A winter survey of the smaller mammals of the uMkuze section of the iSimangaliso Wetland Park, KwaZulu-Natal Province, South Africa.

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P. J. Taylor[1], A. Rautenbach[1], M. C. Schoeman[2] and X. Combrink[3]

[1] Durban Natural Science Museum.
Email: petert@durban.gov.za

[1] Durban Natural Science Museum.
Email: rautenbacha@durban.gov.za

[2] School of Conservation & Biological Sciences, University of KwaZulu-Natal.
Email: schoemanc@ukzn.ac.za

[3] iSimangaliso Wetland Park Threatened Species Project, Ezemvelo KZN Wildlife.
Email: combrinx@kznwildlife.com

Introduction

The iSimangaliso (formerly the Greater St Lucia) Wetland Park was listed in 1999 as South Africa's first World Heritage Site. It is situated in the north-eastern corner of South Africa and its geographical position at the southern tip of the Moçambique coastal plain combined with a mixture of both tropical and temperate climates has resulted in an exceptional number of landcover types, from Dune forest in the east to Lebombo woodland in the west. This habitat heterogeneity has resulted in species diversity unequalled for a protected area of similar size in southern Africa, and many of these species are listed as rare, threatened or endemic.

The iSimangaliso Wetland Park Threatened Species Project, an Ezemvelo KwaZulu-Natal Wildlife Special Project, supported by the iSimangaliso Wetland Park Authority and Wildlands Conservation Trust, was initiated in 2003 to update information on the presence and distribution of rare, threatened and endemic species, with a special focus on the less charismatic taxonomic groups such as rodents, shrews, bats, reptiles, amphibians, fruit chafer beetles, birds, spiders, scorpions and selected floral groups. This was done through a synthesis of existing information as well as standardised field surveys, ranging from two to six weeks at a time. These baseline surveys conducted in 2003 – 2005, covered 14 sample areas representative of the overall habitat diversity of the Park. During 2006, with the assistance of Operation Wallacea (providing volunteers as well as some taxa field coordinators) it was possible to increase the number of sample stations as well as conduct equal effort surveys based on an Atlas approach. This small mammal survey is a continuation of the current survey work in uMkhuze and represents the findings of the winter survey for 2007.

The term "small mammals" is often reserved for mammals weighing less than some arbitrary threshold (e.g. 2 kg or 5 kg). However, in this study, the term small mammal is limited to rodents, shrews and bats. Small mammals play an important role in terrestrial ecosystems through nutrient cycling and sustaining a considerable component of predators in healthy ecosystems (Willan 1992). Due to habitat loss (especially habitat-specialist species), the use of insecticide and roost disturbance, some smaller mammal species are threatened with extinction (Friedmann & Daly 2004).

It is imperative to conduct field surveys on these groups in order to gauge a better understanding of their distribution, habitat associations and relative abundance, determine and compare species composition and species richness using standardised survey methods. Surveys also contribute to the taxonomy and phylogeny of many groups (e.g. shrews) which has undergone radical changes as a result of modern molecular systematic techniques which are now assisting both taxonomists and phylogeneticists.

Study area

uMkhuze, which forms part of the iSimangaliso Wetland Park, is situated in the north-eastern part of KwaZulu-Natal, South Africa. This protected area is located between 27° 32′ 30″ S and 27° 48′ 30″ S and between 32° 06′ 00″ E and 32° 26′ 00″ E. It is situated approximately 40 km west of the coast. The Mkuze River forms the north and eastern boundaries, with the Msunduzi River forming the southern boundary. In the West the fenced boundary extends along the Lebombo Mountains (Goodman 1990). The area is approximately 290 km^2 in size. uMkhuze is linked to the Ozabeni section of the iSimangaliso Wetland Park, on its eastern side. The climate is sub-tropical, consisting of warm summers and mild arid winters. The rainy season usually starts in October and ends in March.

