

Evolution on your dinner plate?

Malin Pinsky

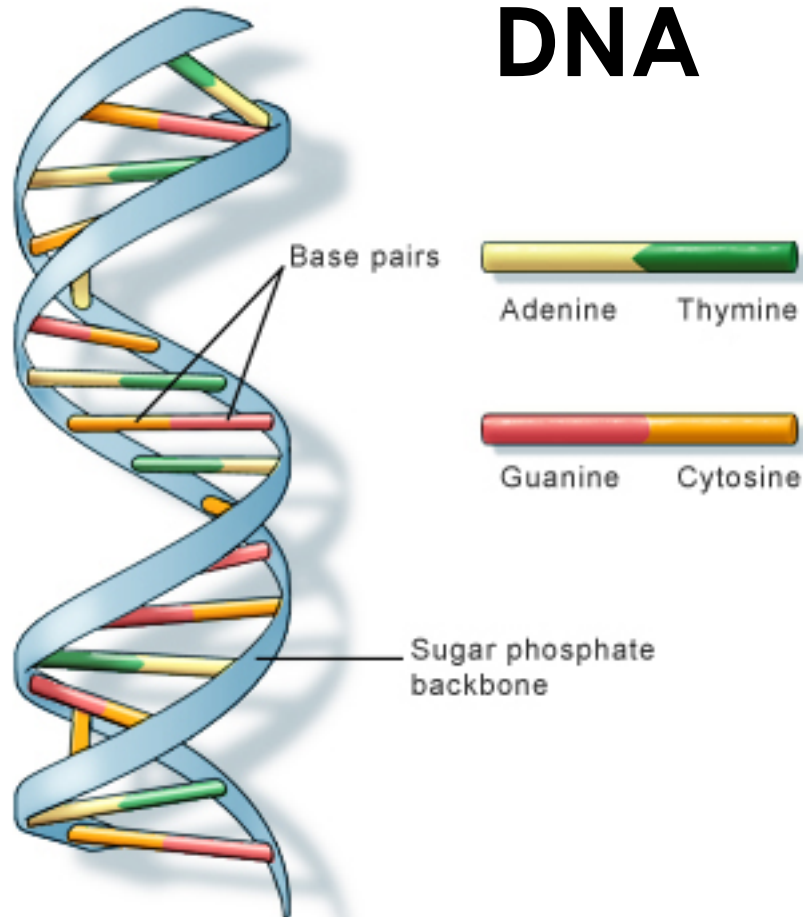
Ecology, Evolution, and Natural Resources

