Appendix

Appendix 1A

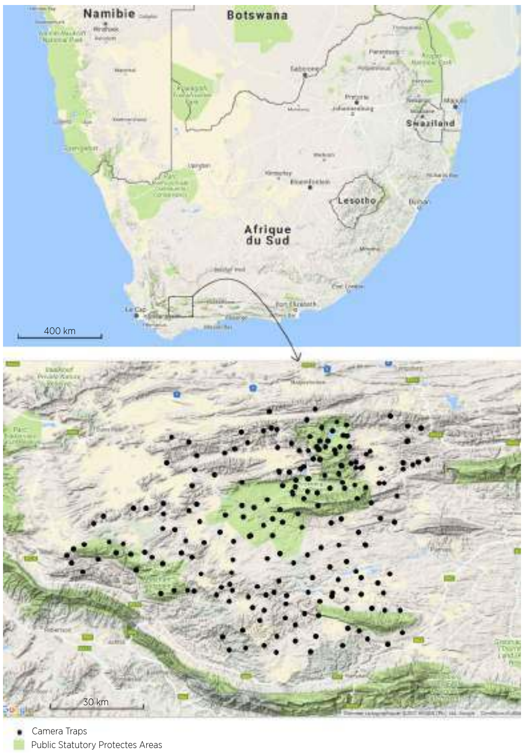

Figure 1A.1: The Little Karoo in South africa
The Little Karoo of South Africa is a semi-arid inter-montane basin falling into the Cape Floristic Region, where three globally-recognised biodiversity hotspots intermingle [230, 231, 240]. The succulent Karoo biome is one of two international biodiversity hotspots located in arid regions [230]. In South Africa, although these semi-arid rangelands contain some of the most biodiversity rich landscapes in the country, they are also some of the least conserved spaces; falling under the national average of 6% of their area under protection [253].

Appendix 2A

Data Volume

Table 2A.1: Camera trap data volumes.
These statistics describe the amount of data collected throughout the camera trap study, which took place in the Little Karoo.

	Northern Sanbona included	Northern Sanbona excluded
Overall dataset		
Camera trap sites:	222	207
Camera trap nights:	17631	16409
Photo-captures:	26312	25211
Percentage of duplicates:	55	56
Independent photo-captures:	11742	10991
Species:	91	86
Mammals:	51	46
Birds:	39	39
Reptiles:	1	1
Seasonal dataset		
Camera trap sites:		207
Total camera trap nights:		14331
Photo-captures:		21469
Percentage of duplicates:		58
Independent photo-captures:		9057
Species:		80
Mammals:		46
Birds:		33
Reptiles:		1

Appendix 3A

Chloropleth maps

These shaded graphical representations show the preferences in terrain roughness (ruggedness) for 27 mammal species in the Little Karoo [Chapter 1 section 1.3.3.2].

