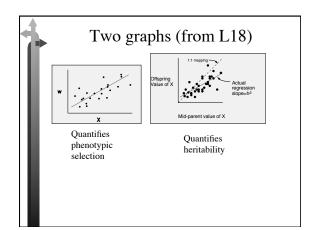
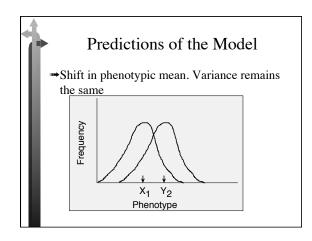
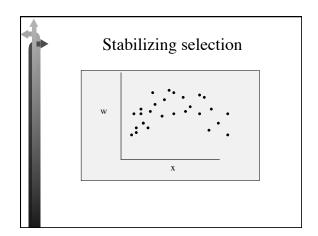
Lecture 19 (and probably 20!)

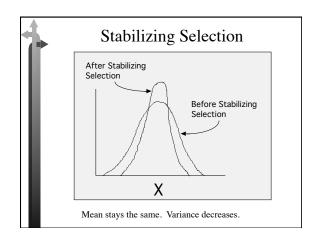
Complete selection on bean bag traits
Origins of Species

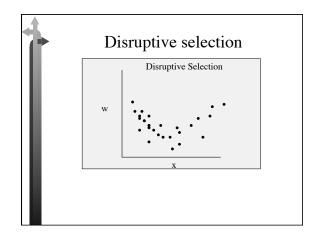
Selection Model $R = h^2 S$ $R = \frac{V_G}{V_P} S$

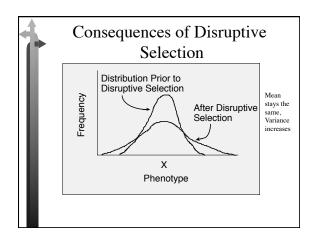


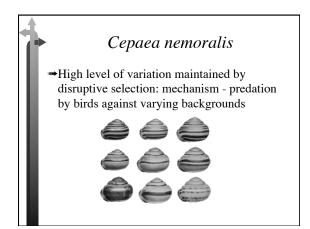


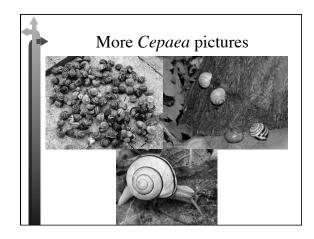






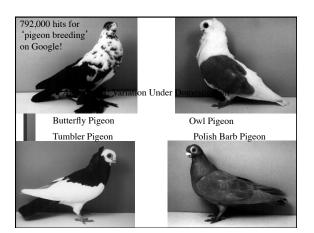




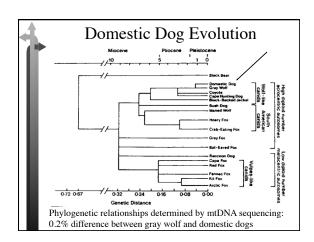


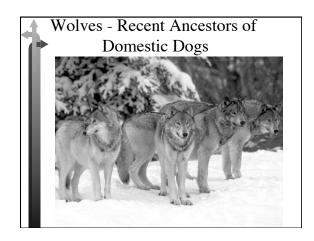
Does Selection Lead to New Species?

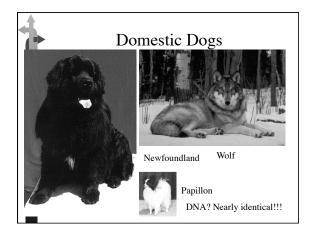
- Darwin s arguments:
 - →1. Variation under domestication (i.e., artificial selection as an analogue of natural selection)
 - ⇒2. Natural variation among varieties within species grades into species differences (i.e., ecotypes are common)
 - →3. Consistencies in the fossil record (i.e., primitive to advanced forms in progressively younger strata)
 - ⇒4. Patterns of geographic variation among species on islands are consistent with evolution by natural selection (microevolution on islands is likely)

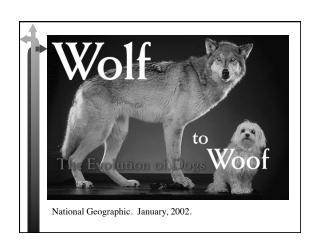














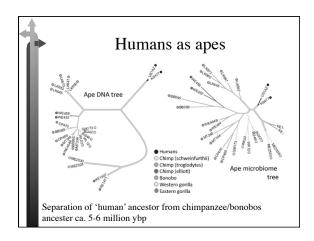


Miniature Australian Shepherds 1978. Doris Cordova from California began breeding a line of small Australian shepherds. Some don't recognize it as a separate breed from Australian shepherds, others do.



