Macronvertebrate variation in endorheic depression wetlands in North West and Mpumalanga provinces, South Africa

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Aquatic macroinvertebrates are rarely used in wetland assessments due to their variation. However, in terms of biodiversity, these invertebrates form an important component of wetland fauna. Spatial and temporal variation of macroinvertebrate assemblages in endorheic depressions (locally referred to as 'pans') in Mpumalanga and North West provinces were compared in wet and dry seasons in 2012 and 2013. A total of 29 taxa were identified from both provinces, with similarities in the structure of communities, with the exception of one or two species, in perennial endorheic depressions in both provinces. Macroinvertebrates sampled in Mpumalanga endorheic depressions were similar to those reported in previous studies completed in the area, and most macroinvertebrates sampled in Mpumalanga and North West were known to be commonly found in temporary habitats. Long-term studies are required to understand better the ecological functioning of the pans in the North West province.

Keywords: aquatic, macroinvertebrate assemblages, pans, spatial variation

Online supplementary material: GPS coordinates and the seasonal water quality of the sampled pans in Mpumalanga and North West provinces are available online in Supplementary Tables S1–S5 at http://dx.doi.org/10.2989/16085914.2015.1074060.

Introduction

Aquatic macroinvertebrates play important ecological and functional roles in wetlands, but their use in wetland assessments is often problematic and unreliable due to their inherent variability (Bird et al. 2013; Bird and Day 2014). Macroinvertebrates possess certain traits that make them useful for wetland assessment, such as being diverse, having different sensitivity levels and being good site-specific indicators due to their relative immobility (Rosenburg and Resh 1993; Dallas 2008). However, there are a few disadvantages to using macroinvertebrates, such as their varied distribution, which can lead to temporal and spatial variability in macroinvertebrate assemblages. As the advantages far outweigh the disadvantages, macroinvertebrates remain the most commonly assessed component of all biota, especially in river systems (Resh et al. 1995; Bird et al. 2013).

The use of aquatic macroinvertebrates in the study of endorheic wetlands, specifically of endorheic depressions, is much less frequently applied (Ewart-Smith et al. 2006; Ollis et al. 2013). Numerous endorheic wetlands occur in Mpumalanga province in the north-east of South Africa, and only a few studies have been completed in this area, the earliest being by Hutchinson et al. (1932) on Lake Chrissie and other depressions in the Mpumalanga Lake District, based on the physico-chemical properties of the pans. The literature currently available on aquatic invertebrates in endorheic depression ecosystems is surprisingly limited.

The studies done by Hutchinson et al. (1932) revealed that the most common species were *Lovenula excellens*, *Metadiaptomus transvaalensis* and *Daphnia gibba*. More recently, Ferreira (2010) and Ferreira et al. (2012) also reported on the presence of many typical pan macroinvertebrates in Mpumalanga, such as Anostraca, Conchostraca and Notostraca. The most common crustaceans found during these two studies included *Lovenula falcifera*, *Metadiaptomus* sp. and *Daphnia carinata* and various hemipteran and dytiscid predators. In selected reed pans de Klerk and Wepener (2011) evaluated which biotopes and specific sampling methods were more accurate in characterising the macroinvertebrate community, whereas de Klerk and Wepener (2013) focused on the use of macroinvertebrates as indicators of water quality. Riato et al. (2014) studied impacted depressions in Mpumalanga, focusing on their diatom and zooplankton communities.

Information on these systems in the North West province is even more limited, whereas most studies took place in the Free State province, central South Africa, near the small town of Bains Vlei (Meintjies et al. 1994; Meintjies 1996). Hutchinson et al. (1932) found that Barberspan, a perennial wetland in North West, had similar physico-chemical properties to the Mpumalanga systems, but that their invertebrate communities differed immensely, being dominated by species such as *Mesocyclops schuurmanae*, *Monia dubia*, *Ceriodaphnia ruguadi* and *Daphnia barbata*. 
Differences in geological features, geographical location and climate determine the water quality conditions, which in turn influence the macroinvertebrate community (Rosenberg and Resh 1993). Some pans in North West, and the majority of those in Mpumalanga, are perennial. Thus, the aim of this study was to determine how aquatic invertebrate communities differed between the Mpumalanga and North West provinces, taking into account the fact that those in North West should be more temporary.