Institute of Marine and Coastal Sciences

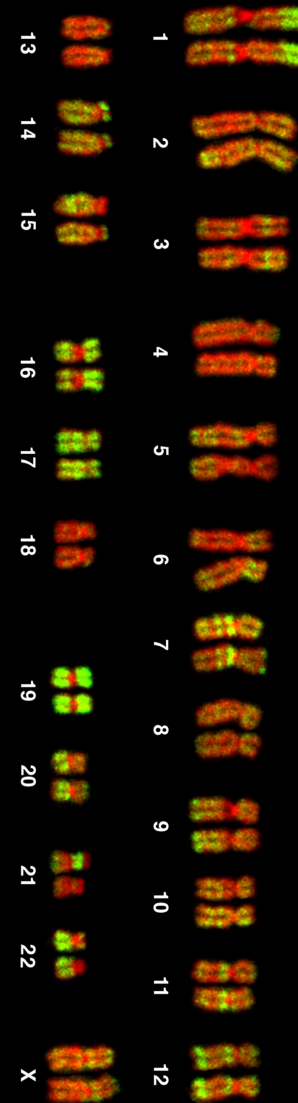
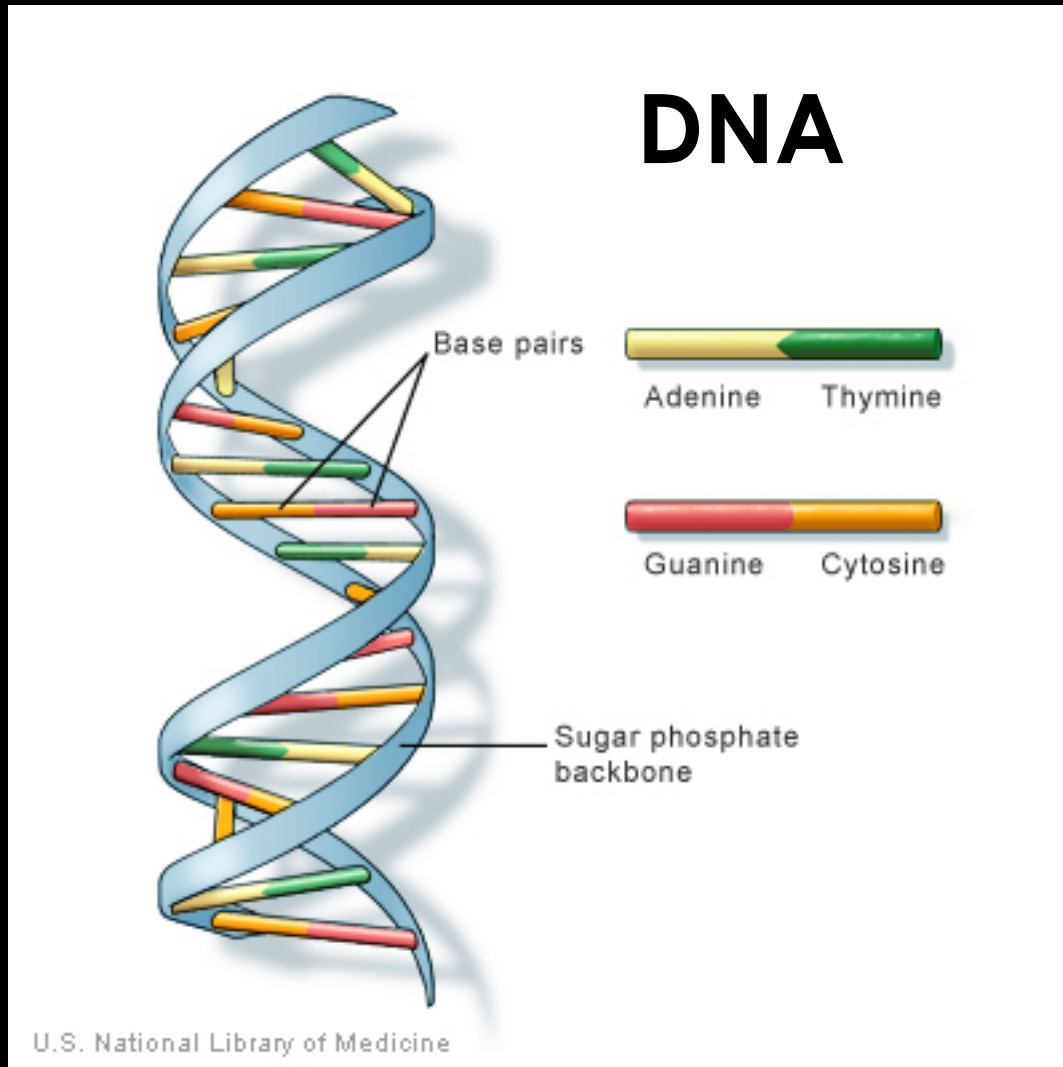
Rutgers University