Methods

Two 5 x 5 km grid squares where selected within uMkhuze for the survey. Each square was subdivided into 25 x 1km² and 5 of these 1km² were chosen for the survey based on the overall habitat diversity. Pitfall traps and baited live traps (Willan PVC traps) were employed to sample the mammalian fauna present at each site. Mist nets and Hand nets were used to catch bats at specific locations where bats were likely to occur (e.g. hides, buildings and water bodies.).

Pitfall traps were set in each of the 10 x 1km² (5 sample sites per 5km²). Each trap station comprised of 25 x 20 litre plastic buckets imbedded in the ground, spaced c.3.3 m apart, with a 40 cm high plastic drift fence passing over the centre of each bucket. The three trap lines were approximately 120 degrees apart. Traps were checked every morning for the duration of the survey.

PVC Willan box traps were used to survey rodents at each of the 10 trap stations. The traps were baited with a mixture of peanut butter, oats and sunflower oil. Traps were checked and re-baited early in the mornings.

Bats were surveyed with mist nets at the following locations; kuMalibali hide, kuMasinga hide, across the Mkhuze River near the Ophansi Gate and in Mantuma Camp at the communal ablution facilities and the Abattoir. The nets were opened just before dusk and taken down approximately two hours after sunset.

Captured animals that could be identified (e.g. *Saccostomus campestris*, *Lemniscomys rosalia spinalis*) were marked by means of a small fur clipping in the neck area and subsequently released to permit the recognition of recaptures. These animals received a unique identification number, were weighed and sexed prior to their release. Captured animals that could not be identified to species level were euthanized in the field and taken as voucher specimens. Each specimen was assigned a unique identification number and the following external measurements were taken; body mass, total length, tail length and ear length, hind foot length, with and without the claw. The sex and reproductive status were noted as well. For bats, a forearm measurement was included.

Specimens were prepared by Anita Rautenbach and identified by Dr. Peter Taylor, Mammal Curator for the Durban Natural Science Museum. Tissue samples were taken from all specimens and analysed at the University of KwaZulu Natal. The data were captured in the

iSimangaliso Wetland Park Threatened Species database and sent to the Durban Natural Science Museum as well as to Ezemvelo KwaZulu-Natal Wildlife's Biodiversity database.

Results and Discussion

A total of 27 small mammal species were collected between 12 July and 28 August 2007; four shrews, fifteen rodents and eight bats (Table 1), representing a highly diverse community. None of the species listed are recorded as Threatened in the South African Red Data Book (Friedmann & Daly 2004); however all the shrew species, as well as *Mus neavei* and *Grammomys dolichurus*, are listed as Data Deficient, and the Natal Long-fingered Bat, *Miniopterus natalensis* is listed as Near Threatened. Of the total of 27 species, one bat (*Mops condylurus*) (generally common in the region) and five very rarely caught rodents (all captured just once or twice during the current trapping period) have not previously been recorded from uMkuze Game Reserve. The rodents include *Dendromus melanotis*, *Steatomys krebsii*, *Steatomys pratensis*, *Mus neavei* and *Mus cf. indutus*. The two last-mentioned species are new records for the Province of KwaZulu-Natal.

Mus indutus is typically a desert-living species which should not occur at uMkuze; genetic analysis is in progress to compare the DNA of the uMkuze sample with *M. indutus* collected from typical habitats in Namibia. One species (*Lemniscomys rosalia*) which was recorded quite commonly in this study was surprisingly not trapped at all during the 2006 survey in uMkhuze (Operation Wallacea). Nevertheless it was collected (by P. J. Taylor) at uMkuze in July 1994 in thick grassland in open thornveld (two specimens in the Durban Natural Science Museum Mammal Collection). This provides an indication that rodent abundances may fluctuate from year to year, probably in relation to climatic changes. Such fluctuations in abundance may affect different species differentially (e.g. drought years may benefit gerbils over other rodent species), resulting in community composition being highly dynamic in space and time, and this may explain in part the unpredictability in the species richness estimates outlined below.