Materials and methods

Study area

Pans are generally prevalent across the broad belt near the interior of South Africa, from the Northern Cape to the North West province and into Mpumalanga, with most pans occurring in the drier regions of the country (Cowan 1995; Ferreira et al. 2012). The pans selected for the present study were situated in North West and Mpumalanga provinces (Figures 1 and 2). A total of nine pans were sampled in North West province and 10 in Mpumalanga province. Although nine pans were sampled in North West, only six pans had any macroinvertebrates present and thus the results of these six pans are presented here. Geographic coordinates of each sampled site are provided in Supplementary Table S1 (available online).

The North West province is situated on the borders of the Northern Cape province, Free State and Gauteng, and shares an international border with the Republic of Botswana. The North West province forms part of the Western Plateau of the Plateau Wetland Group which is commonly known to have the greatest concentration of pans in the country (Cowan 1995), as seen in Figure 1. Most of the pans in the North West are endorheic pans, which are characteristically closed with no outlet and are an average size of 8 ha (from a total of 636 pans located in the Western Plateau). There is a distinct variation in the climatic conditions in the North West province from the west to the east of the province. The western region is known to be far drier with less than 300 mm of rainfall per annum in contrast to the temperate eastern region which receives an average of 600 mm of rain per annum. The province is also known...
for its unique seasonal and daily variations in temperature, often being extremely hot in summer averaging 32 °C in January and dropping down to a cold 0.9 °C average in July (de Villiers and Mangold 2002). The pans in North West province sampled in this study included ephemeral (temporary) pans, but included two pans that are thought to be perennial. Due to high evaporation rates, high concentrations of salts such as calcium and silica are present in the soil, particularly in pans. Thus endorheic soils tend to be alkaline with low levels of organic matter. The northeastern portion of the province tends to have lithosols of arenaceous sediment, whereas the southern and central regions tend to have black and red clays and ferrisiallitic soils of sands, loams and clays.

In Mpumalanga province, pans are commonest near the town of Chrissiesmeer (Figure 2). These pans differ in numerous ways from the other pans in South Africa, due to their permanent inundation (Ferreira 2010), oval shapes high density and perennial flooding. These unique features make the Mpumalanga Lake District a rare geomorphic entity in the South African landscape (McCarthy et al. 2007). This province is in a summer rainfall area, which makes up the majority of the annual rainfall (usually in the form of thunderstorms) and is divided by an escarpment into two regions: highveld, with cold frosty winters with a moderate summer; and lowveld, with mild winters and a subtropical climate. The Mpumalanga pans selected in this study were generally perennial, but included a few ephemeral pans for comparison. The selection of ephemeral and perennial pans is often difficult in this area, as seasonality can result in certain pans holding water for a few years and then suddenly dry up during another year. The southern part of Mpumalanga that includes the Mpumalanga Lake District is covered by the Ecca Group of the Karoo Supergroup (Bullock and Bell 1997). The geology therefore is generally made up of sandstones and shales of the Karoo Supergroup with highly resistant dolerite sills and dykes that intrude at some places (Tooth and McCarthy 2007).

**Sampling and sample analysis**

Relatively unimpacted pans were selected, with each pan having low-impact land use. Cattle grazing was considered an acceptable impact, since low-intensity cattle grazing can fulfil the role of the grazing herbivore mammals that would have historically used these systems. Horticultural land use was considered unacceptable, and distance from mining areas was included because the impacts from these activities could affect macroinvertebrates.