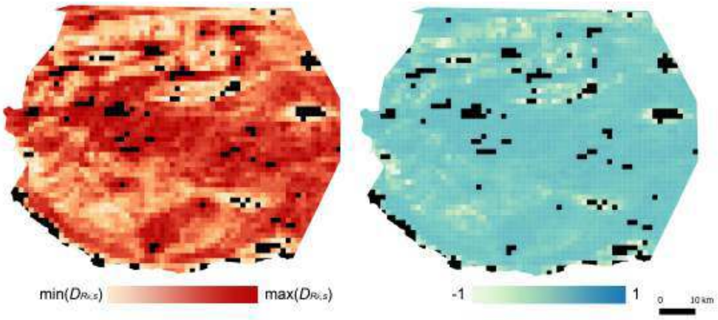

Figure 3A.1: aardvark

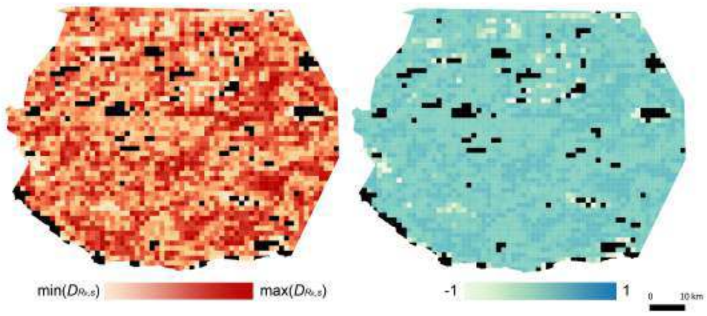

Figure 3A.2: aardwolf

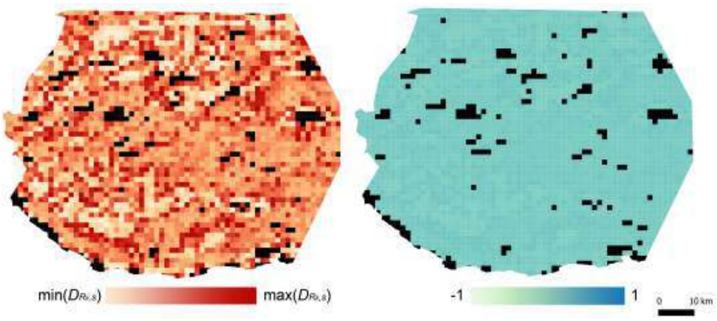

Figure 3A.3: African wildcat

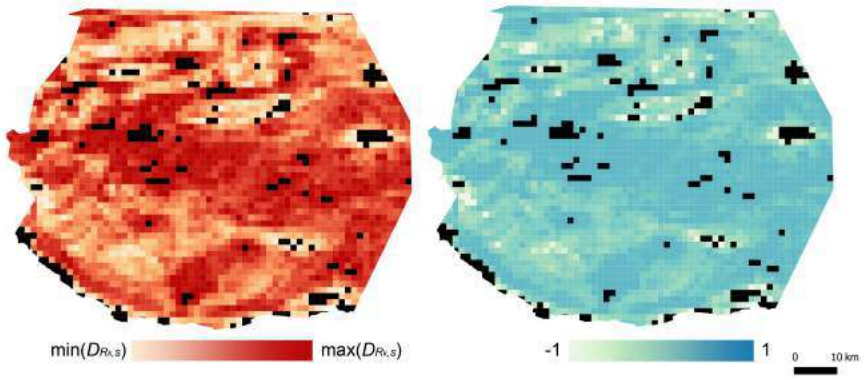

Figure 3A.4: black-backed jackal

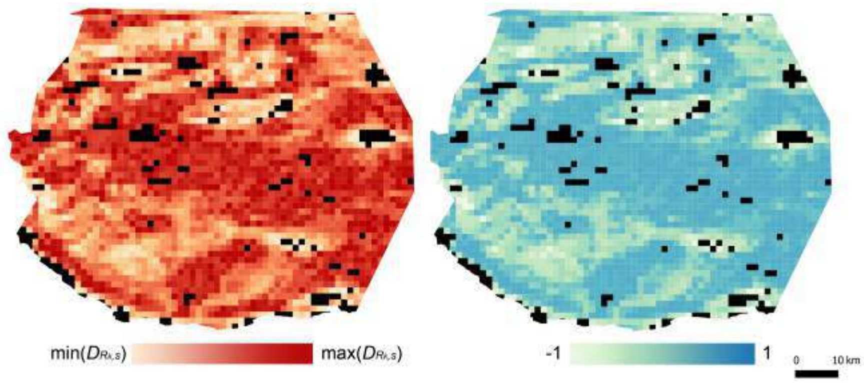

Figure 3A.5: brown hyena

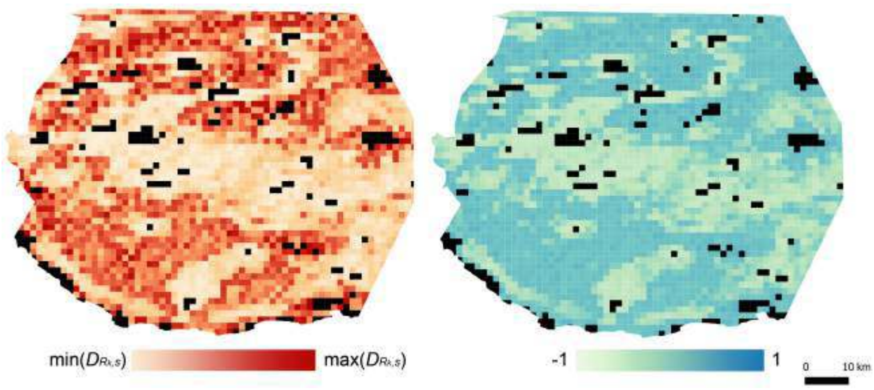

Figure 3A.6: Cape gray mongoose

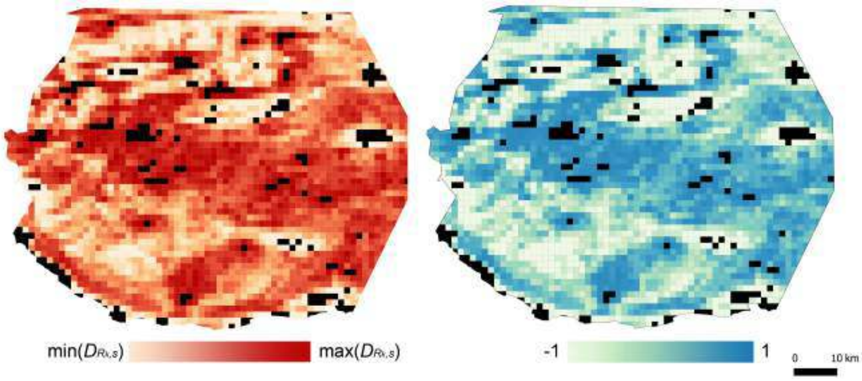

Figure 3A.7: Cape hare