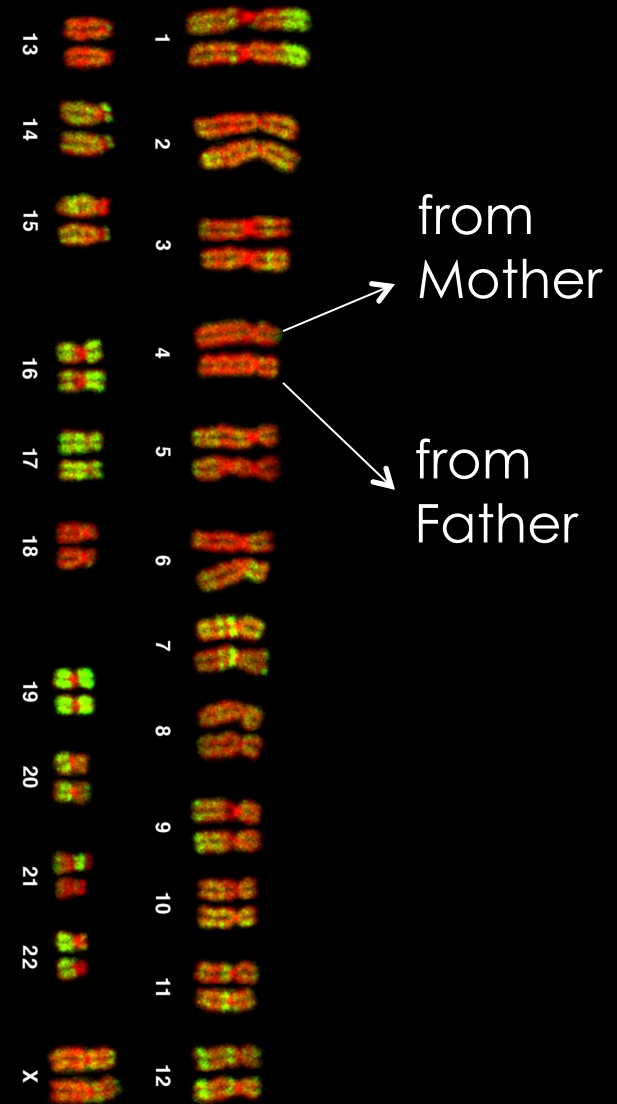
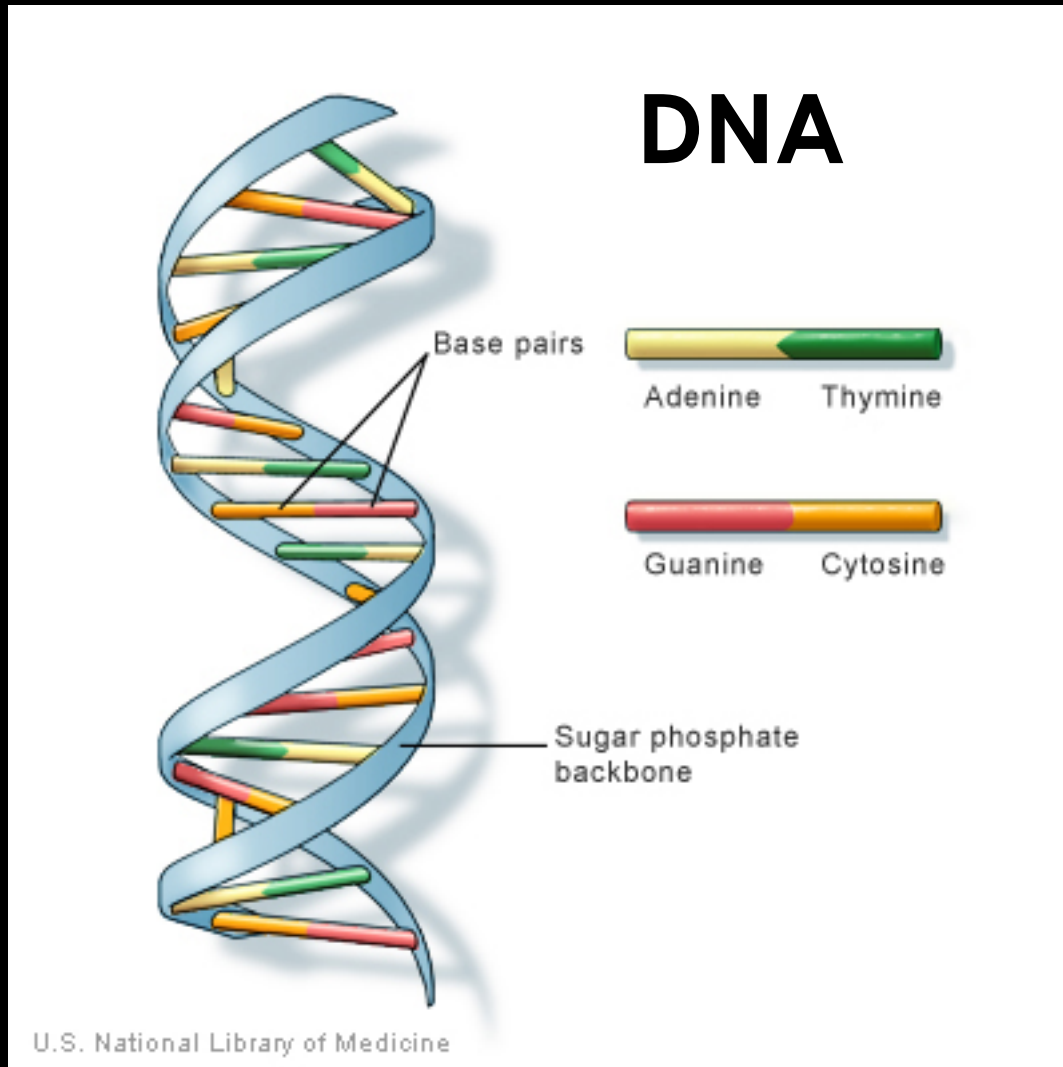
The raw material for evolution