It is notable that two species of shrew, *Crocidura fuscomurina* and *Suncus lixus*, which are very rarely represented in Museum collections, were commonly to fairly commonly collected in our pitfall traps. These species are too small to be caught in rodent box traps, and therefore have been underrepresented in previous surveys (which typically relied on rodent box traps alone). This emphasizes the extreme importance of using pitfall traps in conjunction with rodent box traps to accurately and completely sample small mammal communities.

Of the 15 rodent species, only two were not captured from the standardized trapping stations: *Graphiurus murinus* (kuMalibali Hide) and *Grammomys dolichurus* (Environmental Camp). Focusing on the results of the 10 trapping sites, Table 2 documents species richness for each of the 10 sites, both observed and estimated from non-parametric and asymptotic approaches using EstimateS (version 7.7, Colwell 2004) and Fig. 2 shows species rarefaction curves (Colwell & Coddington 1994, Gotelli & Colwell 2001) for five of the sites (1, 2, 3, 6 & 7).

Expected values of species richness exceeded observed species richness at all sites. Whilst observed richness varied from 4 (Site 10: Sand Forest) to 11 (Site 2: Mixed Bushveld), mean expected values (barring obvious outlying values, and notwithstanding high standard deviations and 95% confidence limits) varied from 4 to 18. The maximum expected value of 18 corresponds quite closely with the observed species richness when all sites were combined

(18). The high occurrence of singletons and doubletons (species caught only once or twice) contributes to these results and suggests that other yet unrecorded species of very rare small mammals may be present in the community.

Spatial heterogeneity at small geographic scales may also be contributing to the high standard deviations we obtained for our expected values. More specifically, sample-based rarefaction (Fig 2) showed that species richness of rodents and shrews was significantly higher at Site 2 than at Site 1 despite the sites occurring in relative close proximity in the same broad habitat type (Mixed Bushveld) on different sides of a road. The differences in species composition between these two sites can be seen in Table 1 and also from the Correspondence Analysis plot (Fig. 3) showing relationships between sites and species. *Mastomys natalensis* (a pioneer species) is very dominant at Site 1 but not Site 2 and this may be related to greater disturbance or other microhabitat variables. It is possible that this dominance resulted in depressed species richness at Site 1 compared with Site 2.

Differences in species composition between sites do not appear to be due to habitat; e.g. the two Sand Forest sites (7 and 10) plot far apart in the Correspondence Analysis, as do the Mixed Bushveld sites (1-4, 8). No strong species or site associations emerge from the Correspondence Analysis. Some species (plotting close to the origin: Fig. 3) are widespread (e.g. *C. hirta*, *M. natalensis*, *M. minutoides* and *L. rosalia*) whereas many others are singletons or doubletons, making it difficult to establish if these site occurrences are stochastic or not. It must be noted the that habitat classification was based on very broad vegetation types and therefore any comparison between sites must be interpreted with some caution until more detailed habitat measurements have been collected.

In the absence of vegetation and soil (microhabitat) variables, or weather data for each site, it is difficult to speculate on possible environmental correlates of community structure in the surprisingly variable small mammal communities sampled. This should be remedied in future trapping sessions when vegetation, soil and weather data will be collected.

The eight species of bats collected in this trapping session conform to our expectations; only *Mops condylurus* has not previously been recorded from the Park although it has been recorded close by at the Pongola Nature Reserve (records in the Durban Natural Science Museum Mammal Collection). For logistic reasons bats were not sampled in a systematic manner as were the terrestrial small mammals. This will be remedied in the 2008 trapping session when a variety of methods (mist netting, harp traps and acoustic surveys using bat detectors) will be used to sample bats in the same grids sampled for rodents and shrews.

