Environmental associations of small ground mammals in the Pilbara

Lesley Gibson
Department of Environment and Conservation, Science Division, Woodvale

Aims

- **Provide an overview of the status and distribution of small terrestrial mammal species in the Pilbara**

- **Identify environmental attributes influencing the occurrence of individual species of small ground-dwelling mammals**

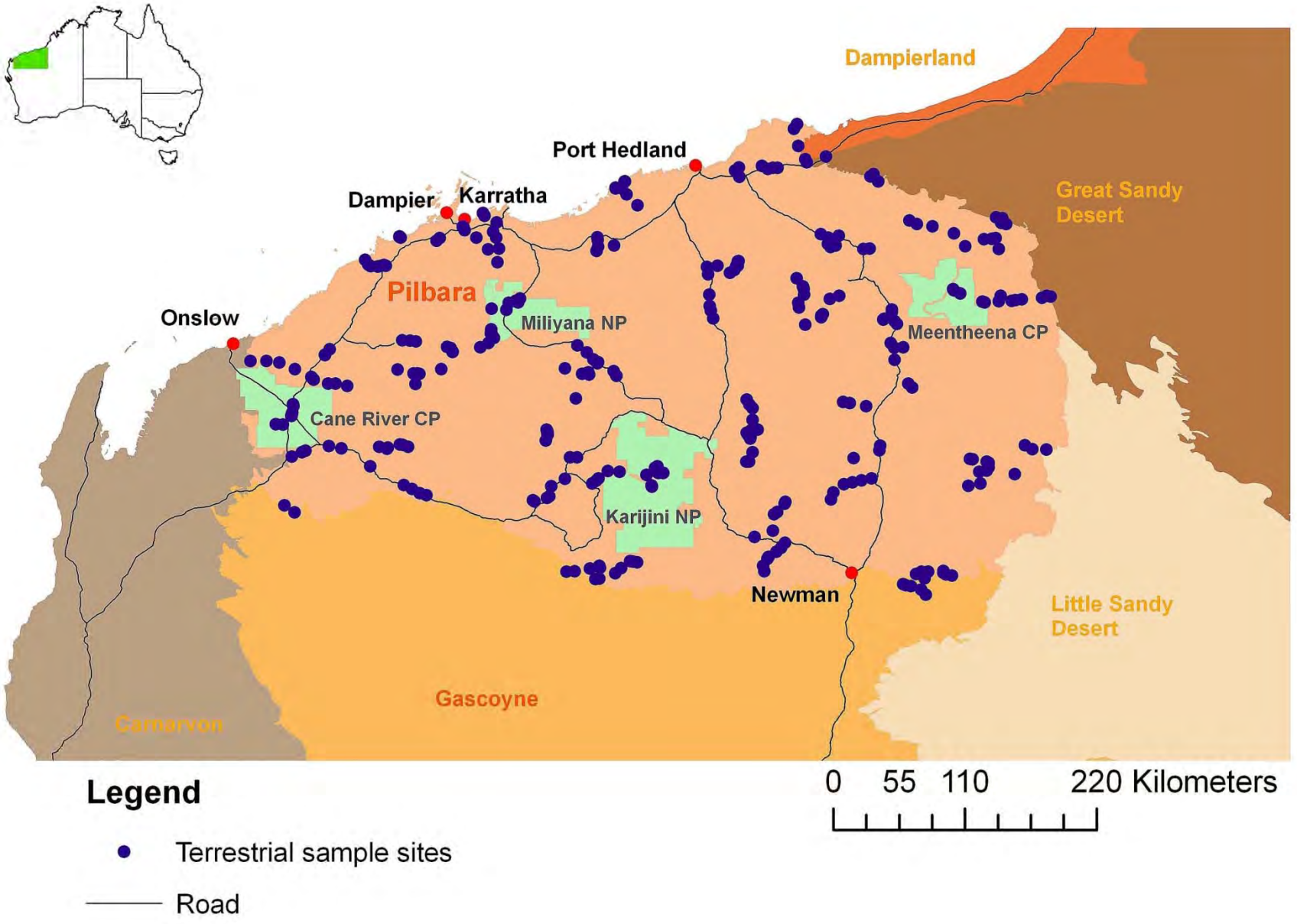
Survey area – the Pilbara

- The region covers an area of about 179 000 km^2
- Consists of a broad range of habitat types including tidal flats, mangroves, hummock & tussock grassland savannas, mountain ranges, gorges and arid tropical woodlands
- Has elements of northern and desert species, as well as endemics
- The climate is considered arid, with mainly summer rainfall

