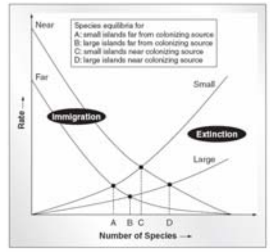
Lecture 15, 10 Oct 2006
CH5 Paradigms, CH6 Genetics

Conservation Biology
ECOL 406R/506R
University of Arizona
Fall 2006

Kevin Bonine
Kathy Gerst



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)

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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

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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>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.

All lectures begin at 7pm and are free to the public. Call 520.621.4090 for more information.

http://cos.arizona.edu/climate/

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

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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

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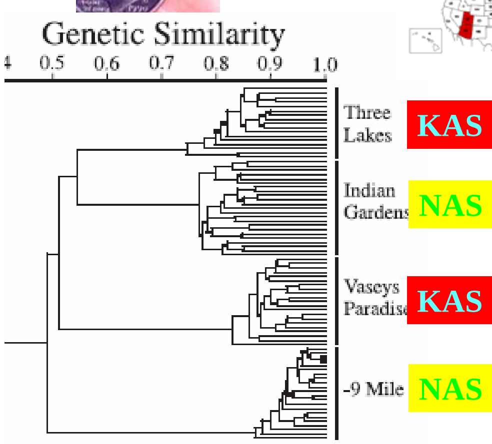
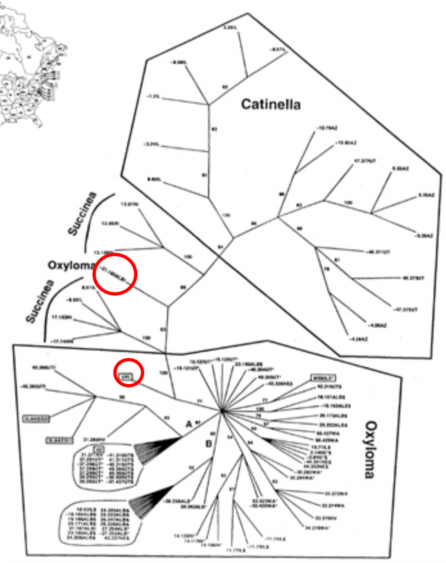
KAS, NAS, VIS, ESA





Can we flood the Grand Canyon?

6

10 October Question 4 (due 17 October)

Which unit of biology deserves protection? Why?

New Question!...

(5 points to winner)

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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?

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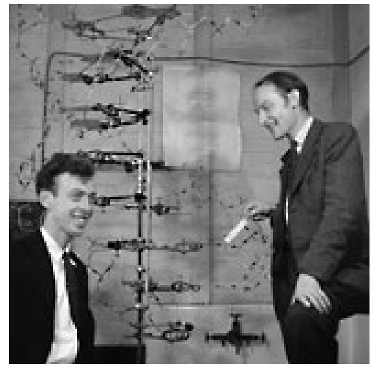
Chapter 5 (Paradigms…)



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

Chap 6 – Genetics of Conservation Biology

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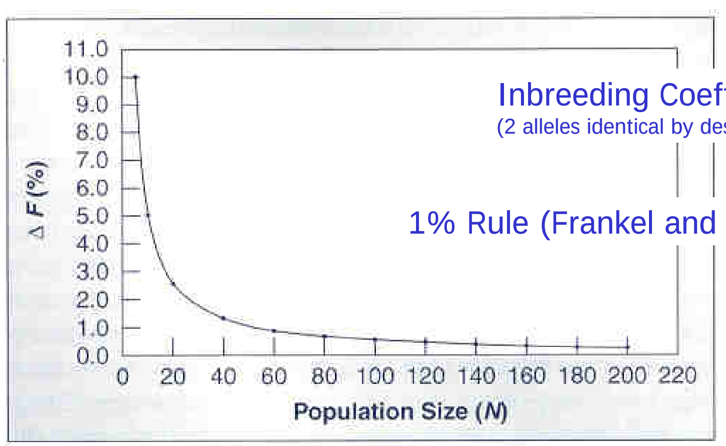

Inbreeding Coefficient
(2 alleles identical by descent)

1% Rule (Frankel and Soule)

Figure 5.3
Percent change in the inbreeding coefficient (Δ*F*) at different population sizes. Note that the value of the inbreeding coefficient increases as population size declines.

After Frankel and Soulé (1981).

Van Dyke 2003

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Quickly lose rare alleles in bottlenecks

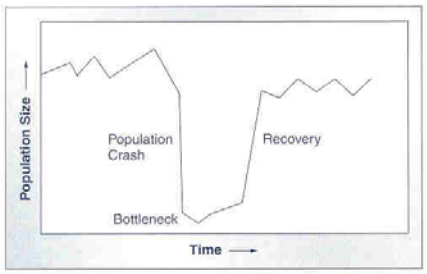
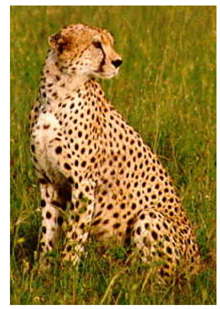


Figure 5.2
A graphical representation of population size before, during, and after a population bottleneck.



