.	*Bulinus globosus* *Biomphalaria pfeifferi* *Lymnaea natalensis* *Melanoides tuberculata* *Spathopsis petersi* *Corbicula fluminalis*

paring the mean rainfall of the 1991–1994 period with the mean rainfall of all records available, it is clear that Punda Maria (61 %), Shingwedzi (72 %), Mooiplaas (62 %), Letaba (64 %), Houtboschrand (72 %), Nwanetzi (73 %) and Pretoriuskop (71 %) received less than 75 % of their mean rainfall. Looking at the molluscs collected in dams nearest to these monitoring stations, varying results were found. No molluscs were present in the Klopperfontein Dam (Punda station), Krapkuil Dam (Shingwedzi station), Shitlhave Dam (Pretoriuskop), and Ngotsi Dam (Houtboschrand station). No previous records exist on the first four collection sites (Table 4). Molluscs were, however, present in Pioniers Dam (Mooiplaas station), the Nwanetzi waterhole, Gudzani Dam (Nwanetzi station) and the Engelhard Dam (Letaba station). No previous records are available on the Engelhard Dam habitat either. No molluscs were found in the Orpen Dam, Leeupan, Mazithi Dam, Silolweni Dam, Manzimahle Dam, Olifantdrinkgat, Kumana Dam, which are all near the Tshokwane monitoring station and which received 77 % of its mean rainfall during the 1991–1994 period. No previous records exist on the latter five habitats (Table 4). No molluscs either were found in the Mpanamana Dam and Gezamtombi Dam, which are near the Crocodile Bridge station and which received 88 % of its mean rainfall during this period (Tables 2 and 4). Satara received 96 % of its mean rainfall, Skukuza 77 % and Lower Sabie 76 %. No molluscs were found in the Nsemani Dam and Nkayapan near Satara or the Vervoer Dam near Skukuza and Mhlanganzane Dam near Lower Sabie.

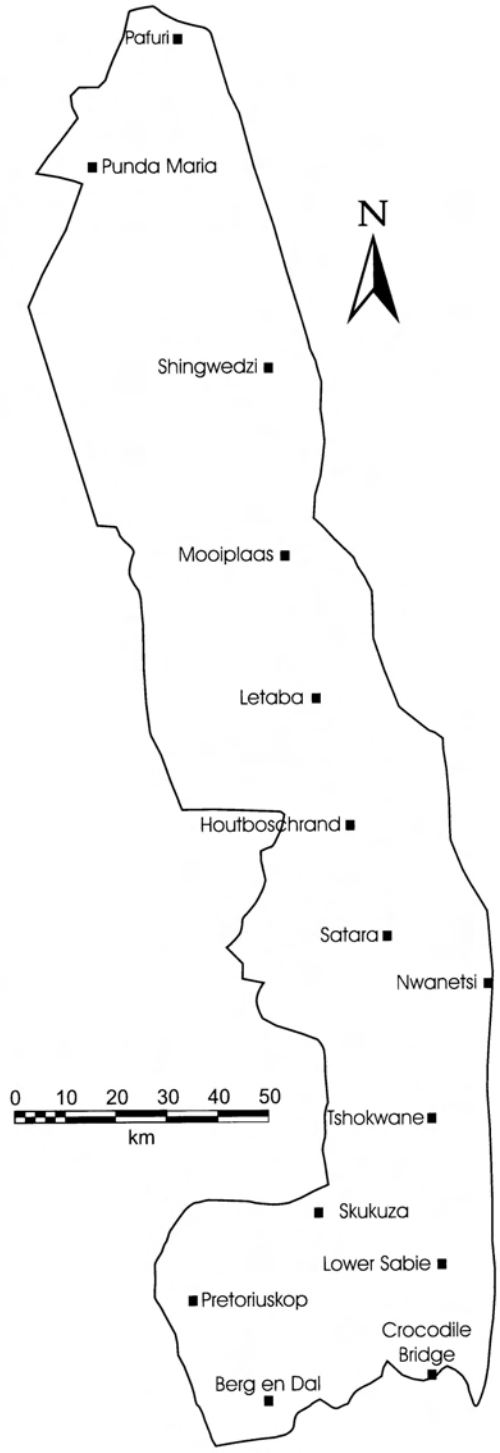

Fig. 1. Rainfall monitoring stations referred to in the text

Table 3

Rainfall records of the Kruger National Park at the different monitoring stations nearest to collection sites over different time periods

Monitoring station	Collection site	Average rainfall of all records available	Average rainfall for 1985–1987	Average rainfall for 1988–1990	Average rainfall for 1991–1994	Total rainfall 1991
		(mm)	(mm)	(mm)	(mm)	(mm)
Pafuri	Pafuri	332	422	356	297	121
Punda Maria	Klopperfontein Dam	528	520	329	327	167
Shingwedzi	Krapkuil Dam	462	356	380	334	163
*Mooiplaas	Pioniers Dam Tsende Drif	449	447	336	281	151
Letaba	Engelhard Dam, Olifants River	435	335	454	281	237
Houtboschrand	Ngotso Dam, Timbavati	386	355	477	279	190
Satara	Nsemani Đam Nkayapan	526	428	695	507	430
*Nwanetsi	Nwanetsi water hole	515	437	460	376	241
Tshokwane	Nwaswitsontso River	533	547	522	411	256
	Mazithi Dam					
	Kumana Dam					
	Orpen Dam					
	Leeupan					
	Sitoweni Dam					
	Manzimahle Dam					
	Olifantdrinkgat					
Skukuza	Skukuza fish pond	533	547	522	411	256
	Manzimable Dam					
	Vervoer Dam					
	Olifantdrinkgat					
Lower Sabie	Sabie River					
	Lower Sabie Rest Camp	577	536	493	441	139
Pretoriuskop	Shitlhave Dam	709	428	695	507	430
Crocodile Bridge	Gezantambi Dam	574	521	609	506	370
	Mpanamana Dam					
	Mlambane					
	Matjulu Spruit					