Recommendations for future surveys

- Preparation of voucher specimens in uMkhuze.
- The placement of small mammal traps in trees on study sites.
- Analysis of soil and habitat variables at the various sites.
- Weather plays an extremely important role in the movement of small mammals. A detailed weather report of weather conditions during the survey must be obtained from the weather station at Mantuma Camp.
- The bat fauna in this region must be surveyed more intensely using acoustic methods (bat detectors linked to passive monitoring system), harp traps, mist nets and hand nets. Suitable sites for the harp trap were limited during the previous survey. Bats will be sampled in same grids as rodents and shrews.

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Table 1: Abundances (no. captures, including released) of small mammals (27 species) at trap sites (1 – 10) and additional sites at uMkuze during winter 2007 season (12 July – 28 August 2007). E = Environmental Camp; T = Tails Camp; KH = kuMasinga Hide; M = Mantuma; R = Ranger's House; A = Abattoir; MH = kuMalibali Hide G = Gorge; MR = Mkuze River

	Sample sites 1 - 10										Other (see above)								
Taxa:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**E**	**T**	**KH**	**M**	**R**	**A**	**MH**	**G**	**MR**
Shrews																			
Crocidura hirta		1	3	5	2	1		1											
C. silacea		1					3												
C. fuscomurina	5	2	4	2	1			6	1										
Suncus lixus		2		2			2	3											
Rodents																			
Tatera leucogaster		4		1		5		8		2									
Saccostomus campestris		4			10			2	1										
Dendromus mystacalis							1												
D. melanotis						1													
Steatomys krebsii		1																	
S. pratensis	1		1																
Thallomys paedulcus	1			1						2									
Aethomys ineptus		2									2								
Mastomys natalensis	23	8	2	1	12	5	1	1	1										
Lemniscomys rosalia		1		2	8	1	3			3									
Mus minutoides	5	8	14	7	3	8	12	1	2	1									
M. neavei							1												
M. cf. indutus									1										
Graphiurus murinus																	1		
Grammomys dolichurus											1								
Bats																			
Miniopterus natalensis																		1	
Neoromicia capensis																	2		
Nycticeinops schlieffeni											1						2		
Scotophilus cf viridis													2						
Nycteris thebaica												2	3						
Hipposideros caffer													1						
Chaerephon pumilus														3	1		2		1
Mops condylurus																			2

Table 2 - Observed and estimated (mean ± SD) species richness of terrestrial small mammals for ten mammal trap sites at uMkuze.

Site	Habitat	Species richness	Species richness estimators		
			Non-parametric		Asymptotic
			Chao2	Jack2	MM Means
Site 1	Mixed Bushveld	5	5.98 ± 2.16 (5.07 – 18.25)	8.88	5.83
Site 2	Mixed Bushveld	11	13.25 ± 3.1 (11.36 - 27.68)	17.86	17.97
Site 3	Mixed Bushveld	5	5.0 ± 0.24 (5.0 – 5.88)	6.00	6.9
Site 4	Mixed Bushveld	8	8.73 ± 1.4 (8.06 – 16.32)	11.00	14.2
Site 5	Dry Bushveld	6	6.49 ± 1.28 (6.03 – 14.12)	8.94	6.87
Site 6	Ecotone Sand Forest	6	8.94 ± 4.33 (6.36 – 30.13)	11.81	8.38
Site 7	Sand Forest	7	9.94 ± 4.1 (7.38 – 29.57)	13.81	10.48
Site 8	Mixed Bushveld	7	8.47 ± 2.55 (7.15 -21.81)	11.87	11.01
Site 9	Red Sand Bushveld	5	7.94 ± 4.1 (5.38 – 27.57)	11.81	29.63
Site 10	Sand Forest	4	4.0 ± 0.61 (4.0 – 5.82)	1.19	7.78