Survey design

- 24 survey areas were positioned so that the geographic extent and environmental gradients of the region was sampled.
- Each survey area consisted of between 11 and 13 sites positioned to represent the geomorphic profile of each survey area
- Sites were also placed in the least-disturbed examples of each habitat type that could be found
- 301sites sampled

Terrestrial survey sites



Field sampling

- Each site contained two lines of 5 pitfall traps. Pits were 10 m apart, 60 cm in length & connected by a drift fence (25 cm high).
- Four sampling sessions were conducted (October 2004/5 and May 2005/6), with each session consisting of 7 nights
- Accidental captures by invertebrate traps at the same sites were also recorded

Model building - analysis

- Only species with a prevalence of ≥ 5% modelled
- Pearson correlation between variables examined (< 0.8 included)
- Expert opinion to reduce candidate variable set (n/10 variables)
- Multivariate adaptive regression splines (MARS) used to model presence/absence

Environmental variables selected for modelling

Variable code	Description
MTEMP	Mean temperature of the coldest period
RAIN	Mean annual rainfall
SILT	Percent silt
NITGN	Total nitrogen (ppm)
XCAL	Exchangeable calcium
CLAY	Percent clay
GCOV	Ground vegetation cover (≤1 m)
ELE	Elevation (m)
SLP	Slope (degrees from horizontal)
RUG500	Topographic ruggedness
CST	Distance to the coast (km)
RIV	Distance to major drainage lines (km)
FMAX	Maximum coarse fragment size (1-7)
OUTCRP	Abundance of rock outcrop (0-5)

Model building

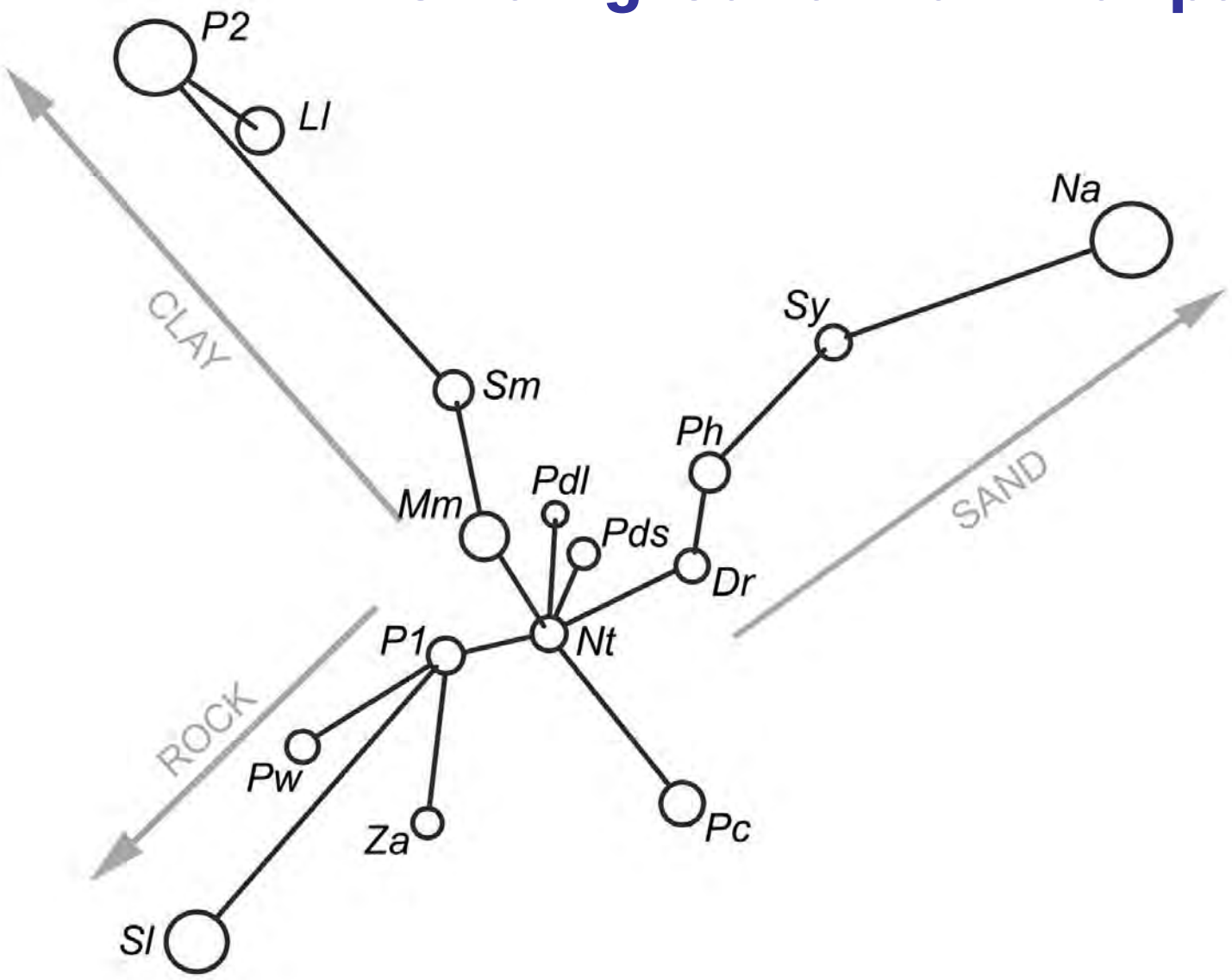
- Run in R using *mda* package and customized code (Elith & Leathwick 2007)
- Evaluated models using ROC/AUC (k-fold cross validation) and % deviance explained
- Also, PATN analysis to cluster species according to co-occurrences to aid with comparisons of MARS models