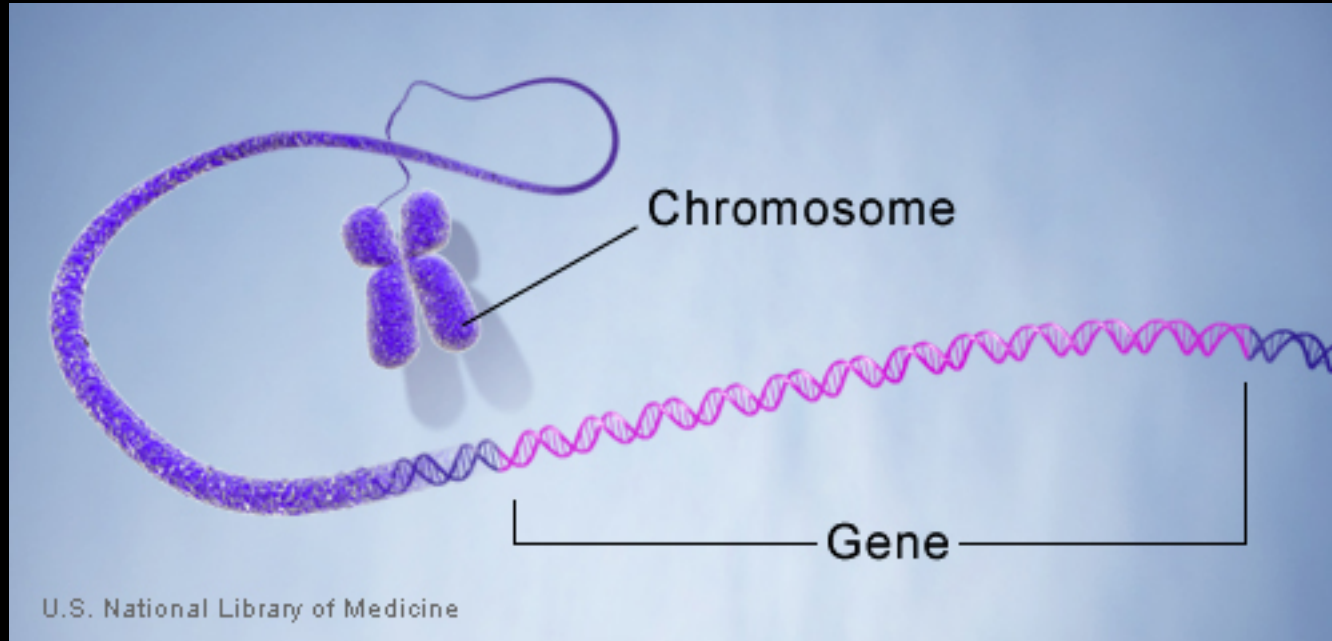
The raw material for evolution



The raw material for evolution

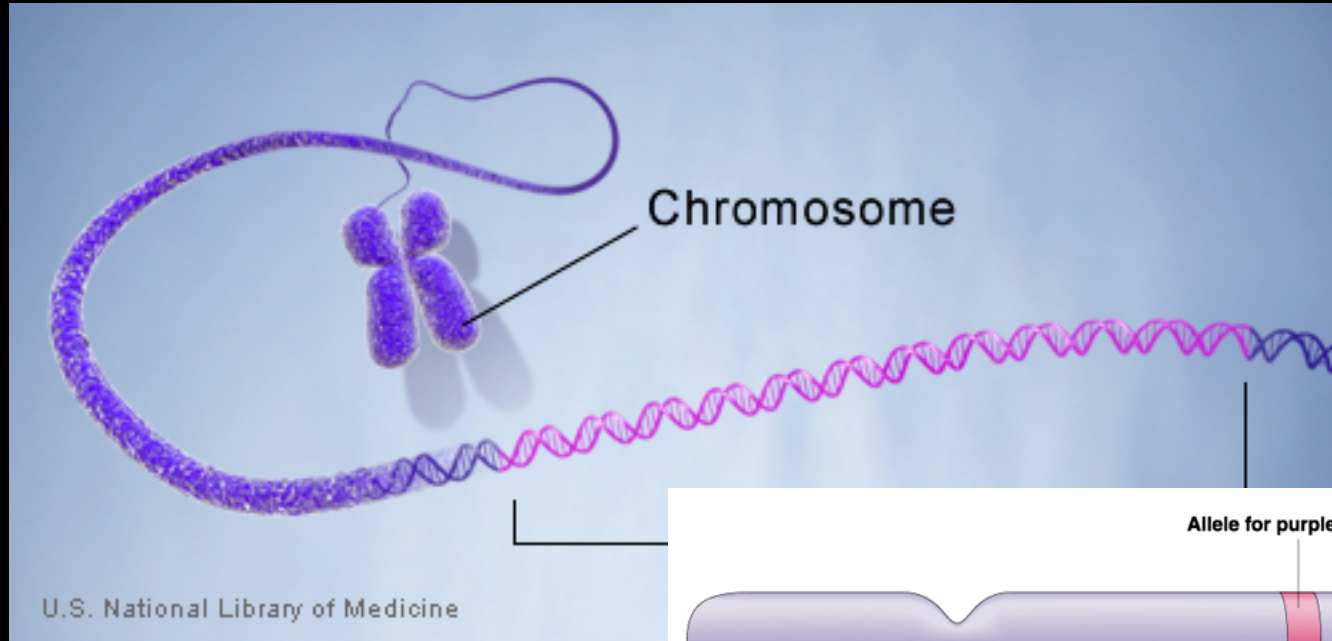


