01

# Lecture 14, 07 October 2004

Van Dyke Ch 5 n 6

Conservation Biology
ECOL 406R/506R
University of Arizona
Fall 2004

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02

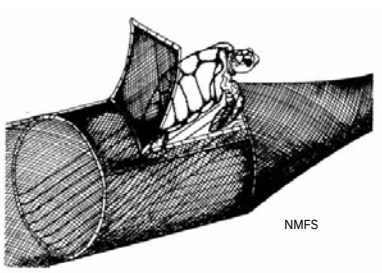
Conservation Biology 406R/506R

1. Paradigms and Theories
   -Van Dyke Ch 5

2. Conservation Genetics
   -Van Dyke Ch 6

-Announcements
-Thank Yous
-Return Exams
-Turn in Write-Ups

## TED and drowning turtles






04

## Chapter 5

-Metapopulations

-Genetic Diversity

-MVP, PVA

-Island Biogeography

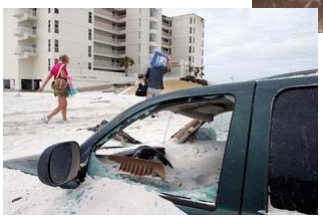
-Disturbance

Chap 6 – Genetics of Conservation Biology

05

## Disturbances

-Endogenous
-Exogenous



An SUV is seen covered by sand as residents walk to their homes to inspect the damage by hurricane Ivan Wednesday, Sept. 22, 2004 in Pensacola Beach, Fla. Beach residents were allowed to see their homes for the first time since the hurricane. (AP Photo/Alan Diaz)

06

## Metapopulation:

"Spatially disjunct groups of individuals with some demographic or genetic connection"

"largely independent yet interconnected by migration"

1. All local populations must be prone to extinction
2. Persistence of entire population requires recolonization of individual sites.

See p.193 in VanDyke text

07

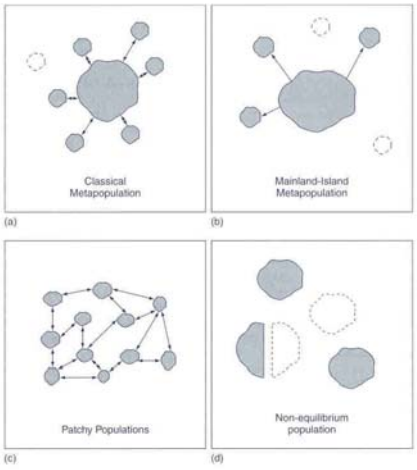



**Figure 5.16**
Types of metapopulation models. In a *classical metapopulation*, (a) some colonies may not exhibit high rates of movement for long periods of time. Also, colonization may unite several patches within a larger patch as a single entity that contributes to other sinks. Colonies farthest from the source are most prone to extinction. The *mainland-island metapopulation* (b) depicts local extinctions occurring mainly among a subset of populations. The mainland/source, resistant to extinction, functions as the major provider of colonists. The island and sink metapopulations have little effect upon regional persistence. In *patchy populations* (c), because of the high levels of emigration and immigration, the patches function as a single unit. It is rare that discrete local populations become extinct. The absence or insufficiency of recolonization to balance extinction distinguishes *nonequilibrium populations* (d). Extinction of metapopulations occurs as part of an overall regional decline (i.e., a product of the reduction, fragmentation, or deterioration of a habitat).

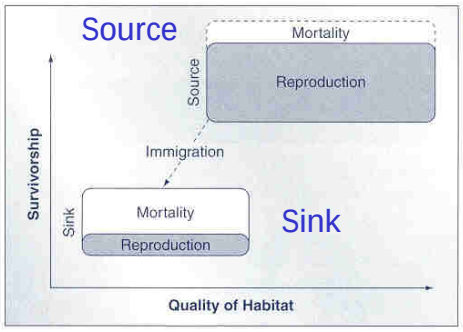



**Figure 5.17**
A visual representation of the source-sink model of habitat distribution. In source habitats, reproduction produces a population surplus (i.e., mortality does not decrease the number of individuals because of overcompensation through reproduction). Surplus individuals move to sink habitats where mortality exceeds survivorship. Sink habitats cannot be maintained by reproduction, but depend on immigration to maintain a population.

08

Genetic Diversity

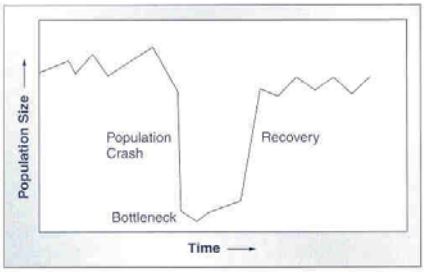



**Figure 5.2**
A graphical representation of population size before, during, and after a population bottleneck.

Small Populations

- -reduced gene flow
- -inbreeding depression
- -drift
- -stochasticity
- -effective population size ($N_e$)

Declining Populations

# Effective Population Size

- $N_e = 4N_mN_f / N_m+N_f$
- Eg: a population of seals with 6 males and 150 females?
- $N_e = (4*6*150)/(6+150) = \sim 23$

Thanks to Chuck Price



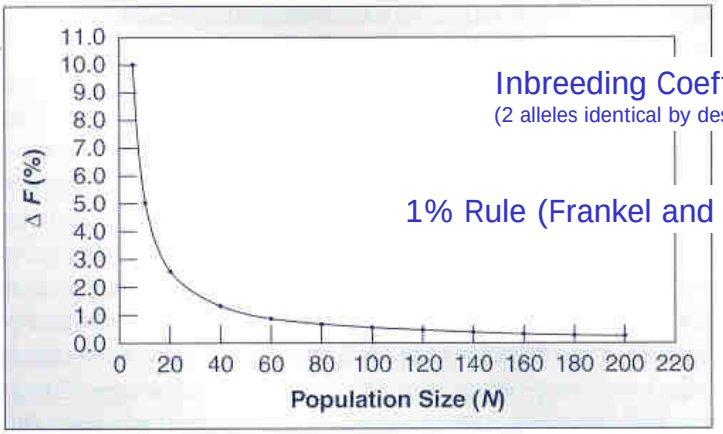



**Figure 5.3**
Percent change in the inbreeding coefficient ($\Delta F$) at different population sizes. Note that the value of the inbreeding coefficient increases as population size declines.
*After Frankel and Soulé (1981).*

Van Dyke 2003

11

# 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 = $H_e$

12

# 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

13

Equilibrium Heterozygosity ($\Delta H = 0$)

$H^* = 2Nm$

Therefore, smaller populations have lower equilibrium heterozygosity

14

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

50/500/+ Rule

Short term

Mid term

Long Term

PVA...

15

Conservation Biology identifies
5 threats with Respect to Genetics:
(p. 147 Van Dyke)

1. Inbreeding Depression
2. Loss of Genetic Variation and Heterozygosity
3. Accumulation of Harmful mutations
4. Introgression/Hybridization
5. Outbreeding Depression

16

Quickly lose rare alleles in bottlenecks

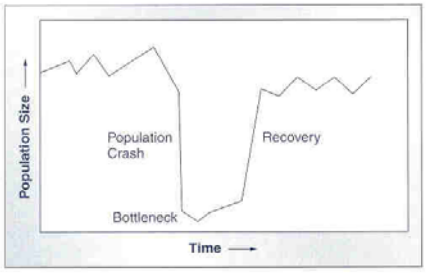



**Figure 5.2**
A graphical representation of population size before, during, and after a population bottleneck.

Cheetah
Major Histocompatibility Complex

xx

El Endo