**Outline for disparity paper/chapter**

Currently just morphological; add ecological later or keep that separate?

**Broad question:** Is morphological disparity in tenrecs more than skin deep?

**Possible journal:** Biology Letters? (2,500 words including references, figure legends, acknowledgements)

**Current story** (if results stay the same after I check my code with simulated data)

* Tenrecs appear to be morphologically diverse so we expect them to have high disparity
* Define high disparity as more than their nearest relatives and more than expected by chance
* Compared to golden moles; tenrecs are more disparate in skull shape but not in mandible shape
* Compared to chance; tenrecs (and golden moles) are less morphologically disparate than expected by chance
* Conclusion; important to test assumptions, tenrecs are diverse but they’re not exceptional in their diversity

**Introduction**

* Adaptive radiation; taxonomic diversity therefore expected high levels of disparity (but remember that the two may not be correlated throughout a clade’s history ([Ruta et al., 2013](#_ENREF_7)))
* Common assumption that superficial morphological diversity corresponds to significant levels of disparity
* Tenrecs are a superficially diverse and therefore presumably disparate group but this hasn’t been tested quantitatively…
* (Convergence is expected to evolve by chance ([Stayton, 2008](#_ENREF_8)) so the same could be true of disparity?)
* If tenrecs are truly an exceptional example of morphological diversity then there are two predictions;

1. Tenrecs show a significantly higher level of morphological disparity than their closest relatives, the golden moles
2. Tenrecs are more morphologically disparate than expected by chance

* Focus on morphological disparity of the skull
* Generalist insectivore diet in most of the species so don’t expect significant changes in dentition
* However, even superficial observations of the crania indicate that there are different shapes among the species
* Interested in overall shape rather than direct changes between corresponding homologous features; geometric morphometric approaches are a great improvement for studying morphological disparity compared to previous work based on discrete character traits ([Foote, 1997](#_ENREF_3))

**Methods**

* Data collection; museums, photographs, replicates (*supplementary file with museum accession numbers/ figshare reference?)*
* Sample size as a proportion of the total species in that family
* Taxonomy and phylogenies
* Landmarking; example picture for each view *(landmark* *definitions and descriptions in supplementary?)*
* Superimposition, PCA, choose axes for 95% of the variation
* Simulations of shape evolution separately on each phylogeny (tenrecs and golden moles)

**Disparity calculations**

* There isn’t a single best method to measure disparity, it’s important to compare methods ([Ciampaglio et al., 2001](#_ENREF_2))
* Sum and product of range and variance ([Brusatte et al., 2008](#_ENREF_1), [Foth et al., 2012](#_ENREF_4), [Ruta et al., 2013](#_ENREF_7), [Wainwright, 2007](#_ENREF_9))
* Directly from the Procrustes shape data ([Zelditch et al., 2012](#_ENREF_10))
* *Morphological disparity index (*[*Harmon et al., 2003*](#_ENREF_5)*) – probably not relevant because they calculated subclade disparity through time but I might be able to modify it*
* *Maybe use a different method? (*[*O'Meara et al., 2006*](#_ENREF_6)*) Disparity depends on the rate of evolution, length of evolution and the relationships of the taxa.*
* Could I sub-divide some disparity comparisons into sub-genera to try and get around the problem of having large numbers of Microgale?

**Results**

1. Morphospace plots – just tenrecs and golden moles for each data set
2. Tenrecs vs. golden moles:

* Boxplots for different disparity measures (variance comes from bootstrapping PC axes?)
* NPMANOVAs – significantly different areas of morphospace (doesn’t test for significant difference in disparity measures directly)
* Subdivide disparity comparisons into genera?
* *Rarefaction curves to show it’s not an artefact of sample size (supplementary?)*

1. Tenrecs vs. chance

* Compare observed to simulated disparity measures – just give p values, distributions in supplementary?

**Discussion**

* Tenrecs are more disparate than golden moles in their skull shape but not their mandible shape; *I don’t understand why there’s a difference*
* Tenrecs are not more disparate than expected by chance- importance of testing assumptions
* Yes they’re a diverse family but most (19/31 in my data) are Microgale – general shrew-type morphology. *There’s probably greater disparity among tenrec genera but this comparison will be tricky because there are both tenrec and golden mole genera that are only represented by single species*

**References**

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