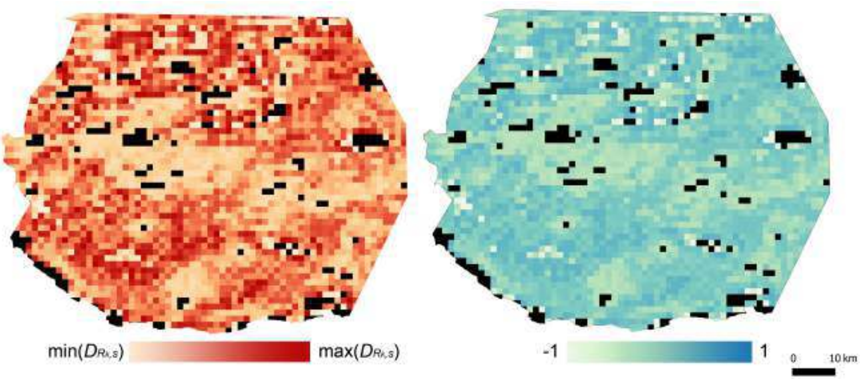

Figure 3A.8: Cape mountain zebra

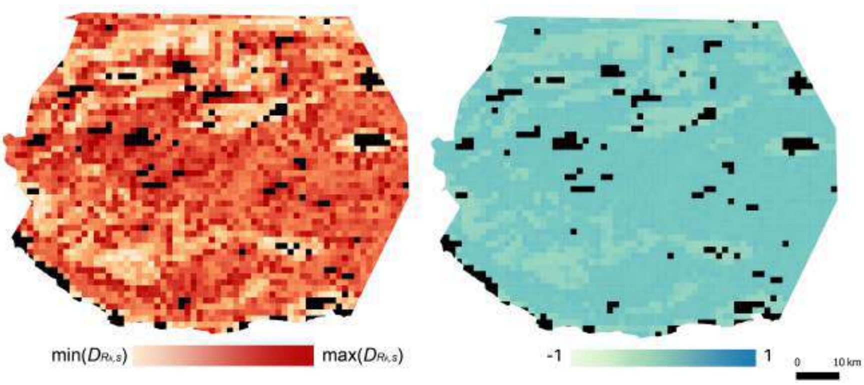

Figure 3A.9: Cape porcupine

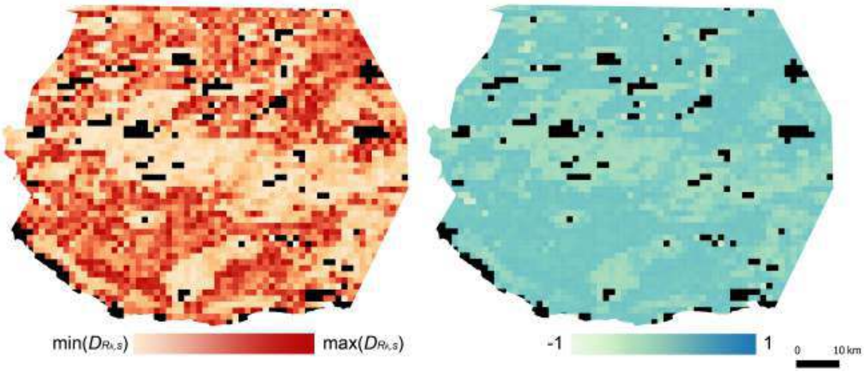

Figure 3A.10: caracal

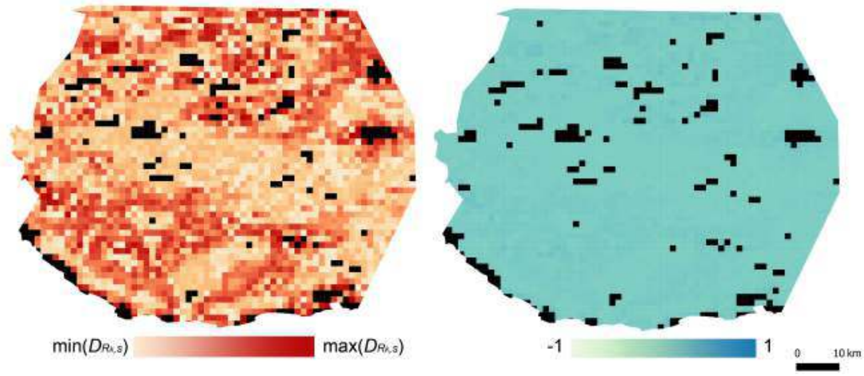

Figure 3A.11: chacma baboon

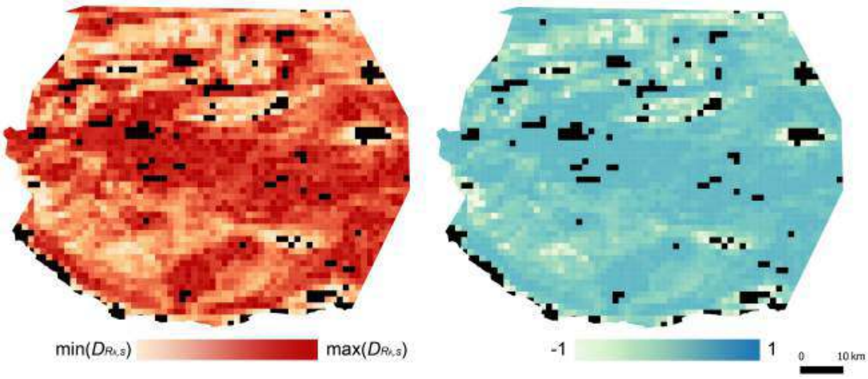

Figure 3A.12: eland

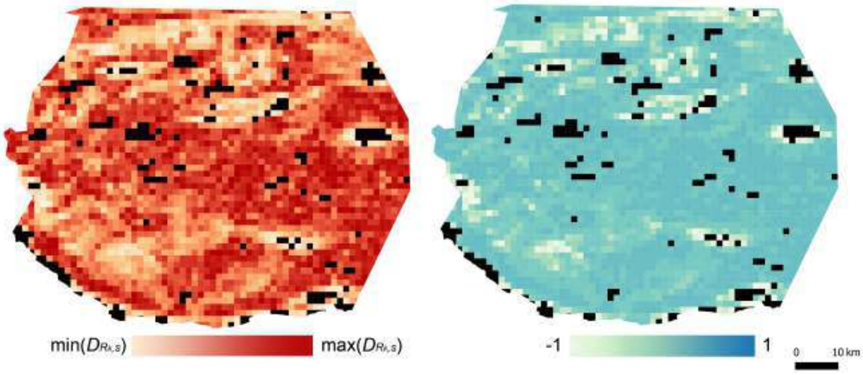

Figure 3A.13: gemsbok

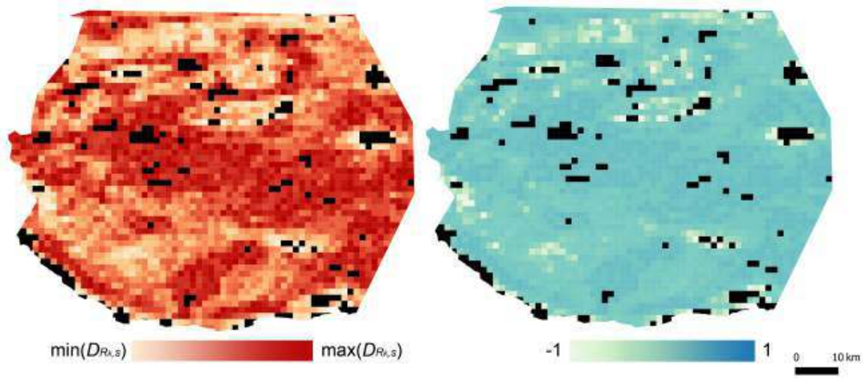

Figure 3A.14: greater kudu