Bottom Line

- →Human desires ('artificial' selection) can easily produce species-sized genetic changes in <u>very</u> short periods of time
- These genetic changes can be at a few key loci, and they will serve to isolate gene pools



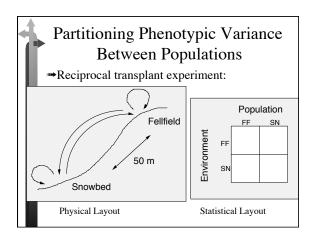
2. Natural variation within species

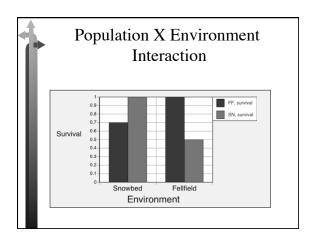
- Species actually or potentially interbreeding populations
- Numerous gray areas exist in nature about what a species is! e.g., when lions and tigers are crossed, what do you get? A liger, of course! (AND, lions consist of 8 subspecies, tigers 9 subspecies!)

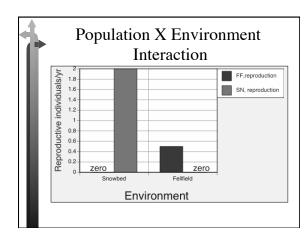




2. Natural Variation	Within Species
Are these two plants different species?	72 May 10
A. Yes	
B. No	
2000年100日	
Dryas octopetala ssp. octopetala	Dryas octopetala ssp.
*note: these photos are to scale!	alaskensis





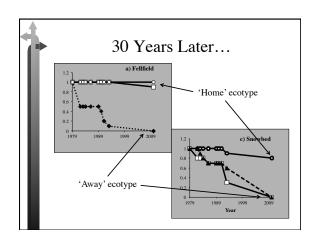




Ecotypes

- → Ecotypes genetically distinct populations whose differences result in adaptation to local environments
- In plants, ecotypic differentiation is the norm
- → Ecotypic variation is a process that may lead to speciation <u>if reproductive isolation evolves</u>





" » Th∈	se are kr	nown 's	pecies' -	 except 	here in
Mo	rgantowi	n, where	e we can	't tell or	ne from
ano	ther!				
An Among Spr	Des Stores D reactor love City®	Aura 9 Octo	South Street On Street County	* [Programme Connect Glama
Grand bland Lingson		and one	Che Che	Penns Penns	freeze a no brown
Salata Salata	Const O Const	territore of territore	nderapole Degron @Colum Rational Bile		Waryland New Jersey
Kanasa Crass	Outre Server	and and	n Chonses	- 200	Central Contract
- Anna	1/.	Cape Camala	Lourselle & company	I for some	. 7
es End 0	Type Regen		o O O O O O O O O O O O O O O O O O O O	Onester Constant	minus of the same
Oklahoma SA Oklahoma	Facilities possess	Margha Jahan	esse Supra	Second Quanting Carolina Go	Grande antices
Landa Con	O Life Foot	- Comment		1	- Annual Control

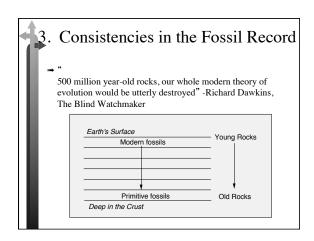
Bottom Line

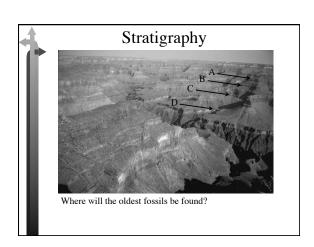
- Subspecies, varieties, ecotypes are transitional phases that are 'nearly species' (and some of these may be actual genetically isolated gene pools); some species may be better classified as varieties or ecotypes, and occasionally interbreed in nature!
- Ecotypes are locally-adapted populations that may be as different as products of artificial selection
- Large population-level differences evolve easily and frequently in nature under selection pressures