Parts of the genome

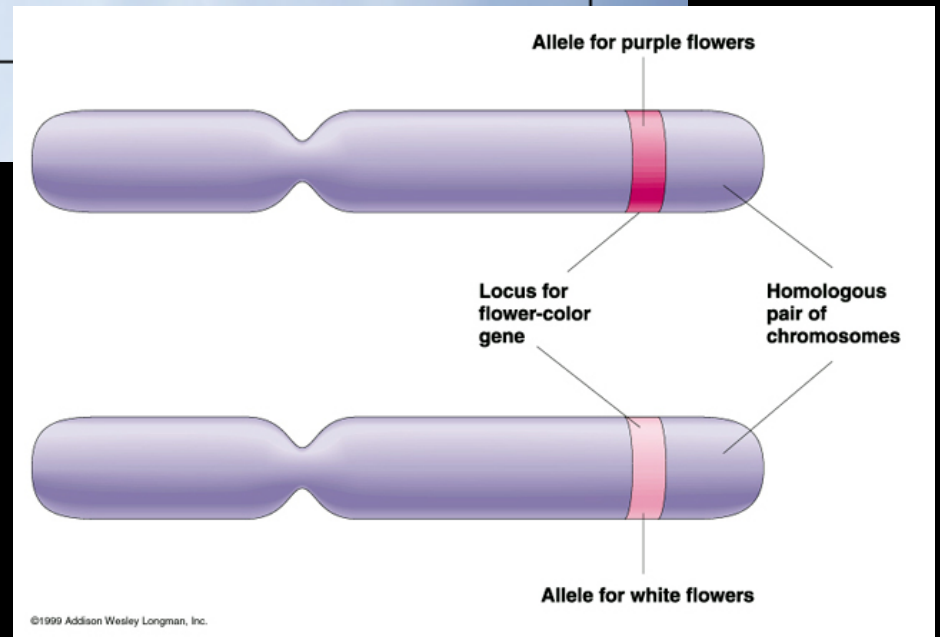


Gene or locus

Parts of the genome

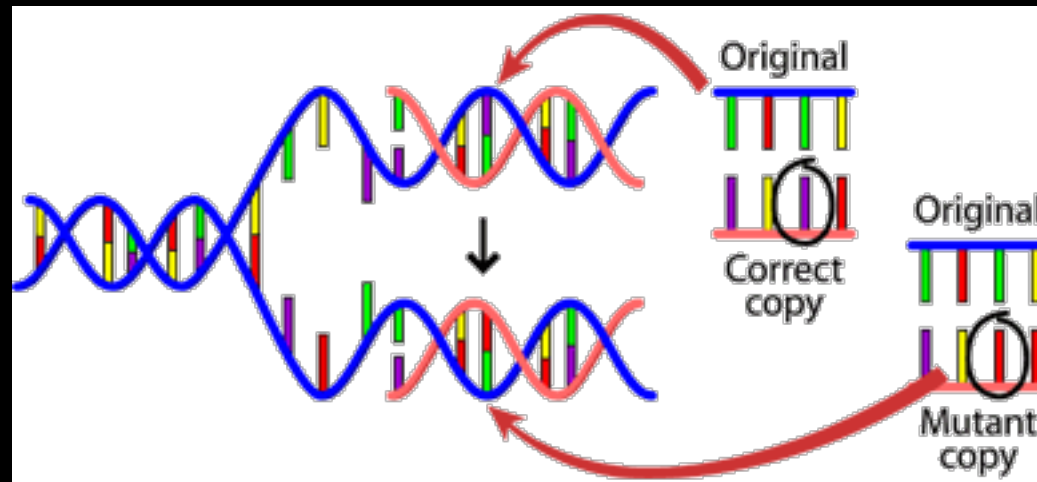


Allele



