Theoretical Paradigms

Genetics

Lab this week:
none until sewage treatment plant on 20 October
27-29 October = ORPI, Pinacate, CEDO (Mexico)
(see website for lab readings)

Housekeeping, 10 October 2006
Thank Hans-Werner Herrmann
506 Topic and References (12 Oct → 19 Oct)

Upcoming Readings
today: Text Ch.5, Biogeography excerpt, Ch.6

Thurs 12 Oct: Text Ch. 6 and 7
Tues 17 Oct: Text Ch. 7 (Kathy Gerst, invasive species)
Thurs 19 Oct: Text Ch. 7 and 8

Short oral presentations
10 Oct Viola Sanderlin & Crystal Richt
12 Oct Robert Dietz
17 Oct Sarah Karasz and Allison Peterson
19 Oct Rachel Smith and Shea Cogswell
2) SNR WEDNESDAY SEMINAR
On Wednesday, October 11, at noon in BSE 225, Tom Degomez (Associate Extension Specialist, SNR) will give a talk on Maintaining an Extension Program While Drowning in Bark Beetles.
All are encouraged to attend.

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3) LABORATORY OF TREE-RING RESEARCH SEMINAR
THOMAS HARLAN
University of Arizona
The Bristlecone Project Brought Up To Date
WHEN: Wednesday, October 11 2006
TIME: 12:00 noon
WHERE: Building 45, Tree-Ring West* Room 20 (*Math East Building)
For more information please call 621-1608
MAP:
<http://www.ltrr.arizona.edu/map.html>

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Global Climate Change Lecture Series
All lectures will take place at UA Centennial Hall.

Tuesday, October 17
Global Climate Change: The Evidence
Malcolm Hughes, Professor of Dendrochronology

Tuesday, October 24
Global Climate Change: What's Ahead
Jonathan Overpeck, Director of the Institute for the Study of Planet Earth and Professor of Geosciences

Tuesday, October 31
Global Climate Change: The Role of Living Things
Travis Huxman, Assistant Professor of Ecology and Evolutionary Biology

Tuesday, November 7
Global Climate Change: Ocean Impacts and Feedbacks
Julia Cole, Associate Professor of Geosciences

Tuesday, November 14
Global Climate Change: Disease and Society
Andrew Comrie, Dean of the Graduate College and Professor of Geography and Regional Development

Tuesday, November 21
Global Climate Change: Could Geoengineering Reverse It?
Roger Angel, Regents' Professor of Astronomy

Tuesday, November 28
Global Climate Change: Designing Policy Responses
Paul Portney, Dean of the Eller College of Management and Professor of Economics
Viola Sanderlin & Crystal Richt

Just the fashion facts
Old trends avoid the trash can
Randi Eichenbaum
AZ Daily Wildcat 9/21/06

Cheetah Conservation Fund in Namibia

KAS, NAS, VIS, ESA

Can we flood the Grand Canyon?
10 October Question 4 (due 17 October)

Which unit of biology deserves protection? Why?

New Question!...

(5 points to winner)

1. Given limited resources, would you concentrate conservation efforts on one species with high genetic diversity and perhaps several subspecies, OR, would you focus on several different species, each of them with low genetic diversity? Why?

2. Do genetically modified organisms (GMOs) constitute or lead to a conservation problem? Why?

3. You have just been hired as a conservation consultant. Based on what you know from the SDCP and other research, what do you believe are the most important components of an effective policy? Why are these components so important to good conservation planning?

4. If islands are such "endemic hotspots," should they be considered a conservation priority even though they comprise a small percentage of the world’s land mass? (similar scenario for coral reefs in marine systems)

5. How do advances in technology and increased understanding of molecular biology/genetics both bolster and detract from the goal of Conservation Biology and the ESA?
Chapter 5 (Paradigms...)

- Genetic Diversity (MVP, PVA)
- Island Biogeography
- Metapopulations
- Habitat Heterogeneity
- Disturbance

Chap 6 – Genetics of Conservation Biology

Figure 5.3
Percent change in the inbreeding coefficient ($\Delta f$) at different population sizes. Note that the value of the inbreeding coefficient increases as population size declines.

*After Frankel and Soule (1981).*
Quickly lose rare alleles in bottlenecks

Drift

When populations number less than a few hundred individuals random events become more important to genetic structure of population than natural selection

3,000-10,000 breeding adults
Cyprinodon macularius
Desert Pupfish

Desert pupfish declined due to the introduction and spread of exotic predatory and competitive fishes, water impoundment and diversion, water pollution, groundwater pumping, stream channelization, and habitat modification.

Extinction Vortex for a population

F Vortex: inbreeding depression, lethal equivalents (homozygous recessives)

A Vortex: genetic drift and loss of variation (can’t adapt)

R Vortex: \( r = \) spontaneous rate of increase (coupled with environmental stochasticity)

D Vortex: discontinuity (isolation)
Figure 5.5
The F vortex and A vortex: two accelerating and degenerative cycles of population decline driven by an increasing level of reducing depression (F vortex) or a decreasing ability of the population to adapt to a changing environment (A vortex). Both are exacerbated in small populations. N is the population size, D is the population distribution, r is the population’s instantaneous rate of increase, and ND is the effective population size.

After Gilpin and Soulé (1986).

VanDyke 2003

Figure 5.6
The R vortex: an accelerating and degenerative cycle of population decline driven by increasing vulnerability to environmental disturbance in the population size. N is population size, D is population distribution, r is the population’s instantaneous rate of increase, and ND is the effective population size.

After Gilpin and Soulé (1986).

VanDyke 2003

Figure 5.7
The D or disconnectivity vortex: an accelerating and degenerative cycle of population decline driven by the fragmentation of the population into smaller and smaller units. N is population size, D is population distribution, and ND is the effective population size. A lowering of N and r increase in demographic randomness can alter the spatial distribution of the population, contributing to increasing fragmentation. More fragmented distributions increase the likelihood of local extinctions.

After Gilpin and Soulé (1986).

VanDyke 2003
Hardy Weinberg Equation

two alleles: p, q

\[(p + q)^2 = p^2 + 2pq + q^2\]

Under Hardy Weinberg Equilibrium

\[H_o = 2pq\]

\[H_o\] can be calculated

If \(p=0.6\), \(q=0.4\), then \(2pq = 0.48 = H_o\)

Fst = 0, or <0.01 indicate little divergence among pops.

Fst > 0.1 indicate much divergence among pops.

Wright’s Fixation Index

Fst = \(\frac{(H_t-H_s)}{H_t}\) (H= heterozygosity)

Total Pool \begin{align*}
&\text{Separate populations} \\
\end{align*}
Equilibrium Heterozygosity ($\Delta H = 0$)

$$H^* = 2Nm$$

$H =$ heterozygosity  
$N =$ population size  
$m =$ mutation rate

Therefore, smaller populations have lower equilibrium heterozygosity

Minimum Viable Population (MVP)  
(Frankel, Soule, Franklin, Shaffer)

50/500/+ Rule

Short term  
Mid term  
Long Term

PVA...