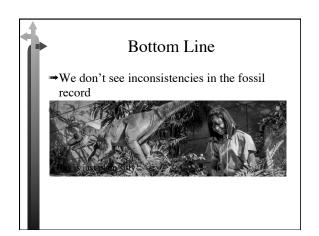
1

Bottom bottom line

Evolution of species-level differences is easily accomplished by the same mechanisms we can readily show with simple mathematics (e.g., R=h²S)









4. Speciation on Islands

- Speciation on islands is likely where:
 - →Immigration is slow (S<equilibrium S for a long time), and
 - → High diversity of niches exist on the island (high S)
- →These conditions are met when islands are DISTANT and LARGE
- ⇒2 examples: Galapagos, Hawaii



Galapagos Islands

→600 mi. west of S. America, 3000 mi. east of Polynesia



>

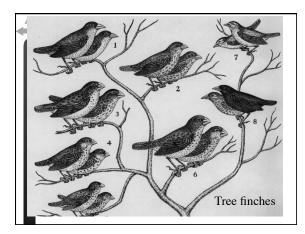
Original Immigrants of the Galapagos

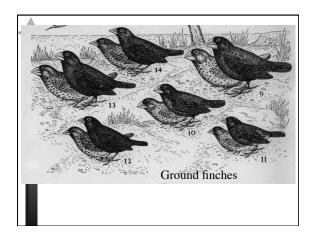
- [™]2 species of mammals
- [™]5 species of reptiles
- →6 species of songbirds; 1 was a finch
- ⇒5 other types of land birds

1	$^{\circ}$
	4
1	.)

Current Finch Fauna

- →14 species of finches are presently found in the Galapagos:
 - →Ground finches 6 species
 - seed eaters of arid/coastal habitat
 - Tree finches 6 species
 - ⇒insect eaters of moist forests
 - →Warbler finches originally misclassified as a warbler!
 - ⇒narrow beak, flitting habit
 - Cocos Island Finch different from all the others





Origin of Darwin's Finches by Speciation

- Early in island history, 1 species of finch migrated from South America
- Immigration of other bird species was slow (empty niche space)
- Differences in selection pressure among islands led to different subspecies
- Eventually, isolating barriers arose that protected gene pools of subspecies from intrusion of maladapted genes from sister subspecies

Origin of Darwin's Finches by Speciation

→ Migration between islands occurred with maintenance of species integrity (e.g., 4 ground finches regularly coexist, but differ in beak size and therefore seed size use).



Å

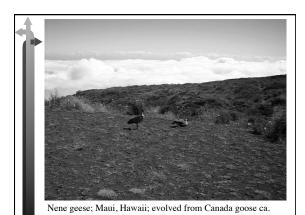
Update in the Darwin's Finch Story

- Grant, P. R. and B. R. Grant. 2002. Adaptive radiation of Darwin's finches. American Scientist 90: 130 139.
- Grant, P. R. and B. R. Grant. 2011. How and Why Species Multiply: The Radiation of Darwin's Finches (\$23.71 on Amazon.com. Free supersaver shipping ;)
- →(1) it was not necessary for speciation that two divergent groups re-establish contact
- (2) the islands were not static during the time of evolution (e.g., new islands appeared)
- →(3) bird song divergence reinforces mating isolation



Islands and Endemism

- Endemic species species found only in one location. Due to the prevalence of speciation on large, distant islands, places such as Hawaii and the Galapagos have very high numbers of endemics.
- ™Hawaii has:
 - → 10,000 endemic species
 - >350 species in the genus *Drosophila* alone





Homo floresiensis





Discovered on the Indonesian Island of Flores ~18,000 years old New species previously unknown to science Chimp-size brain; 3 feet tall! Human tool-using and fire-using traits First published; October 28, 2004, Nature.





Bottom Line

■ Islands produce clear, repeated storylines of speciation that are consistent with Darwin's theory of natural selection as the primary means of speciation



Darwin's arguments

- → Phenotypic variation, trait heritability, and phenotypic effects on fitness, yield adaptive evolution
- ⇒Evidence for this process giving rise to species:
 - → Humans have produced 'species' (therefore nature can, easily, with time)
 → In nature, incipient 'almost' species are very common (and in fact, the line between species and varieties/ecotypes/subspecies is a matter of
 - The fossil record is long, and consistent (though incomplete, it is getting
 - → Islands have been a visible natural laboratory for evolution (and islands are everywhere!)