Small ground-dwelling mammal species recorded

18 species (10 dasyurids & 8 rodents)

Species	Code	Prevalence (n)
Ningaui timealeyi (D)	NTIM	0.59 (179)
***Planigale* sp1** (D)	PLA1	0.50 (149)
Sminthopsis macroura (D)	SMAC	0.44 (131)
Pseudomys hermannsbergensis (R)	PHER	0.42 (125)
Dasykaluta rosamondae (D)	DROS	0.39 (118)
Pseudomys desertor (R)	PDES	0.27 (80)
Mus musculus (R)	MMUS	0.26 (77)
Sminthopsis youngsoni (D)	SYOU	0.11 (33)
***Planigale* sp2** (D)	PLA2	0.11 (33)
Pseudomys chapmani (R)	PCHA	0.10 (29)
Pseudomys delicatulus (R)	PDEL	0.06 (19)
Leggadina lakedownensis (R)	LLAK	0.06 (18)
Pseudantechinus woolleyae (D)	PWOO	0.05 (16)
Zyzomys argurus (R)	ZARG	0.05 (14)
Notomys alexis (R)	NALE	0.03 (9)
Sminthopsis longicaudata (D)	SLON	0.03 (8)
Pseudantechinus roryi (D)	PROR	0.02 (5)
Sminthopsis ooldea (D)	SOOL	0.02 (5)

