SMALL MAMMAL DIVERSITY AT 24 SITES
TARGETED FOR SHALE GAS EXPLORATION
IN THE KAROO

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RATIONALE

- **FRACKING IMPACTS IN THE KAROO?**
  - Local communities
    - Habitat loss or degradation
    - Pollution
    - Groundwater contamination
    - Many others
  
- Landscape effects
  - Reduced ecosystem services
  - Loss of connectivity between habitats (reduced dispersal)

STUDY AIMS

**Broad Goals**

- Assess diversity of terrestrial small mammals at varying spatial scales
- Understand what drives diversity and shapes local communities assemblages
- Prioritize the sites most vulnerable to fracking

**Specific Aims**

- $\alpha$, $\beta$ and $\gamma$ diversity of small mammal communities in footprint area and Nama-Karoo
- Small mammals: < 1kg body size – 3 orders
FRACKING IN THE KAROO

- **GEOGRAPHIC SCOPE**
  - Shale Gas Development Area
METHODS

- **SHERMAN TRAPPING**
  - Protocol
  - Checking
  - Processing

- **HISTORICAL RECORDS**

Transect x

\[15 \text{ m} \quad 100 \text{ m} \quad \text{..} \quad 15 \text{ m} \quad \text{..}\]

Transect y
METHODS

DATA ANALYSES

- Sampling effort and site diversity
  - Rarefactions and Chao estimates

- Diversity
  - Trapping results/Historical records
  - Ordination: Multiplicative beta (‘True’ $\beta$)
    - Pairwise Sorensen dissimilarity
    - Clustering (Sorensen similarity)
    - Non-metric Multidimensional scaling (NMDS)
  - Principal component analysis

Magurran 1998, Tuomisto 2012 (a,b)
RESULTS

- **Common species**
  - Rock mice (*Micaelamys* spp.)
  - Elephant-shrews (*Macroscelides/Elephantulus*)
  - Hairy-footed gerbil (*Gerbillususcus paeba*)
**Rarefaction and Sampling Efficiency**

- Chao asymptote estimation to estimate additional sampling effort to identify more species

86 – 92 % sampling efficiency (312 individuals)

765 additional individuals to obtain 100 %


**NK = Nama-Karoo; GR = Grassland; SK = Succulent Karoo, SV = Savanna**
RESULTS

Combining trapping results from historical records, we found:

- **α** (local) diversity: 2.92 (1-6 species/site) vs 5 (2-14 species/site)
- **γ** (regional) diversity: 14 vs 23
- **β** (species turnover between sites) diversity: 4.79 (+-1.58/0.70) vs 4.6 (+-7.43/0.50)

**Graph:**
- Nama-Karoo: Alpha = 5,000, Beta = 2,500, n = 16
- Succulent Karoo: Alpha = 3,000, Beta = 1,500, n = 1
- Albany Thicket: Alpha = 2,000, Beta = 1,000, n = 3
- Savanna: Alpha = 7,000, Beta = 3,500, n = 2
- Grassland: Alpha = 1,000, Beta = 500, n = 2

Note: The graph shows species richness per biome, with stars indicating significance levels.
RESULTS

DIVERSITY

- Diversity vs. Longitude

Pairwise Sorensen dissimilarity

Linear (Pairwise Sorensen dissimilarity)

\[ y = 0.0233x + 0.3708 \]

\[ R^2 = 0.48 \]

NK = Nama-Karoo; GR = Grassland; SK = Succulent Karoo, SV = Savanna, AT = Albany Thicket
RESULTS

NK = Nama-Karoo; GR = Grassland; SK = Succulent Karoo; SV = Savanna; AT = Albany Thicket
# Principal component analysis

## PCs scores/Environmental data

<table>
<thead>
<tr>
<th></th>
<th>PC1</th>
<th>PC2</th>
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<tbody>
<tr>
<td>Altitude</td>
<td>-0.644</td>
<td>0.732</td>
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<tr>
<td>NDVI</td>
<td>-0.534</td>
<td>-0.675</td>
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<tr>
<td>Annual Mean Temperature</td>
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<td>-0.672</td>
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<td>Max temp of warmest month</td>
<td>0.861</td>
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<tr>
<td>Min temp of coldest month</td>
<td>0.428</td>
<td>-0.867</td>
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<td>Annual precipitation</td>
<td>-0.794</td>
<td>-0.5671</td>
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<tr>
<td>Precipitation of wettest month</td>
<td>-0.853</td>
<td>-0.332</td>
</tr>
<tr>
<td>Precipitation of driest month</td>
<td>-0.651</td>
<td>-0.594</td>
</tr>
</tbody>
</table>
CONCLUSIONS

DIVERSITY

- Highest $\alpha/\gamma$ diversity = Nama-Karoo & Savanna
- High species turnover between biomes
- Savanna sites = most vulnerable

VULNERABILITY TO FRACKING

INCREASES ALONG PRECIPITATION GRADIENT

+ IMPORTANT BASELINE DATA
REFERENCES

- Chao et al. 2009
- Delcros et al. 2009
- Holness et al. 2016
- Magurran 1988
- Scholes et al. 2016
- Todd et al. 2016
- Tuomisto 2012 (A,B)
ACKNOWLEDGMENTS

- **SANBI**
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- **Ms. Zoe Woodgate**
- **Farmers**
- **Justin O’Riaain & Gary Bronner**
ANY QUESTIONS?
LIMITATIONS - OUTLINES

- **LIMITATIONS**
  - Short time assessment
  - Vast area
    - Important logistical aspects
  - Decision makers
    - Guidelines purposes

- **RESEARCH OPPORTUNITIES**
  - Small mammals and vegetation
  - Long-term monitoring