Sampling was done twice, once during the dry winter in May 2012 and once during the wet summer in December 2012.
2012/January 2013. A standard sweep net (30 cm × 30 cm × 30 cm; mesh size = 500 µm) was utilised to sample marginal habitats such as vegetation, if present, and benthic habitats. Macroinvertebrates were collected for approximately 5–8 min per site, and specimens were preserved with 5% neutrally buffered formalin (NBF) and rose bengal, fixed and the staining agent was used in order to aid identification (Malherbe et al. 2010). In the laboratory, each sample was cleaned with water to remove fixative and sorted from plant debris before being transferred into 70% ethanol. The macroinvertebrates were identified to the lowest taxonomic level possible using guides by Day et al. (1999, 2001), Day and de Moor (2002), de Moor and Day (2002), and de Moor et al. (2003a, 2003b).

A water sample was collected at each site and kept on ice for analysis of nutrients, salts and metal concentrations. The analyses of the water samples were completed by a nationally accredited laboratory (SANAS accreditation) following the EPA Method 200.7 for the determination of ions and trace elements in water and wastes by inductively coupled plasma-atomic emission spectrometry (ICP-AES). In situ measurements of dissolved oxygen (% and mg l⁻¹), pH, electrical conductivity (mS cm⁻¹), total dissolved salts and temperature (°C) were also taken using calibrated Extech DO 610 and EC610 portable water quality meters.

Statistical analysis
Various uni- and multivariate statistical techniques were used to assess spatial and temporal variation in the community structure data of all of the pans sampled. The macroinvertebrate communities were described using Margalef's index (Margalef 1978) to express species richness, evenness was expressed using Pielou's evenness index (Pielou 1969) and the Shannon–Wiener diversity index (Shannon and Weaver 1963) was calculated to provide integrated results of both the species richness and equitability (evenness) components (Ferreira et al. 2012).

Bray–Curtis similarity matrices were compiled using the macroinvertebrate abundance data at each pan during the different seasons sampled. The abundance data from the two surveys were log-transformed to down-weight the effect of dominant taxa. Group-average hierarchical clustering and ordination by non-metric multidimensional scaling (nMDS) were used to determine community patterns and groupings (Clarke and Warwick 1994). ANOSIM was used to determine if any of the a priori groupings such as provinces and sampling season identified were significant (Clarke and Warwick 1994). The SIMPER procedure in Primer was used to determine which macroinvertebrate taxa were responsible for the groupings. Primer v. 6 was used for the initial multivariate analysis (Clarke and Gorley 2006).

The environmental variables that could be responsible for the assemblages were tested using redundancy analysis (RDA) and interpreted through triplots in Canoco v. 5 (ter Braak and Šmilauer 2012). Triplots provide a map of each sample analysed on a two-dimensional basis with placements showing the similarities or dissimilarities between the sampling sites (Shaw 2003). Significance was tested using a Monte Carlo permutation test (p < 0.05).

Results
The Mpumalanga samples contained 24 taxa from 14 orders and 20 families (Table 1). Results from the North West pans showed 15 taxa from 9 orders and 13 families (Table 2). The majority of the taxa collected from both provinces comprised Arthropoda, specifically hexapod insects and Crustacea.

Table 1: Macroinvertebrate taxa found in 10 Mpumalanga pans surveyed in 2012 and 2013

