# Patterns of Richness:

# Ground-dwelling Beetles of the Pilbara

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Figure 1


Figure 2


Figure 3


Figure 4


Figure 5


Figure 6


Figure 7

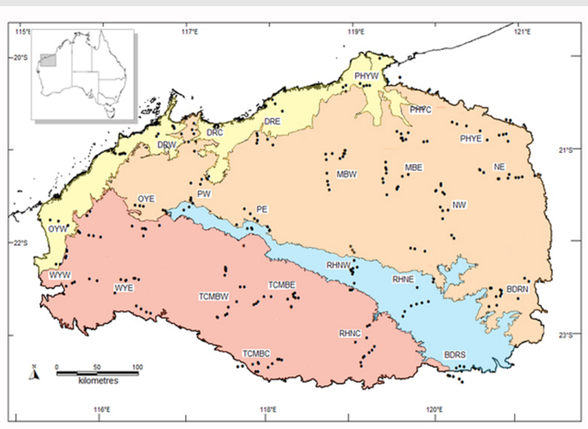

Figure 9


Figure 8

## INTRODUCTION

Ground-dwelling beetles are a major component of most terrestrial habitats and some of the most visible and easilyrecognised are the ground beetles (Carabidae, Figs. 1-3), pie-dish beetles (Tenebrionidae, Figs. 4-6) and the 'dung' beetles (Bolboceratidae, Fig. 7; Hybosoridae and Scarabaeidae, Figs. 8,9). However, attempts to estimate and document their diversity in Australia have been limited by the state of taxonomic knowledge, and difficulties in access to many habitats and environments (Austin et al. 2004).

As a component of a large study documenting biodiversity patterns in the Pilbara biogeographic region of WesternAustralia, ground-dwelling terrestrial beetle data were collected from 297 quadrats representing the main habitats of the region (Guthrie, Weir and Will 2010). This was the first systematic survey of the region's beetles, and has provided a baseline on distribution, taxonomy and morphological variability for future surveys and monitoring programs. The Bolboceratidae, Carabidae, Hybosoridae, Scarabaeidae and Tenebrionidae were used to assess assemblage structure and species turnover in terms of geographic, climatic and substrate attributes of Pilbara landscapes.




The Pilbara IBRA region is in the north-west of Western Australia and covers179,000km$^2$. Geology and vegetation differ across the four subregions.

## METHODS

Pitfall traps were opened for 12 months at 297 quadrats in a variety of habitats (including outcrops and breakaways, heaving clay soils,sand plains, stoney plains and riparian zones or flood plains; Figs.10-12) across 24 survey areas. The 297 quadrats were positioned to sample the main geomorphic and vegetation components of the Pilbara.

Presence and absence of species at quadrats were compiled as a data matrix and analysed using the computer package PATN. The resulting species compositional patterns were then related to a set of environmental variables for each quadrat.


Figure 10


Figure 12


Figure 11

## RESULTS & DISCUSSION

The Pilbara assemblages of Bolboceratidae, Carabidae, Hybosoridae, Scarabaeidae and Tenebrionidae were species-rich with 429 species identified in the survey. However 68% could not be assigned to currently recognised species. It is likely that more species are yet to be discovered, particularly in habitats and substrates not sampled during the survey. Species recorded at only one qudrat constituted 33% of the fauna, suggesting a high proportion of localised endemic forms.

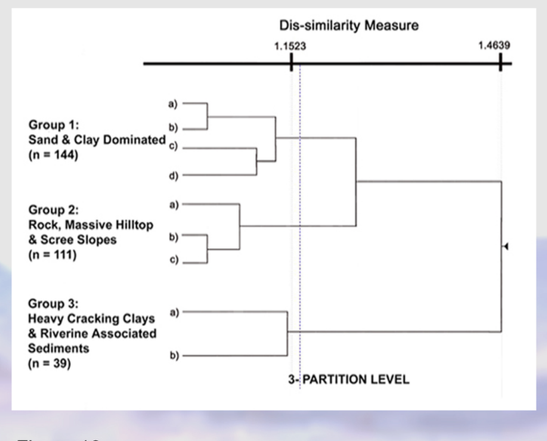



Figure 13

### Quadrat Composition

When classified according to similarities in their species composition, three quadrat groups were apparent, each with internal partitioning (Fig. 13). In combination, slope, soil profile and depth separated all three groups in the parition structure (Fig. 14).

At the quadrat scale, compositional patterns were correlated with landform and soil attributes (slope, soil depth, exchangeable calcium, exchangeable potassium and sandiness). Heavy cracking clays, and saline and riverine associated muds, supported a distinctive suite of species, from which the more widespread or common species were generally absent.