ISSN 0075-6458

Table 4
Sites from which there are no previous mollusc records and in which no molluscs were present during the 1995 collection

Monitoring station	Collection site
Pafuri	Pafuri
Punda Maria	Klopperfontein Dam
Shingwedzi	Krapkuil Dam
Houtboschrand	Timbavati
Satara	Nsemani Dam, Nkayapan
Tshokwane	Mazithi Dam, Silolweni Dam, Manzimahle Dam, Olifantdrinkgat, Kumana Dam
Skukuza	Vervoer Dam
Lower Sabie	Nhlanganzwane Dam
Pretorius Kop	Shitlhave Dam
Crocodile Bridge	Gezantombi Dam, Mlambane, Matjulu Spruit

Table 4 represents the monitoring stations and the nearest collection sites from which there are no previous records and in which no molluscs were recovered during the 1995 survey.

Discussion

Direct comparisons of the species diversity found prior to and including 1966 and during 1995 in the respective habitats is scientifically not acceptable. Aspects that should be taken into account during such a comparison include, amongst others, the number of collections made in a habitat, the precise collection site, and the time of the year when the collection was made. This information is not available to us.

In spite of this, it still seems possible to outline specific trends. With regard to the river systems, it is clear that the largest number of species was found in the Sabie River both during the present collection and up to 1966. The Sabie River rises relatively close to the park, high in the unpolluted and cold Drakensberg Range. It has a wide biodiversity and is probably ecologically the richest in the country. Its banks are, however, infested with the noxious weed *Lantana* and the exotic water lettuce, *Pistia stratiotes*, from South America which clogg the river itself.

In contrast to this, no mollusc species were found in the Crocodile River during the 1995 collection, while only three species were found previously.

The Olifants River has the most serious problems with regard to pollution. Its catchment area is near Witbank and its tributaries flow through old mine workings which make the water very acidic. Then it flows through a heavily industrialised area where it becomes very polluted. It also flows through poor farming areas where overgrazing causes topsoil to wash into the river and then becomes further polluted when the Selati, which picks up all of Phalaborwa's industrial effluent, joins the Olifant just before it flows into the park. These circumstances probably manifest themselves also in the relatively low mollusc diversity present in this river. The fact that three species were found up to 1966, and none during the 1995 collection, may be an indication that the general condition of this river is still deteriorating. This deduction is substantiated by the fact that all three species previously found, are bottom dwellers which probably would not have been there if the river had been heavily contaminated at that stage. The Nwaswitsontso River rises just adjacent to the borders of the Kruger National Park and depends primarily on rainwater falling in the park. The decrease in the species diversity found in this case may probably be ascribed to the drought of 1991–1994.

The consequences of the drought are clearly visible when the species diversity found in the dams in the 1995 survey is compared to what was previously found.

Of all the species, only a few such as *Bu. globosus* and *Bu. forskalii* are capable of resisting droughts for extended periods and can colonise temporary habitats (Brown 1994). *Biomphalaria pfeifferi* can also survive periods of drought, but on account of its longer

generation time and lower innate capacity of increase, seems better adapted to colonise more stable habitats (De Kock & Van Eeden 1981). We may therefore conclude that Nwanetsi waterhole, Gudzani Dam and Mooiplaas also had sufficient water during the 1988–1990 period to support a mollusc population. It must, however, be kept in mind that the physiographic characteristics of a dam may determine to a large extent its capability to support molluscs during a period of drought. It is especially the case for those molluscs which cannot withstand droughts and live in close association with peripheral plants that will be the first to die. Species belonging to the Pelecypoda, like *Corbicula*, *Spathopsis*, *Unio* and *Coelatura* spp., which are all bottom dwellers, are able to burrow into the mud. They will, however, only survive if the bottom stays partly saturated with water.

An important aspect which needs to be investigated, is the repopulation of a habitat which for some reason has lost all its water. Such a study will provide some information on how isolated habitats like dams are repopulated and at what rate this process takes place.

It is quite surprising that none of the intermediate hosts molluscs collected during the present survey shed any cercariae because 14 animal species harbouring *Schistosoma mattheei* were reported by Pitchford *et al.* (1974). A possible reason for the absence of any evidence of helminth infections may be the fact that the collected molluscs were in transport for the remainder of the day, a condition not conducive to the shedding of cercariae.

Conclusions

Eight of the mollusc species found prior and up to 1966 were not recollected during 1995, while three species not found previously were recovered in 1995. No mollusc species were collected from the Crocodile River in 1995 while three species, all bottom dwellers, were found prior and up to 1966. The Sabie River yielded the largest species diversity up to and including 1966 and also during the 1995 survey. The consequences of the drought are clearly visible when the species diversity found in the dams in the 1995 survey, is compared to what was previously found.

Acknowledgements

The authors wish to thank the following persons and institutions for their assistance: The National Parks Board for permission to conduct the research and for partially sponsoring the survey; Dr Leo Braack for selecting the water bodies to which priority was given during the survey; Mr Nick Zambatis for kindly making the necessary rainfall figures and maps available and Mr Samuel Nkuna who acted as guide during the survey.

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