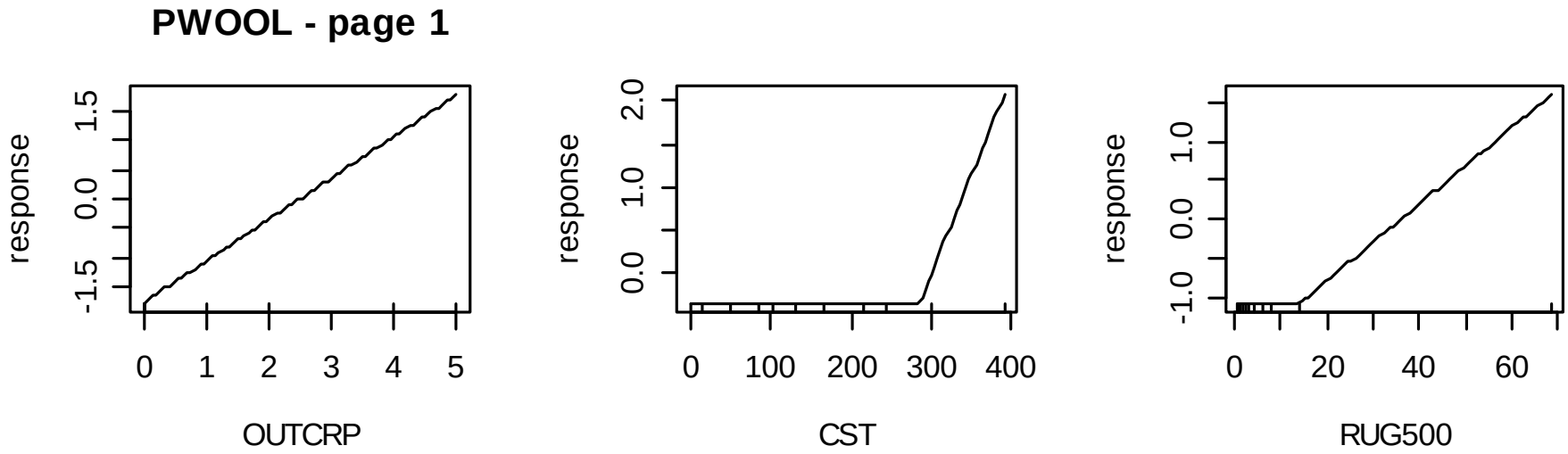
Small ground mammal patterns



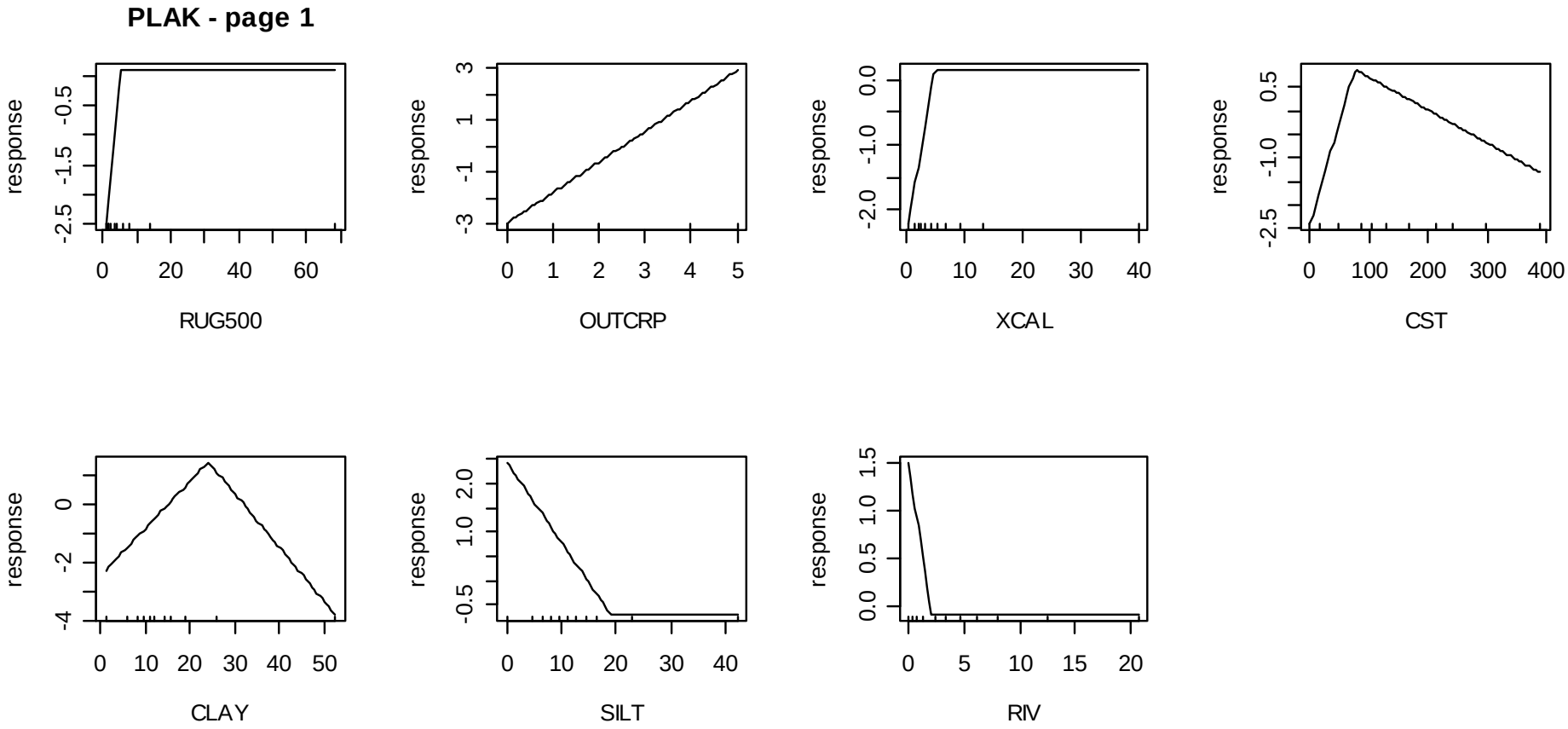
Marginal contributions of each predictor variable to the MARS single-species models