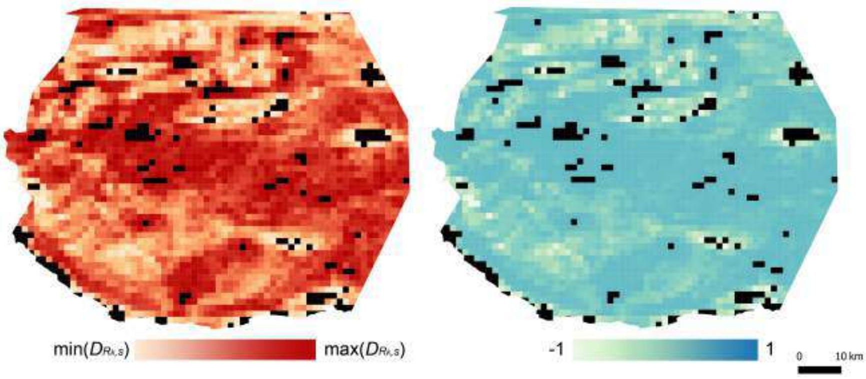

Figure 3A.15: grey duiker

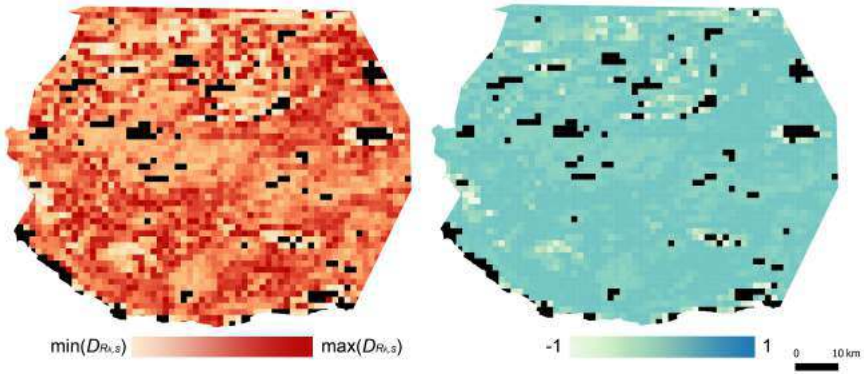

Figure 3A.16: grey rhebuck

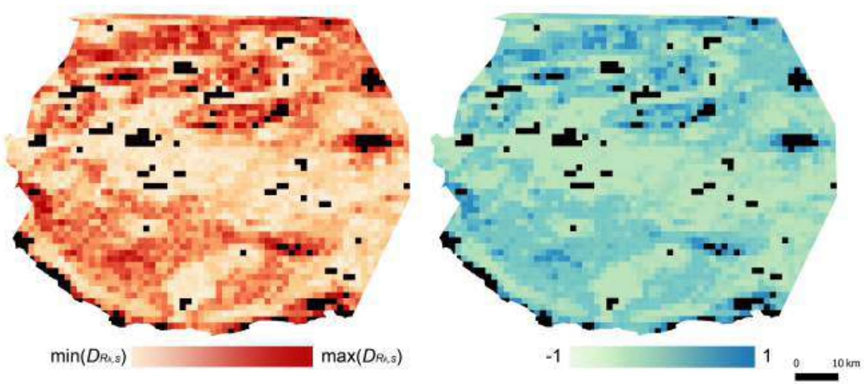

Figure 3A.17: grysbok

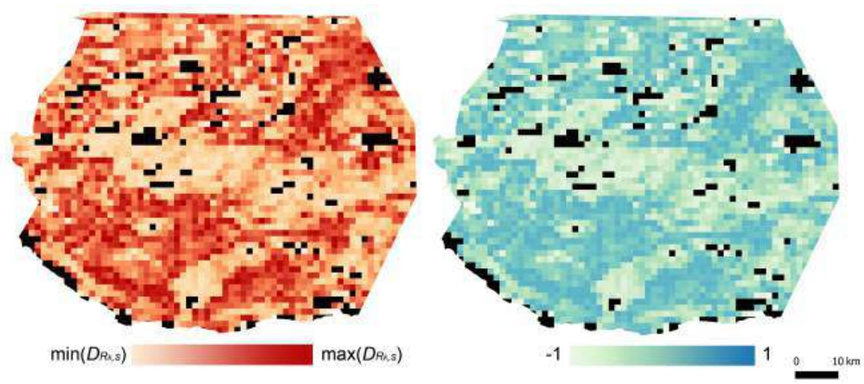

Figure 3A.18: Hewitts red rock rabbit

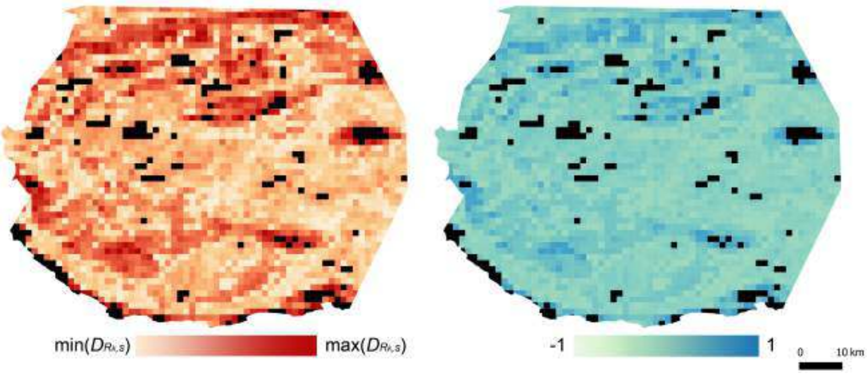

Figure 3A.19: honey badger

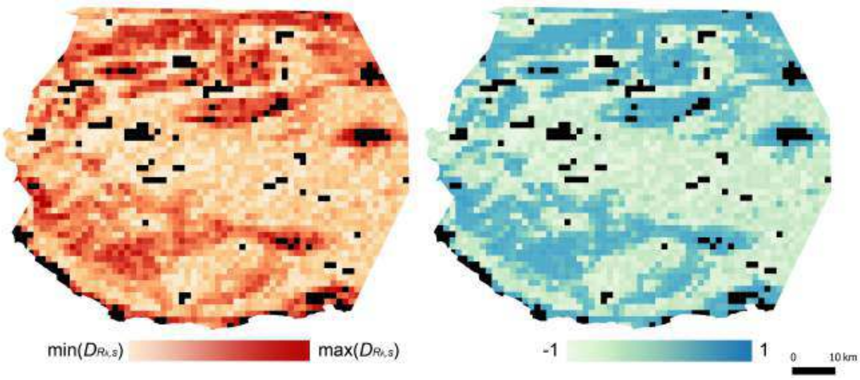

Figure 3A.20: klipspringer

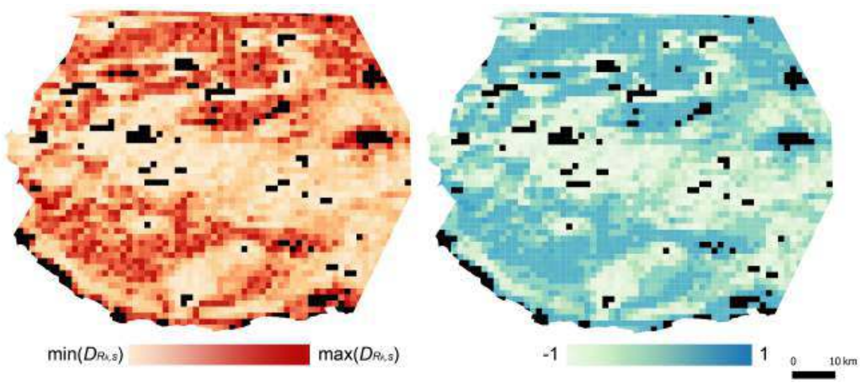

Figure 3A.21: leopard