Cheetah
Major Histocompatibility
Complex

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Drift

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

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3,000-10,000 breeding adults

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Cyprinodon macularius

Desert Pupfish

Photograph Courtesy of John Rinne

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.

Healthy population of almost 10,000 fish inhabits this oasis. This last refuge of a unique fish is being actively managed.

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)

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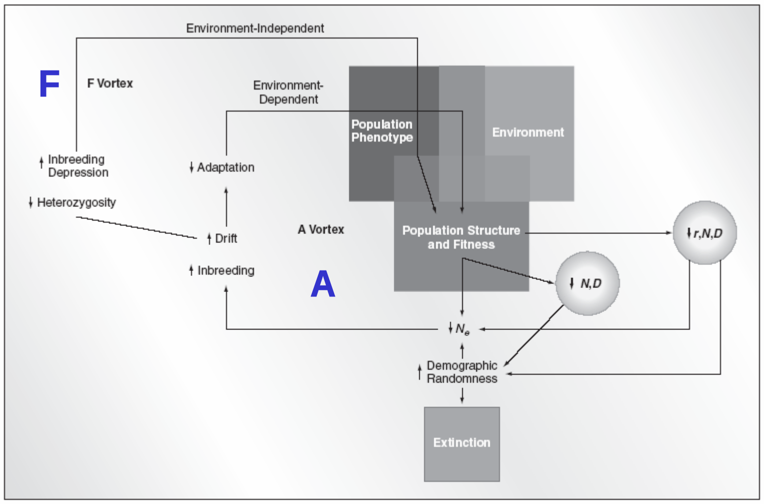

Figure 5.5
The F vortex and A vortex, two accelerating and degenerative cycles of population decline driven by an increasing level of inbreeding depression (F vortex) or a decreasing ability of the population to adapt to a changing environment (A vortex). Both are exacerbated in small populations. *N*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

After Gilpin and Soulé (1986). VanDyke 2003

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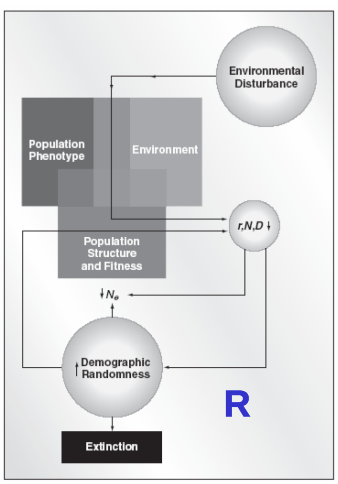

Figure 5.6
The R Vortex, an accelerating and degenerative cycle of population decline driven by increasing vulnerability to environmental disturbance at low population sizes. *N* is population size, *D* is population distribution, *r* is the population's instantaneous rate of increase, and N_e is the effective population size.

After Gilpin and Soulé (1986)

VanDyke 2003

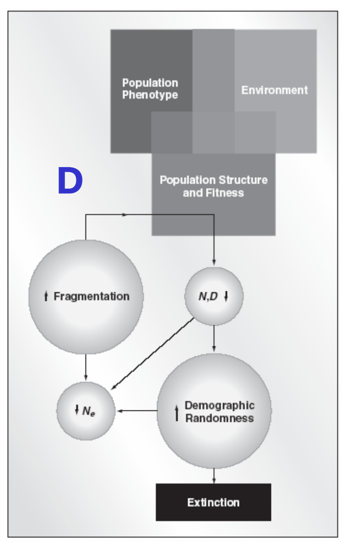

Figure 5.7
The D or discontinuity vortex, an accelerating and degenerative cycle of population decline driven by the fragmentation of the population into smaller and smaller subunits. *N* is population size, *D* is population distribution, and N_e is the effective population size. A lowering of *N* and an increase in demographic randomness can alter the spatial distribution of a population, introducing or increasing fragmentation. More fragmented distributions increase the likelihood of local extinctions.

After Gilpin and Soulé (1986).

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Hardy Weinberg Equation

two alleles: p, q

$$(p + q)^2 = p^2 + 2pq + q^2$$

Under Hardy Weinberg Equilibrium
$H_e = 2pq$
H_o can be calculated

If p=0.6, q=0.4, then $2pq = 0.48 = H_e$

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Wright's Fixation Index

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

Fst > 0.1 indicate much divergence among pops.

Hardy Weinberg Equilibrium, two alleles: p, q
Expected heterozygosity = 2pq

Fst = (Ht-Hs)/Ht (H= heterozygosity)

Ht → Total Pool

Hs → Separate populations

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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...