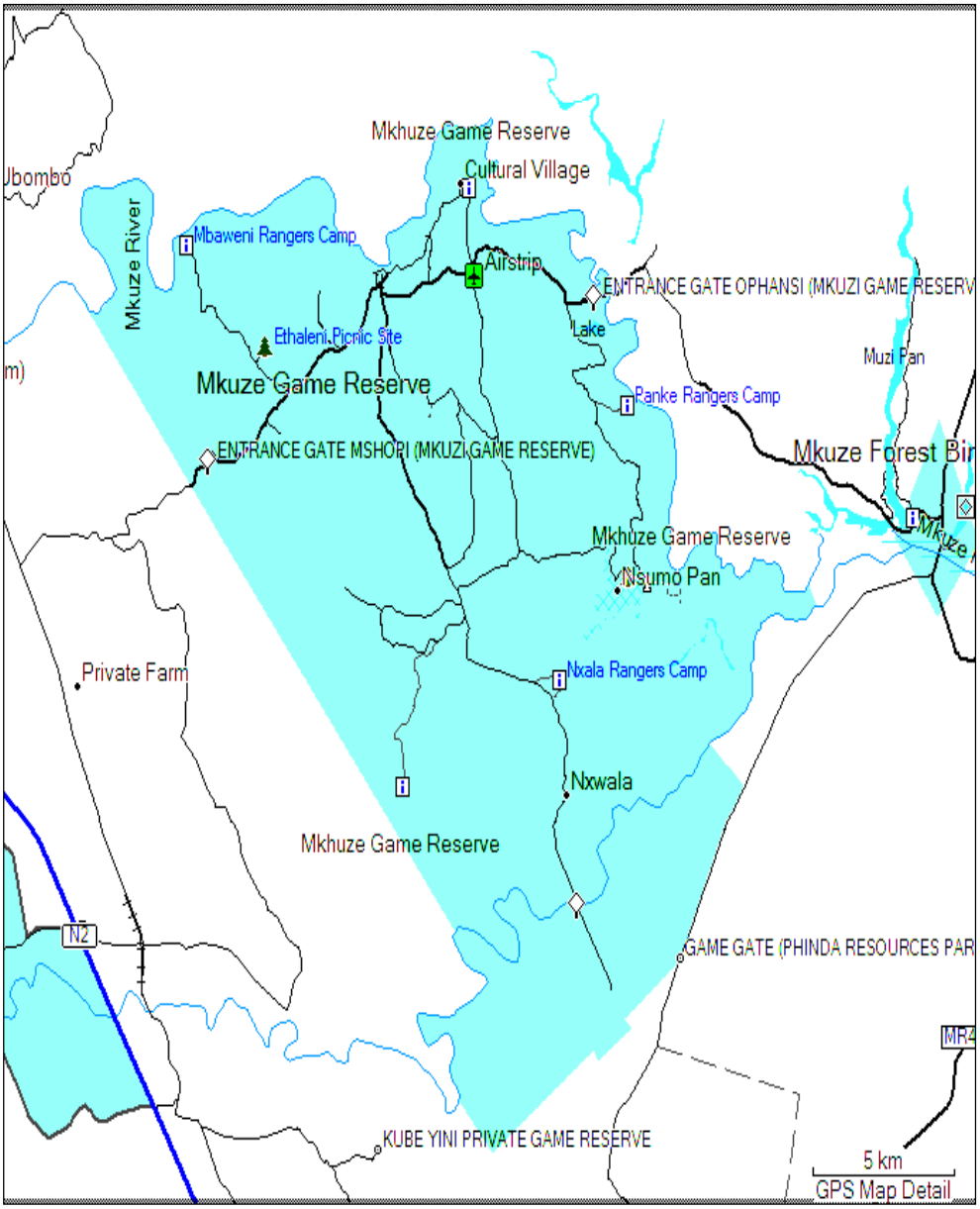

Fig.1 - uMkuze Game Reserve

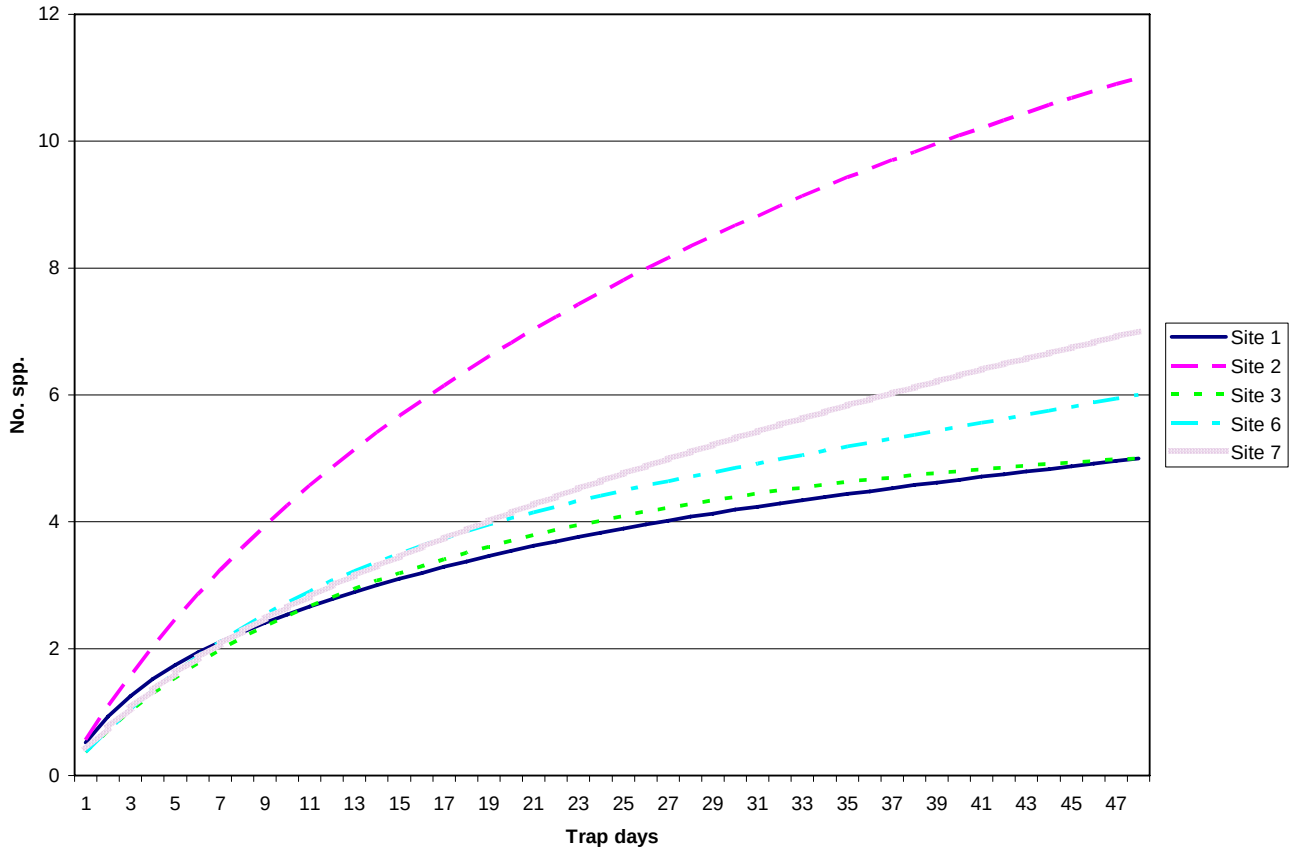

Fig. 2 - Species accumulation (rarefaction) curves for five terrestrial small mammal trap sites. Species number based on Sobs (Mao Tau) estimation. Standard deviations were as follows: Site 1 = 0.9; Site 2 = 1.72; Site 3 = 0.67; Site 6 = 1.4; Site 7 = 1.92.