| Phylum     | Subphylum | Class       | Order       | Family          | Species                      |
|------------|-----------|-------------|-------------|-----------------|------------------------------|
| Arthropoda | Crustacea | Branchiopoda| Diplostraca | Lyceidae        | Lyceus sp.                   |
|            |           |             | Cladocera   | Daphniidae      | Daphnia carinata             |
|            |           |             | Calanoida   | Diaptomidae     | Lovenula excellens           |
|            |           |             |             | Diaptomidae     | Lovenula falcifera           |
|            |           |             |             | Diaptomidae     | Metadiaptomus transvaalensis |
| Chelicerata| Acari     | Trombidiformes| Coleoptera  | Hydrachnidiae   | Hydracarina sp.              |
| Hexapoda   | Insecta   |             |             | Dytiscidae      | Dytiscidae species           |
|            |           |             |             | Dytiscidae      | Laccobius sp.                |
|            |           |             |             | Dytiscidae      | Dineusus sp.                 |
|            |           |             |             | Notonideridae   | Synchortus sp.               |
| Diptera    |           |             |             | Chironomidae    | Culicidae                    |
|            |           |             |             | Culicidae       | Culex sp.                    |
|            |           |             |             | Chaoboridae     | Chaoborus sp.                |
|            |           |             |             | Baetidae        | Cloeon dipterum              |
| Ephemeroptera|         |             |             | Trichoptera    | Trichocorixa sp.             |
|            |           |             |             | Notonectidae    | Enallagma glaucum            |
| Hemiptera  |           |             |             | Coenagrionidae  | Ceriagrion gabrum            |
| Odonata    |           |             |             | Coenagrionidae  | Economus thomassetti         |
| Trichoptera|           |             |             | Ostracoda       | Lymnaea columna              |
|            |           |             |             |                |                              |
| Annelida   | Citellata | Oligochaeta | Lumbriculida | Lumbriculus variegatus |
| Mollusca   | Gastropoda| Pulmonata   | Planorbidae   | Bulinus africanus          |
|            |           |             | Lymnaeidae   | Lymnaea columna        |

Nematoda
The Margalef's species richness index showed that in Mpumalanga the species richness was higher during the dry season with the exception of three pans (MP C, D and H) (Figure 3). The North West province results show that the two pans (NW I and NW F) that could be compared in terms of seasonal variation had the same species richness. The Shannon's diversity index (Figure 4) showed that in the Mpumalanga pans there was a higher diversity during the dry season, with the exception of MP H and MP C. However, higher diversity was observed in two of the North West province pans sampled during the dry season (NW I and NW F) than during the wet season. The Pielou's evenness index indicated evenness in most of the Mpumalanga pans during both seasons (Figure 5). The only exceptions were MP A, B and F during the wet season and MP A during the dry season. Most of the North West pans showed high evenness, while NW F and NW I showed no dominance during both seasons.

The hierarchical cluster and non-metric multidimensional scaling (nMDS) plots (Figure 6) were based on a Bray-Curtis similarity coefficient. The hierarchical cluster (Figure 6a) indicated that a priori groupings for the North West and Mpumalanga provinces differentiated into two groupings at a similarity of approximately 11%. The first grouping contained the pans NW A, NW B, NW E and NW J during the wet season. The second grouping contained all of the Mpumalanga sites, as well as the NW I and NW F pans during both the wet and dry sampling surveys. These groupings were also highlighted in the nMDS plot (Figure 6b). The similarity analysis using ANOSIM indicated that, at a province level, no significant differences were present (Global $R = 0.444$). Analysis of temporal changes within the specific groups revealed no wet/dry seasonality in the Mpumalanga pans. This was also the case for the NW I and NW F pans that grouped with the Mpumalanga pans.

The SIMPER analysis (Table 3) indicated that the species found in the two provinces were similar, but that abundances were different. In general, the Mpumalanga community was made up of more species than were found in North West which was dominated by a few taxa. At the Mpumalanga sites the highest contribution was that of *Lovenula falcifera* at 23.4%, followed by Nematoda at 19.2% and *Lumbriculus variegatus* at 12.7% (Table 3). The North West groupings were dominated by *Branchiopodopsis* sp. and *Ceriagrion glabrum* (49.9% and 23.8%), while Chironomidae, *Lovenula falcifera*, *Hydrocanthus* sp. and *Lumbriculus variegatus* made up smaller contributions to the community.