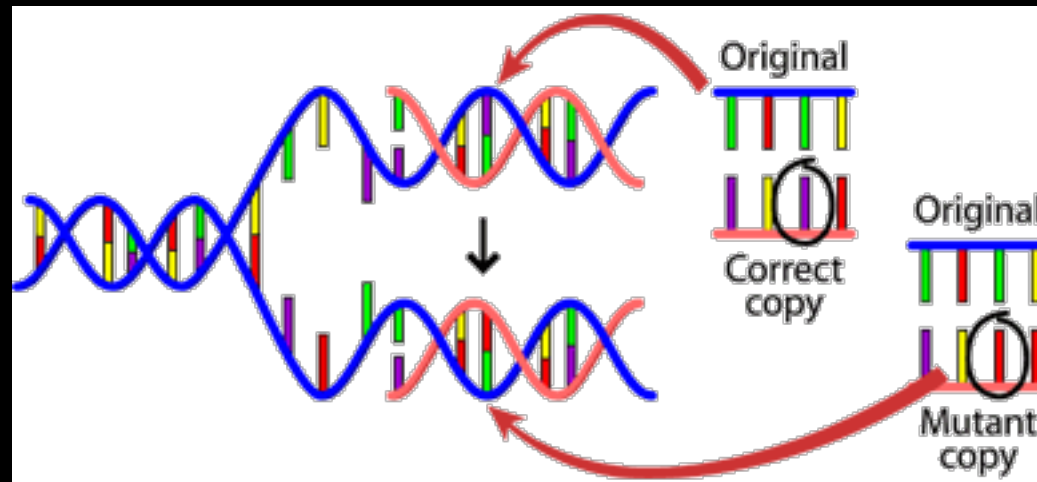
Source of variation

- Mutations



Source of variation

- Mutations



- Germ line copy passed to offspring



