Using museum specimens to investigate biogeographic patterns in the Indo-West Pacific

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Geographic patterns of diversity

- Why are some areas more diverse than others?
Geographic patterns of diversity

- Why are some areas more diverse than others?
  - Comprehensive geographic sampling
  - Clear understanding of species limits
Sanciangco et al, 2013 doi:10.1371/journal.pone.0056245.g001
Sea cucumbers are poorly known

- Focus on skeletal elements
- Few specimens considered
- Nocturnal
- Fall apart

“Slimy, disgusting Holothuriae”, Darwin 1845

“A mass of repulsive slime”, HL Clarke 1922
Multi-million dollar industry
Cuvierian tubules
“Melting” body wall
Asexual reproduction
Evisceration
Hosts
3050 individuals sequenced
390 recognized species
Species delineation with DNA data
• Goal 1
  Assessing diversity in sea cucumbers using genetic data

• How many species does the genetic data suggest?
• How does it compare to the number of species inferred from morphology?
Genetic species vs. Morpho-species distribution among different taxa.
Overall

- For all sea cucumbers
  - Proportion of sampled diversity: 25%
  - Number of morpho-species sampled: 390
  - Number of genetic species found: 613
  - Percent increase in diversity: 58%
  - Proportion of singletons: 37%
Goal 2
What can we learn about the spatial and temporal context of diversification?

- What is the geographical setting of sister species?
- Is there a signal for sympatric speciation?
Assessing geography of diversification
Most sister species are allopatric
Biogeographic barriers
A RESEARCH PAPER

THE NARRATIVE

THE DATA

THE CODE

Methods (part 2)
A RESEARCH PAPER

THE NARRATIVE

THE DATA

THE CODE

Methods (part 2)
Workflows - data validation

Collection database

Data for paper

External data

paper/dataset
Workflows - data validation

- Data
  - Catalog numbers
  - GPS coordinates
  - Taxon names

- Databases
  - iDigBio
  - marineregions.org
  - Google Maps API
  - OpenStreet Map API
  - WoRMS

- Tools
  - ridigbio
  - mregions
  - taxize/rotl

https://ropensci.org
Training

- Data Carpentry
  - https://datacarpentry.org

- Reproducible Science Curriculum

- Field to Database workshop
Acknowledgments

- iDigBio
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  - Yves Samyn
  - Didier VanDenSpiegel

- rOpenSci
- Data Carpentry

- Pre-print: “More than meets the eye: diversity and geographic patterns in sea cucumbers”
  http://biorxiv.org/content/early/2015/01/23/014282
Workflows

Field data
- GPS coordinates
- Tissue sample for DNA
- Field identifier
- Photos

Manuscript
- Data generation
  - Range maps
  - Phylogenetic tree
  - Species limits

Collection Database
- Identifiers
- Taxon name

External Databases
- Open Tree of Life
- GenBank
- iDigBio
- WoRMS

Species description