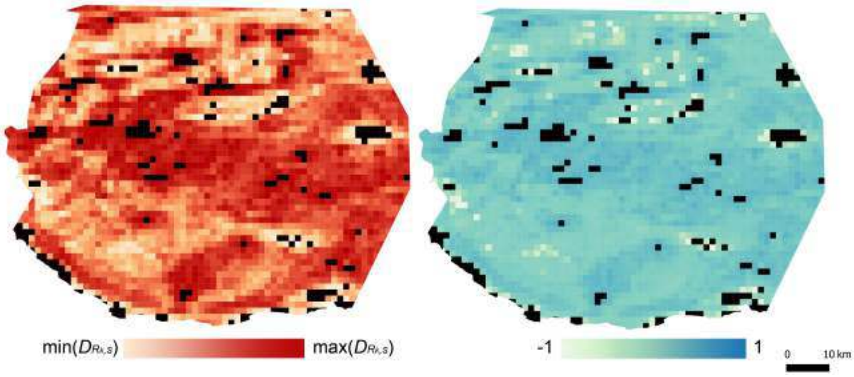

Figure 3A.22: red hartebeest

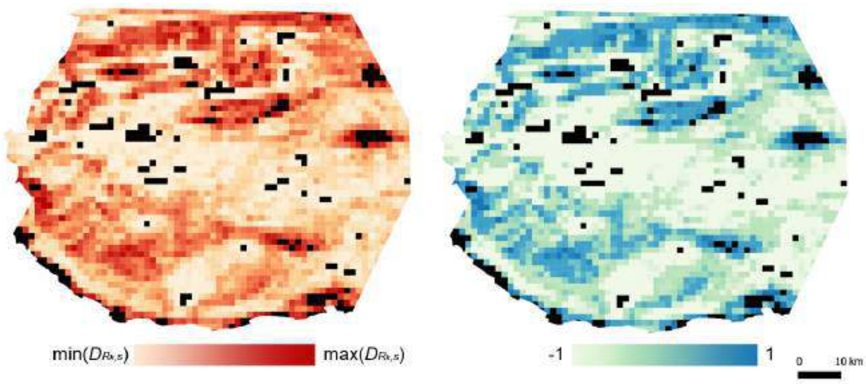

Figure 3A.23: rock hyrax

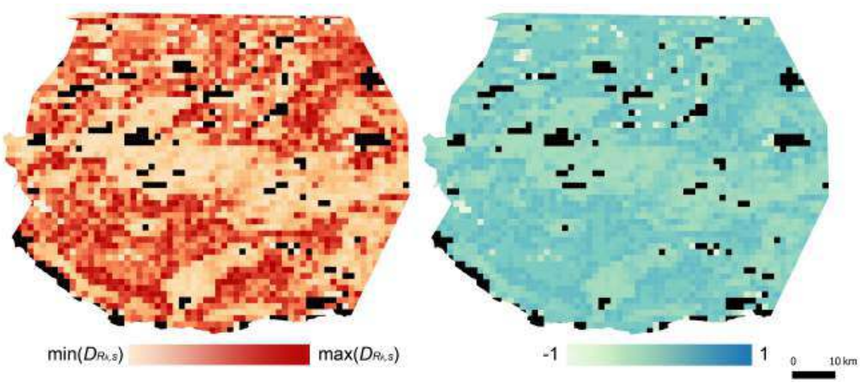

Figure 3A.24: scrub hare

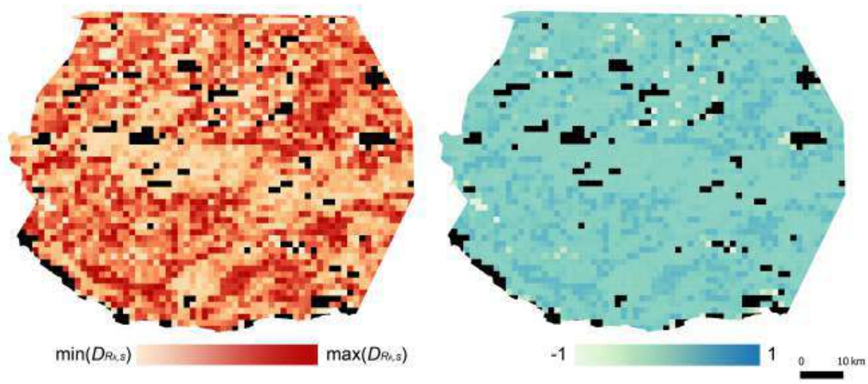

Figure 3A.25: small spotted genet

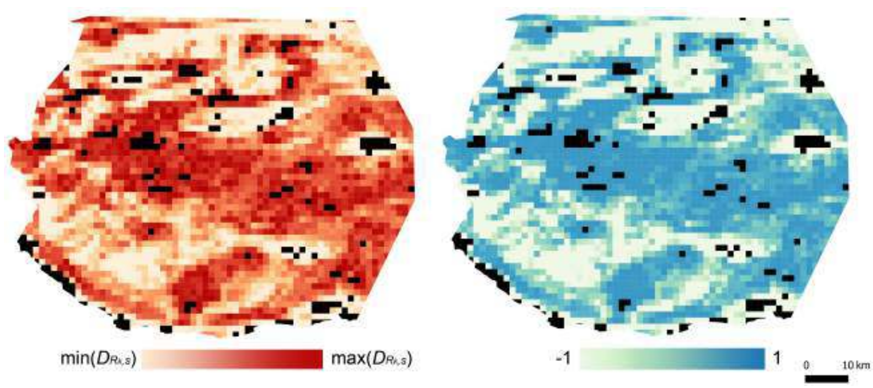

Figure 3A.26: springbok

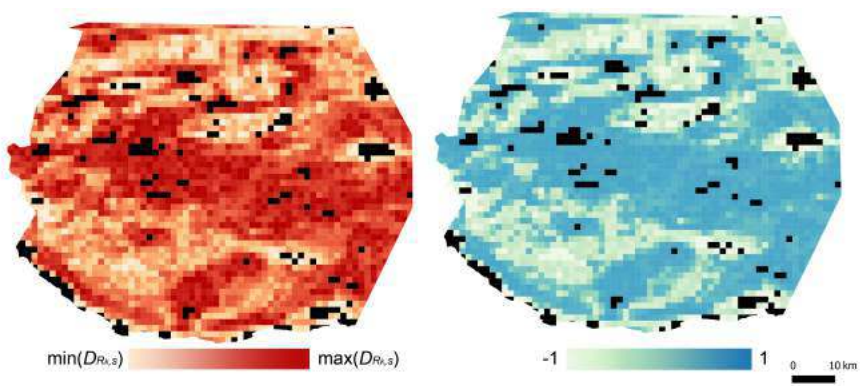

Figure 3A.27: steenbok

Appendix 4A

Demonstration of Eq. 2.11