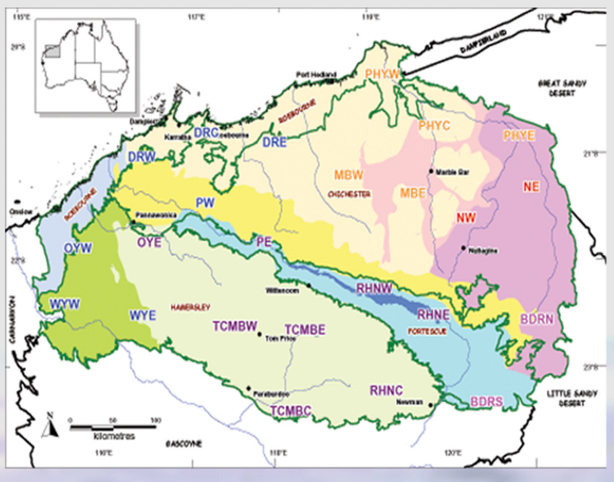



Figure 15

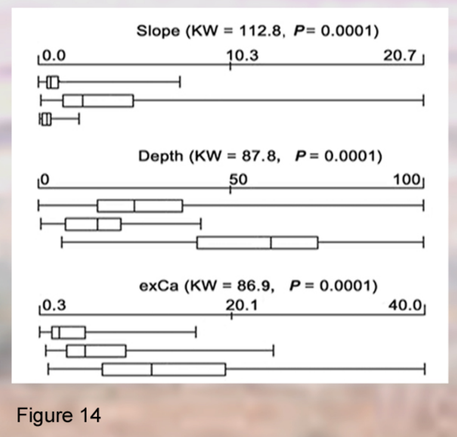



Figure 14

### Biogeographical Regionalisation

Ten survey cell partitions were defined based on their compiled species lists, showing strong geographically localised patterns down to the five partition level at least (Fig.15). The combination of the attributes longitude and elevation statistically separated all five partitions (Fig. 16). At the re-gional scale, patterns in composition reflected the Pilbara region's physio-geographical subregions.

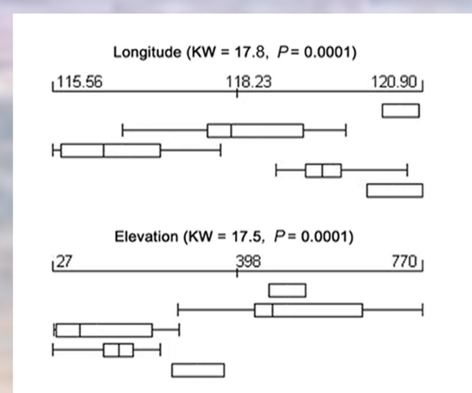



Figure 16

Localised evolutionary processes associated with and promoting low mobility have resulted in a beetle fauna with a high proportion of strongly localised endemic forms.

Comparisons of the beetle fauna with neighbouring semi-arid areas such as the Great and Little Sandy Deserts, Ashburton and Northern Carnarvon Basin are required to determine phylogenetic relationships between taxa, distributions, and to explore further the correlation of species composition with land attributes that have emerged from our analysis.

It is difficult to place our findings into a wider context; an extensive literature search has failed to find comparable studies examining environmental attributes and beetle assemblage turnover. However, when the gross morphology and general ecology of the five families are taken into account, our findings are logical. All five families are ground-dwelling terrestrial beetles, and within each family there exist varying fossorial abilities and adaptations to different soil and terrain types.

**REFERENCES**

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Photos Coutesy Of:
Fig.1: *Loxandrus rectus* (Carabidae: Pterostichinae); K. Will, copyright
Fig.2: *Helluo* sp. nov. (Carabidae: Helluoninae); N. Guthrie,
Fig.3: *Carenum* sp. (Carabidae: Scaritini); N. Guthrie,
Fig.4: *Helea* sp. (Tenebrionidae: Tenebrionini); N. Guthrie,
Fig.5: *Chalcopteroides* sp. (Tenebrionidae: Tenebrionini); N. Guthrie,
Fig.6: *Boreosaragus* sp. (Tenebrionidae: Tenebrionini); N. Guthrie,
Fig.7: *Blackburnium cooperi* (Bolboceratidae: Bolboceratinae); Natalie Banks, copyright CSIRO
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Fig.9: *Teinogenys aurilegulus* (Scarabaeidae: Dynastinae); Natalie Banks, copyright CSIRO
Figs. 10-12: quadrat photos, DEC
Background: Millstream National Park; Neil Hamilton

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