![Figure 3: Margalef species richness for sampled pans in (a) Mpumalanga and (b) North West in wet and dry seasons during 2012 and 2013](image-url)
The RDA triplot (Figure 7) showed that the Branchiopoda and Artemia were most common in NW Pan B in the wet season. A Monte Carlo permutation test on all axes indicated that the triplot is significant at $p = 0.032$. *Lovenula falcifera* was dominant in the Mpumalanga pans, and *Trichocorixa* sp. and *Cloeon dipterum* were dominant in most Mpumalanga pans. Most of the taxa found in Mpumalanga were similar in all of the sampled pans; however, their abundances were different. The exceptions were *Culex* sp., *Dineutus* sp. and *Chaoborus* sp., which occurred in similar numbers in MP D. *Bulinus africanus* (only in MP D), *Synchortus* sp. (only in MP D) and *Hydrophilidae* (only in NW I) were also found to be the most abundant in NW I and MP D.

The water quality variables identified as drivers of the community structure (Figure 7) were generally electrical conductivity, temperature and sodium in the North West pans. The results from Mpumalanga pans indicated that total hardness, phosphates and nitrates were the dominant water quality variables. No temporal differences in the water quality variables were seen to influence the invertebrate communities during the wet and dry seasons. Complete water quality data are provided in Supplementary Tables S2–S5 for reference purposes (available online).

**Discussion**

**Temporal variation**

Seasonal variation in the Mpumalanga pans was evident from the diversity and species richness indices. Higher species richness was observed during the dry season in Mpumalanga, with the exception of sites MP C, D and H. Similar seasonal variation was also reported by Ferreira (2010) who conducted a similar study in the same area. Ferreira (2010) indicated that habitat availability during the different seasons, as well as environmental factors, could be responsible for this. It was also noticeable that higher abundances of many taxa were present during the dry season than in the wet season. *Daphnia* spp. are known to occur in temporary habitats (Ferreira 2010) and *D. carinata* was common in a number of pans sampled during the Mpumalanga dry-season survey but was absent during the wet-season survey. A study on reed pans in the same area of Mpumalanga also found a difference...
Figure 6: (a) Hierarchical cluster and (b) non-multidimensional scaling (nMDS) analysis based on the Bray–Curtis similarity index of the aquatic invertebrates collected at sampled pans in the North West and Mpumalanga provinces for the wet (W) and dry (D) seasons during 2012 and 2013 (NW = North West, MP = Mpumalanga)
between the wet and dry seasons in macroinvertebrate abundances (de Klerk and Wepener 2013). That study ascribed the differences to increases in productivity during the warmer seasons which can lead to new plant growth and animal production during the period. Seasonal variation in species richness, diversity and evenness in pans is a common phenomenon, since climate has an impact on the inhabitants of an aquatic ecosystem (Water and Rivers

### Table 3: SIMPER analysis of macroinvertebrate data to identify taxa responsible for the groupings identified with the hierarchical cluster analysis

| Taxon                        | Average abundance | Average similarity | Similarity/SD | Contribution % | Cumulative % |
|------------------------------|-------------------|--------------------|---------------|----------------|--------------|
| **Group MP – average similarity: 23.61** |                   |                    |               |                |              |
| Lovenula falcifera           | 1.7               | 5.5                | 0.5           | 23.4           | 23.4         |
| Nematoda                     | 1.0               | 4.5                | 0.7           | 19.2           | 42.6         |
| Lumbriculus variegatus       | 0.9               | 3.0                | 0.6           | 12.7           | 55.3         |
| Trichocorixa sp.             | 0.6               | 2.5                | 0.4           | 10.6           | 65.9         |
| Ostracoda                    | 0.7               | 2.1                | 0.3           | 9.1            | 75.0         |
| Daphnia carinata             | 0.6               | 1.5                | 0.3           | 6.3            | 81.3         |
| Chironomidae                 | 0.8               | 1.2                | 0.3           | 4.9            | 86.2         |
| Metadiaptomus transvaalensis | 0.5               | 1.0                | 0.3           | 4.4            | 90.6         |
| **Group NW – average similarity: 19.39** |                   |                    |               |                |              |
| Branchiopodopsis sp.         | 1.5               | 9.7                | 0.6           | 49.9           | 49.9         |
| Ceriagrion glabrum           | 0.5               | 4.8                | 0.6           | 23.8           | 73.5         |
| Chironomidae                 | 0.4               | 1.7                | 0.3           | 8.7            | 82.1         |
| Lovenula falcifera           | 0.5               | 0.8                | 0.2           | 4.0            | 86.1         |
| Hydrocanthus sp.             | 0.4               | 0.7                | 0.2           | 3.8            | 89.9         |
| Lumbriculus variegatus       | 0.5               | 0.7                | 0.2           | 3.5            | 93.4         |