To lighten the presentation, functions' variables were only annotated at the first occurrence of the function definition.

$t \mapsto A_{e,s}(t)$ and $t \mapsto A_{w,s}(t)$ are probability density functions whose domain is $D = [0, 24]$, therefore:

$$\forall\, t \in D,\ A_{e,s} \geq 0, \quad A_{w,s} \geq 0, \quad S_{,s} = A_{e,s} - A_{w,s} \quad \text{and} \quad A_{e,s},\ A_{w,s},\ S_{,s} \in C^o(D)$$

$$\int_0^{24} A_{e,s} \cdot dt = \int_0^{24} A_{w,s} \cdot dt = 1 \quad \Leftrightarrow \quad \int_0^{24} S_{,s} \cdot dt = 0$$

$$O_{,s} = \int_0^{24} \min(A_{e,s},\ A_{w,s}) \cdot dt$$

$$D = D^+ + D^-,$$

$$D^+ = \bigcup_{i=1}^{n} [a_i, b_i],\ \forall\, t \in D^+,\ A_{e,s} \geq A_{w,s} \Leftrightarrow \int_{a_i}^{b_i} A_{w,s} \cdot dt = \int_{a_i}^{b_i} \min(A_{e,s},\ A_{w,s}) \cdot dt$$

$$D^- = \bigcup_{j=1}^{m} [c_j, d_j],\ \forall\, t \in D^-,\ A_{e,s} \leq A_{w,s} \Leftrightarrow \int_{c_j}^{d_j} A_{e,s} \cdot dt = \int_{c_j}^{d_j} \min(A_{e,s},\ A_{w,s}) \cdot dt$$