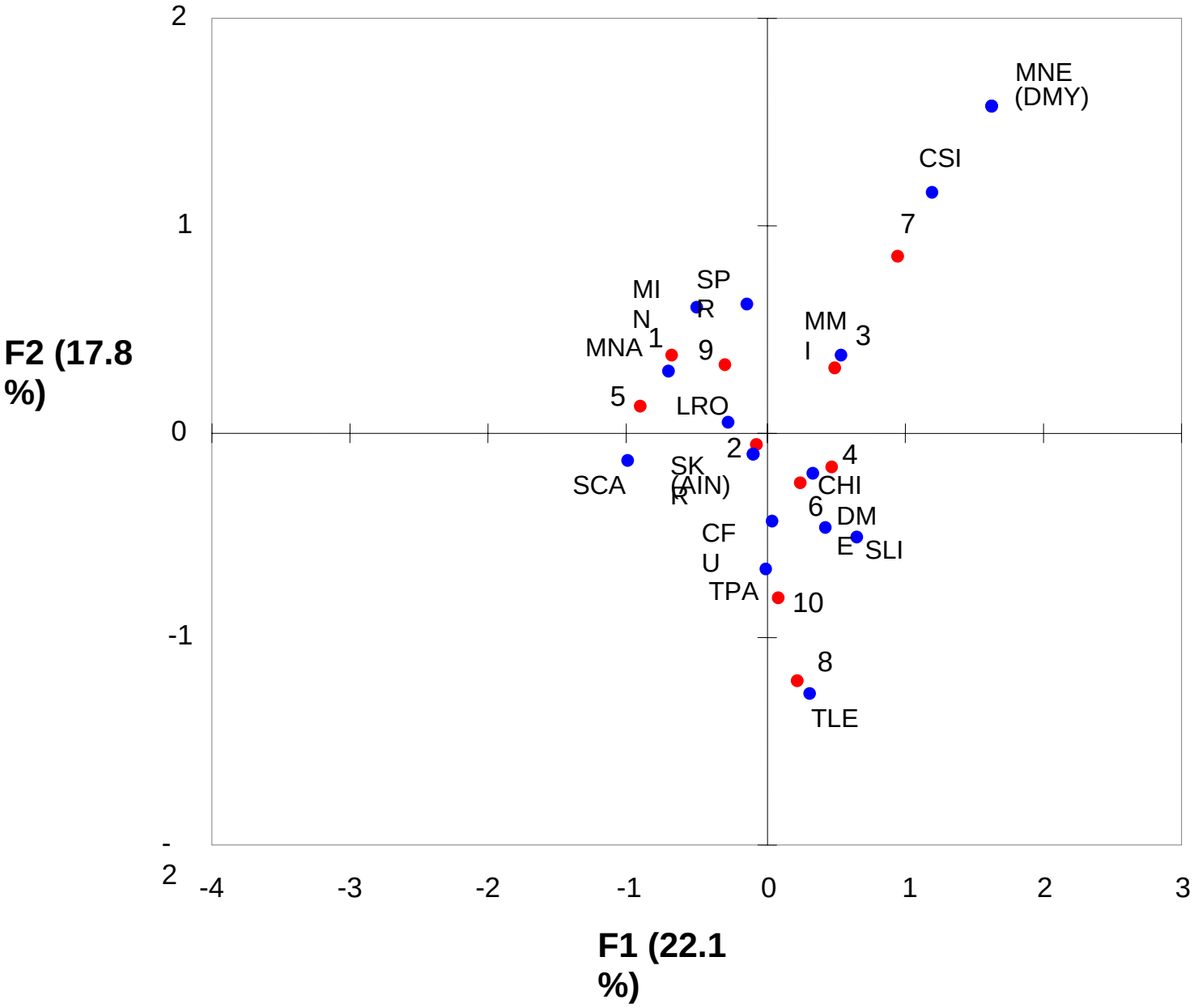

Fig. 3.Correspondence Analysis sowing relationships between terrestrial small mammal species (blue) and trap sites (red)