*Figure 7: RDA triplot illustrating similarities of aquatic macroinvertebrates (triangles) between the various pans (circles) sampled. The triplot explains 31.5% of the variance with 19% explained on the first axis and a further 12.5% on the second axis. EC = electrical conductivity; TH = total hardness. Refer to Tables 1 and 2 for full taxon names*
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Commission 2001; Batzer 2013).

In the North West province only two pans had wet and dry season samples taken, making it difficult to analyse for seasonal variation. Seasonal variation in the macroinvertebrate community was visible at one of these pans but little variation was seen at the other pan. However, the temporary pans that did not have a dry season sample taken had a slightly lower diversity than the pans that were perennial and did have seasonal results. Temporary habitats are often dominated by anostracans, which are known to be amongst the most primitive of all crustaceans (Day et al. 1999). The anostracan families that were dominant were the Artemiidae and Branchiopodidae. A resting egg hatching experiment on pans from the Free State and North West provinces also indicated that the dominant taxa in the resting egg bank are Anostraca and Ostracoda (Henri et al. 2014). The pans containing these taxa were temporary pans that dry up every year and only hold water for a short period (Dumont and Negrea 2002).

Spatial variation in macroinvertebrate taxa

Multivariate statistical analysis showed that the perennial systems in North West grouped with the Mpumalanga systems. The four North West pans that dried up during the dry season grouped separately, indicating the differences between the temporary and perennial systems. The Mpumalanga pans had a slightly higher diversity, especially during the wet season. However, diversity and richness of macroinvertebrates were similar in the North West and Mpumalanga in the perennial systems. This is an indication that the macroinvertebrate communities are similar in diversity and richness between the two areas; however, the taxa found in these two areas are different. Ostracods, which were found in both provinces, are tolerant of a wide variety of environmental conditions and play important roles in the food chain as scavengers and grazers (Day et al. 2001). A few invertebrates such as Culex sp. and Dineutus sp. were identified in MP D during the dry season but were not detected in any of the other pans, and therefore these also grouped separately. MP I and MP D contained Chaoborus sp., which was a unique species only sampled in these two pans. The similarity percentages for all these groupings were extremely low, around 11% for the hierarchical cluster, while the RDA also only explained around 32% of the variation in the community structure. When analysing the community composition of these systems, the different dominant taxa in the community become apparent. The high abundances of Artemiidae and Branchiopodidae made these the dominant taxa at NW B. In Mpumalanga, Cloeon dipterum (Family: Baetidae), Chaoborus sp. (Family: Chaoboridae), which was only found in MP D, and Lovenula falcifera were the dominant taxa (found in MP D and MP I). Invertebrates common to both provinces included Nematoda, Chironomidae and Trichocorixa sp. (Family: Corixidae), while Dineutus sp. (Family: Gyrinidae) and Culex sp. (Family: Culicidae) were found only in MP D during the dry season in Mpumalanga. The water quality variables were overlaid onto the community structure to indicate the influence of electrical conductivity and sodium in North West, while calcium, phosphates and total hardness were higher in the Mpumalanga pans.