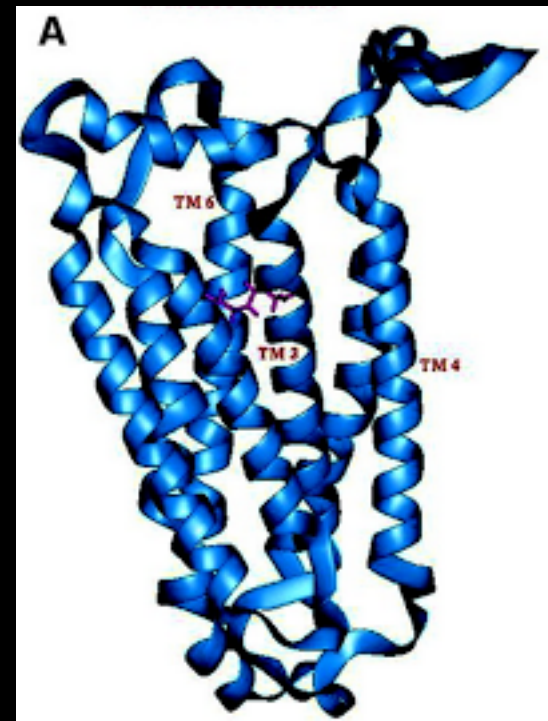
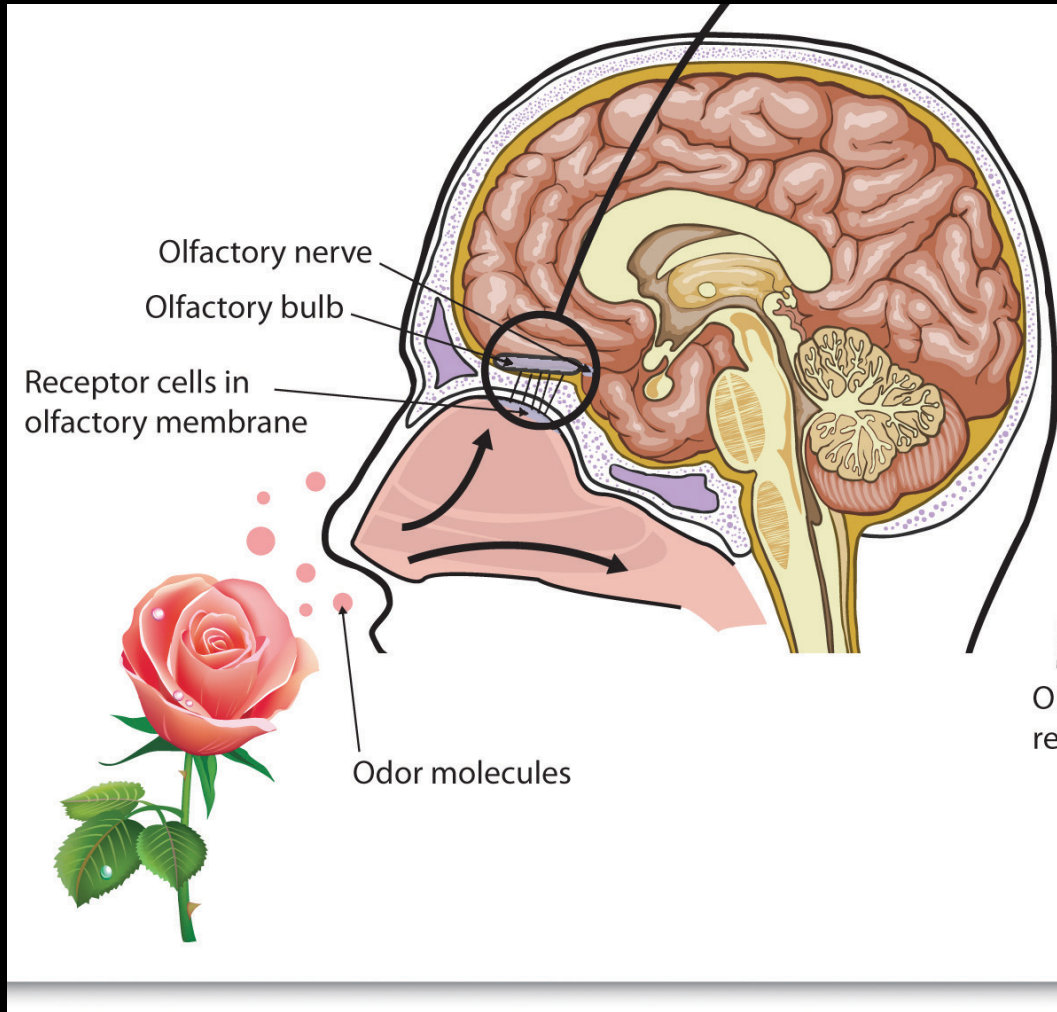


Oh cruel herb of soap,
Bane of burritos worldwide,
The slayer of taste.

