Genetics for Wildlife Landscape Connectivity

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Genetics for wildlife connectivity

Kurushima et al. 2006
Today’s Topics

- The questions
  - Spatial and temporal scales
- Approaches
  - Individual → metapopulations & metagenomes
- Molecular methods
- Analytic and statistical methods
Identification of taxonomic unit and sex
Population Structure
Geneflow analyses
Genetic assignment - dispersal
Relatedness
Non-invasive tracking:
  - “Poopulation“ biology (fecal/scat DNA)
  - Where is a specific individual traveling?
  - How many individuals are there?
Calif. hummingbirds

Anna’s

Black-chinned

Allen’s

Calif. hummingbirds

Costa’s

Rufous

Calliope
RUFOUS HUMMINGBIRD

PIF Species of Continental Concern
What species is it? Allen’s Hummingbird
Two species in Selasphorus genus: Rufous Hummingbird and Allen’s Hummingbird

- Allen’s Hummingbird
  - R2 STRONGLY POINTED
  - R5 1.2 – 1.9 MM

- Rufous Hummingbird
  - R2 NOTCHED ON INNER WEB AND STRONGLY EMARGINATED ON OUTER WEB
  - R5 1.8 – 2.6 MM
How to study DNA in birds the weight of a nickel?

Trace DNA for Population Health & Ecology

- Feathers from banded birds
- Toe nail sample
- Birds that strike windows or caught by cat
WHAT SEX IS IT?

- **DNA Sex-identifying tools**
  - Birds are opposite of mammals
  - Female has 2 different sex chromosomes: ZW
  - Males = ZZ
  - CHD genes located on avian sex chromosomes
  - (chromo-helicase-DNA-binding)


Swainson’s Hawk
Two species in Selasphorus genus: 
Rufous and Allen’s Hummingbird
SNPs

Y=C / T
W=A / T
R=A / G
Bighorn sheep
Landscape genetics

Subspecies groups
- Rocky Mtn
- Desert

- Subdivisions at question
(several slides of unpublished data)
What are genetic relationships among populations?

Gene flow, Genetic differentiation, FST

- = very low gene flow (FST >0.15)
- = moderate gene flow (FST 0.05-0.15)
- = high gene flow (FST 0-0.04)

Ernest et al. 2003 Cons. Genetics
California mtn lion family Pedigree in progress
Great Gray Owls

Hull et al 2010. J. Molecular Phylogenetics and Evolution
<table>
<thead>
<tr>
<th>Sampling Region</th>
<th>Ne (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W Canada</td>
<td>481 (22.8–1)</td>
</tr>
<tr>
<td>S. Oregon</td>
<td>19 (13.4–30.5)</td>
</tr>
<tr>
<td>N. Oregon</td>
<td>15 (6.1–53.9)</td>
</tr>
<tr>
<td>E. Idaho</td>
<td>34 (17.9–128.7)</td>
</tr>
<tr>
<td>S. Sierra</td>
<td>14 (10.2–21.5)</td>
</tr>
</tbody>
</table>

Hull et al 2010. J. Molecular Phylogenetics and Evolution
Hull et al 2010. J. Molecular Phylogenetics and Evolution
Landscape Genetic Modeling

- Adding GIS and resistance theory of animal movements
- Circuitscape (McRae et al.)
- Ecological distances (least-cost paths)

Spear et al. 2010 Use of resistance surfaces for landscape genetic studies: considerations for parameterization and analysis. Mol. Ecol

Graves et al. 2012 – employed home ranges rather than only one point per sample

See special issues of Journals
LANDSCAPE ECOLOGY – 2012
ECOLOGICAL GENETICS - 2011
The Future and Conclusions

- Next generation sequencing (DNA-seq and RNA-seq)
- Computational methods and software changing rapidly
- Considerations for collection of samples and data
- Where to send your samples: choice of genetics lab
  - Experience with species, questions, system, type of analysis
  - Data bases of DNA for species
  - +/- Proximity to study – may not matter
Acknowledgements

- Lab members

- Collaborators and funding agencies
  - National Park Service – Santa Monica Mtns
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