The Coleoptera (aquatic beetles) includes a large number of aquatic species, representatives of a broad spectrum of habitats and water quality. They are more abundant in wetlands and ponds, although they can occur in any aquatic habitat (Bouchard 2004). Aquatic beetles play a major role as ‘excellent indicators of habitat quality, age and history’ (Thakare and Zade 2011), due mainly to their meeting most of the criteria for indicator taxa. The following Coleoptera were found: Dytiscidae (Laccobius sp.), Hydrophilidae (Hydrophilinae species), and Noteridae (Hydrocanthus sp.). The predaceous diving dytiscid beetles were mainly found in Mpumalanga during the dry and wet seasons. These taxa were only found in one depression in the North West province. Hydrophilidae were detected only in NW I (Barberspan) and only one individual was found. These aquatic scavengers prefer standing or still waters.

Only two taxa of the order Diptera were collected, namely Chironomidae and Culex sp. Chironomidae are adapted to a wide variety of environmental conditions (Morais et al. 2009). The high abundance of Chironomidae as seen in MP F in Mpumalanga is usually associated with disturbed conditions either as a result of fluctuations in nutrient levels or human landscape disturbances (Bird 2010). Culex sp. dominated MP D in Mpumalanga; perhaps due to the absence of its main coleopteran predator from the Dytiscidae family (Lundkvist et al. 2003).

Previous studies on the Mpumalanga pans (Ferreira et al. 2010) showed similar community compositions, and most of the species found in the present study are consistent with those identified by Ferreira (2010). Although Lymnaea columella was found only in Mpumalanga, this invertebrate is known to be one of the most widespread colonists of all the freshwater snail species in South Africa. It is commonly found in stagnant water with a muddy substrate (de Kock et al. 1989), much like MP B where it was collected. Lyceuca sp. is usually found in wetlands (Timms and Richter 2002) and was previously found in the Mpumalanga pans (Ferreira et al. 2012) along with M. transvaalensis (Ferreira et al. 2012; Rialto et al. 2014). Metadiaptomus transvaalenensis is also mainly confined to upland, higher latitude, warm subtemperate regions such as Mpumalanga (Hart and Rayner 1994).

Internationally, and especially in North America, research has looked at the presence, abundance and functional roles of macroinvertebrates in wetlands. Batzer (2013) reviewed 14 studies in North America and found that hydrology, vegetation, anthropogenic impacts and predation are some of the key factors that influences macroinvertebrates in wetlands. Locally, the focus has mainly been on variations of taxa within individual depressions and regions, while also determining the effect of human activities. Thus, the present study adds information on the variation and distribution of macroinvertebrates across two provinces in South Africa. Previously, much of the focus has been on Mpumalanga, whereas the present study is one of the first to provide information on endorheic depressions in the North West province. Batzer and Ruhi (2013) compared macroinvertebrate assemblages in 447 wetlands from various ecoregions across the world to determine the similarity, the variation in occurrence and the occurrences of individual taxa. The differences, if any, of these patterns between
temporary and permanent wetlands were identified and a core group of 40 macroinvertebrate taxa that occur in these wetlands was found (Batzer and Ruhi 2013). All taxa found within our study fall in Batzer and Ruhi’s (2013) core group, and yet no specific core group of taxa could be identified for endorheic depressions in these two provinces. The core group of taxa was split into two parts, one being wetlands in semi-arid or mild climates, the other being wetlands from wetter areas. The first group was largely dominated by flying insects, the second by non-insects with passive dispersal. Batzer and Ruhi (2013) also found that hydrology exerted a minor control on macroinvertebrate community structure.

This study builds on the work of Ferreira (2010) and Ferreira et al. (2012) in increasing long-term monitoring data on macroinvertebrates in endorheic depressions (pans) in Mpmalanga and South Africa generally. The information gleaned from the North West province is invaluable as very little published information from there is available. However, more research on these endorheic depressions in South Africa is needed on macroinvertebrate community structure, as well as studies on hydrology, geomorphology and present ecological state. These studies would ultimately be used in the monitoring of endorheic depressions in the face of increased human activities such as agriculture and mining.

More research in regions that contain endorheic depressions in South Africa is needed to determine if a core group of taxa is present in South African wetlands.

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