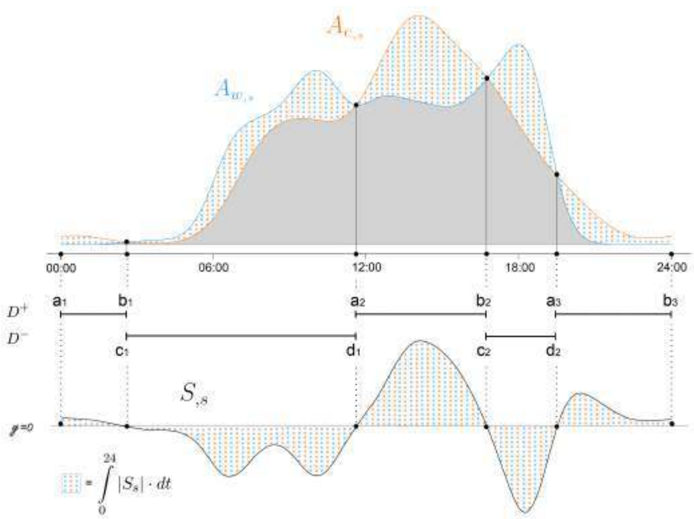

Figure 4A.1: Example showing D^+ and D^-, with $n = 3$ and $m = 2$

$$\begin{aligned}
\int_0^{24} |S_{,s}| \cdot dt &= \int_0^{24} |A_{e,s} - A_{w,s}| \cdot dt \\
&= \sum_{i=1}^{n} \int_{a_i}^{b_i} A_{e,s} - A_{w,s} \cdot dt - \sum_{j=1}^{m} \int_{c_j}^{d_j} A_{e,s} - A_{w,s} \cdot dt \\
&= \sum_{i=1}^{n} \int_{a_i}^{b_i} A_{e,s} - A_{w,s} \cdot dt + \sum_{j=1}^{m} \int_{c_j}^{d_j} A_{w,s} - A_{e,s} \cdot dt \\
&= \sum_{i=1}^{n} \int_{a_i}^{b_i} A_{e,s} - A_{w,s} + A_{w,s} - A_{w,s} \cdot dt + \sum_{j=1}^{m} \int_{c_j}^{d_j} A_{w,s} - A_{e,s} + A_{e,s} - A_{e,s} \cdot dt \\
&= \int_0^{24} A_{e,s} + A_{w,s} \cdot dt - 2 \ \cdot \ \sum_{i=1}^{n} \int_{a_i}^{b_i} A_{w,s} \cdot dt - 2 \cdot \sum_{j=1}^{m} \int_{c_j}^{d_j} A_{e,s} \cdot dt \\
&= 2 - 2 \ \cdot \ (\sum_{i=1}^{n} \int_{a_i}^{b_i} \min(A_{e,s},\ A_{w,s}) \cdot dt + \sum_{j=1}^{m} \int_{c_j}^{d_j} \min(A_{e,s},\ A_{w,s}) \cdot dt) \\
&= 2 \cdot (1 - \int_0^{24} \min(A_{e,s},\ A_{w,s}) \cdot dt) \\
&= 2 \cdot (1 - O_{,s})
\end{aligned}$$

The demonstration would be the same for $A'_{e,s}$, $A'_{w,s}$, $S'_{,s}$ and $A''_{e,s}$, $A''_{w,s}$, $S''_{,s}$:

$$\int_0^{24} |S_{,s}| \cdot dt = 2 \cdot (1 - O_{,s})$$

$$\int_0^{24} |S'_{,s}| \cdot dt = 2 \cdot (1 - O'_{,s})$$

$$\int_0^{24} |S''_{,s}| \cdot dt = 2 \cdot (1 - O''_{,s})$$

Appendix 5A

Parameter coefficients from best-performing models

Modelling leopard population density in the Little Karoo.

Table 5A.1: β coefficients from Model 21

This table provides the β coefficients estimated on the original scale when Model 21 was fitted. Once transformed on the scale given by the link function, the real parameter values (fitted values) can be accessed: log-transformed density D and σ; logit-transformed g0 and pmix.

	Estimate	SE	LCL	UCL
D	-11.02	0.92	-12.82	-9.22
D s(*ruggedness*) 1	8.13	9.16	0.98	26.08
D s(*ruggedness*) 2	0.34	0.56	-0.76	1.43
g0	-3.52	0.12	-3.77	-3.28
σ	7.25	0.15	6.96	7.55
σ *h*2	1.14	0.13	0.88	1.40
σ *session* B	0.28	0.13	0.03	0.53
σ *session* C	0.52	0.15	0.23	0.81
σ *session* D	0.10	0.18	-0.25	0.45
σ *session* E	0.33	0.12	0.10	0.56
σ *session* F	0.28	0.11	0.06	0.50
pmix *h*2	-0.83	0.41	-1.63	-0.03

Table 5A.2: β coefficients from Model 22

This table provides the β coefficients estimated on the original scale when Model 22 was fitted. Once transformed on the scale given by the link function, the real parameter values (fitted values) can be accessed: log-transformed density D and σ; logit-transformed g0 and pmix.

	Estimate	SE	LCL	UCL
D	-11.27	1.10	-13.43	-9.11
D s(*ruggedness*) 1	0.70	1.71	-2.65	4.05
D s(*ruggedness*) 2	5.23	5.71	-5.96	16.42
D s(*ruggedness*) 3	0.66	0.68	-0.67	1.98
g0	-3.53	0.12	-3.77	-3.28
σ	7.25	0.15	6.96	7.55
σ *h*2	1.14	0.13	0.88	1.40
σ *session* B	0.28	0.13	0.03	0.53
σ *session* C	0.52	0.15	0.23	0.81
σ *session* D	0.11	0.18	-0.24	0.45
σ *session* E	0.33	0.12	0.10	0.57
σ *session* F	0.28	0.11	0.06	0.50
pmix *h*2	-0.82	0.40	-1.61	-0.03