Variable	SYOU	PHER	DROS	PDEL	PDES	NTIM	PCHA	MMUS	SMAC	PLA2	LLAK	PLA1	PWOO	ZARG
RAIN	18.7	0.0	14.2	-	15.0	23.2	-	10.6	14.6	5.3	6.1	0.0	-	-
SILT	57.7	17.3	33.5	24.0	0.0	0.0	-	0.0	0.0	-	-	9.0	-	-
NITGN	-	8.1	0.0	7.3	9.6	9.7	20.8	5.5	7.5	-	-	0.0	-	-
XCAL	-	0.0	0.0	-	15.6	0.0	-	0.0	17.0	10.6	3.3	10.1	-	-
CLAY	28.0	10.6	21.6	-	9.5	32.0	11.6	0.0	15.7	21.7	10.3	20.1	-	-
GCOV	-	0.0	0.0	-	4.7	0.0	-	5.7	0.0	-	-	0.0	-	-
RUG500	-	0.0	32.4	-	0.0	23.9	0.0	4.2	10.4	-	-	21.7	3.5	32.3
CST	-	8.5	0.0	14.9	29.3	6.8	16.7	29.9	34.7	-	-	21.0	5.5	-
RIV	-	8.7	12.9	8.9	0.0	0.0	-	8.0	0.0	-	-	8.1	-	-
FMAX	14.1	0.0	0.0	-	0.0	0.0	-	9.5	0.0	-	-	0.0	0.0	0.0
OUTCRP	-	31.3	0.0	-	0.0	0.0	-	0.0	0.0	23.6	0.0	51.2	14.7	0.0
AUC	0.94	0.79	0.71	0.85	0.68	0.76	0.64	0.74	0.74	0.95	0.83	0.89	0.79	0.86
AUC se	0.01	0.02	0.03	0.04	0.02	0.03	0.05	0.03	0.03	0.02	0.05	0.02	0.07	0.04
% Dev exp	60.4	31.1	20.3	30.3	18.0	24.9	20.8	29.2	24.8	62.8	42.9	50.7	24.7	28.5

MARS response curves for *Pseudantechinus woolleyae*



MARS response curves for *Planigale* sp1



Sandy habitats

S. youngsoni

D. rosamondae

P. hermannsbergensis

Rocky habitats

P. woolleyae

Z. argurus

Planigale sp1

Clayey habitats

L. lakedownensis

S. macroura

N. timealeyi

Conclusions

- All small ground mammals (< 50 g) known to occur in Pilbara captured – relatively intact fauna
- Commonly caught – *Ningaui timealeyi*, *Planigale* sp1, *Sminthopsis macroura*, *Pseudomys hermannsbergensis* and *Dasykaluta rosamondae*
- Rarely caught – *Pseudantechinus* species, *Notomys alexis*, *S. longicaudata* and *S. ooldea*

Conclusions

- Variables describing the substrate, such as percent clay and silt in the soil, and estimates of rockiness and/or ruggedness, strongly influenced species' occurrence.

- Species co-occurrence patterns also best explained by substrate.

- Small ground-dwelling mammals largely partition Pilbara landscapes on substrate-type.

Acknowledgements

- Cast of many but special thanks to:
- Those who helped to establish the sites
- Those who participated in the survey
- Colleagues from the Western Australian Museum
- The project was funded by DEC, WAM and NHT