from ihatecilantro.com



OR6A2 gene

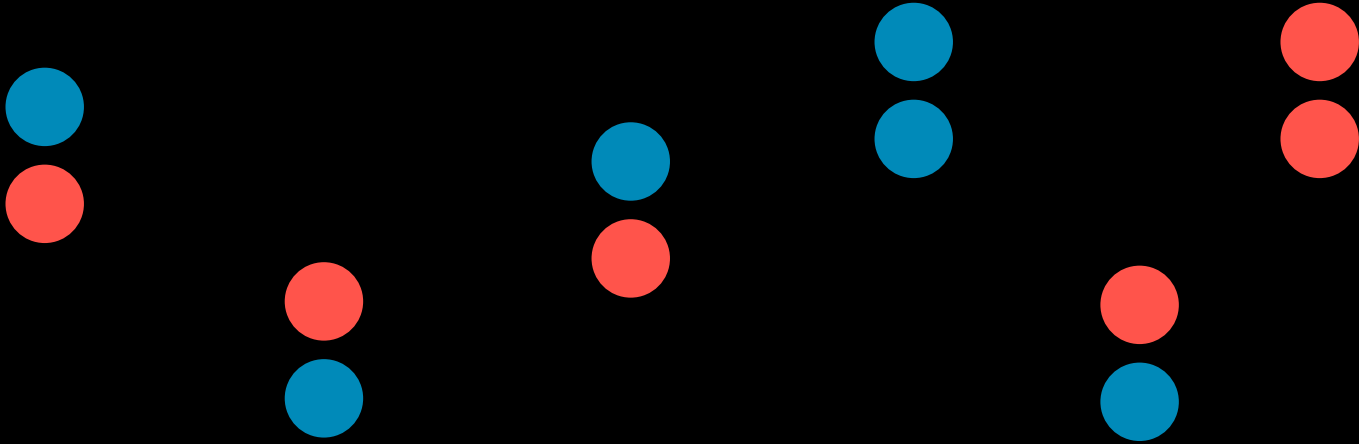


People with two “soapy” alleles more likely than others (15% vs. 10%) to dislike cilantro

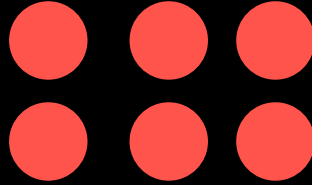
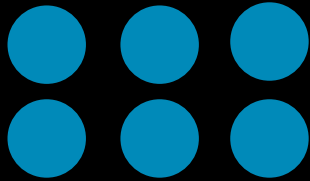
Population



Population



Population

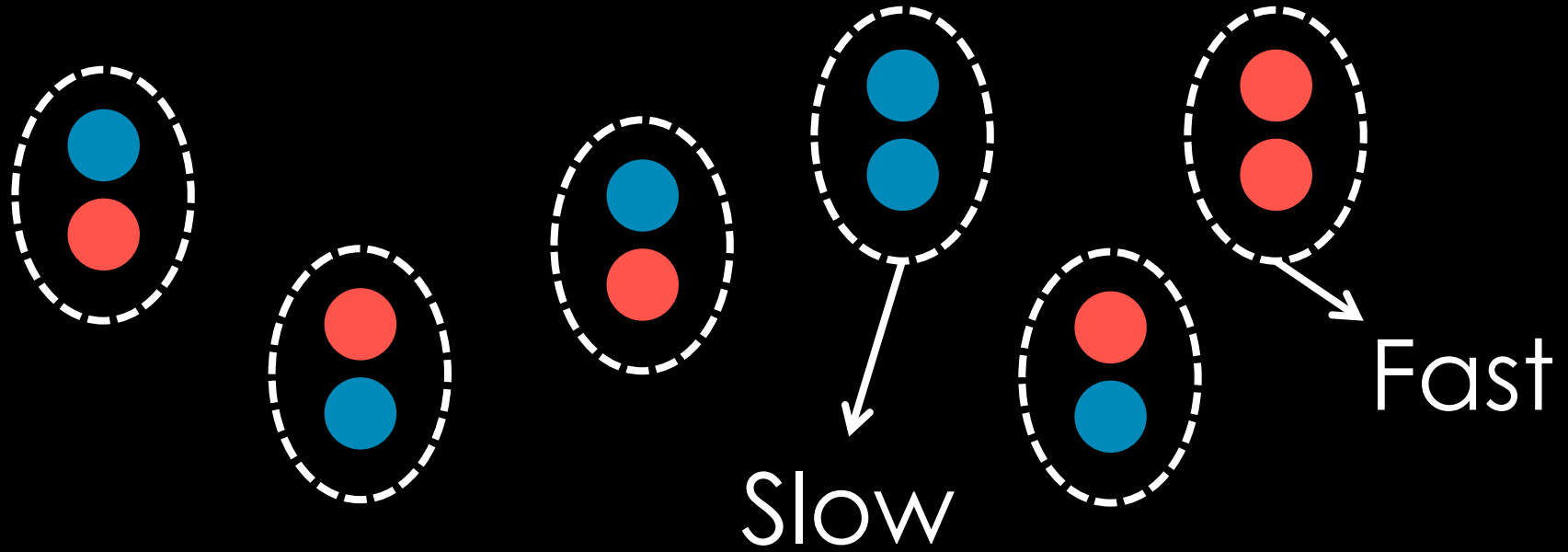


Population

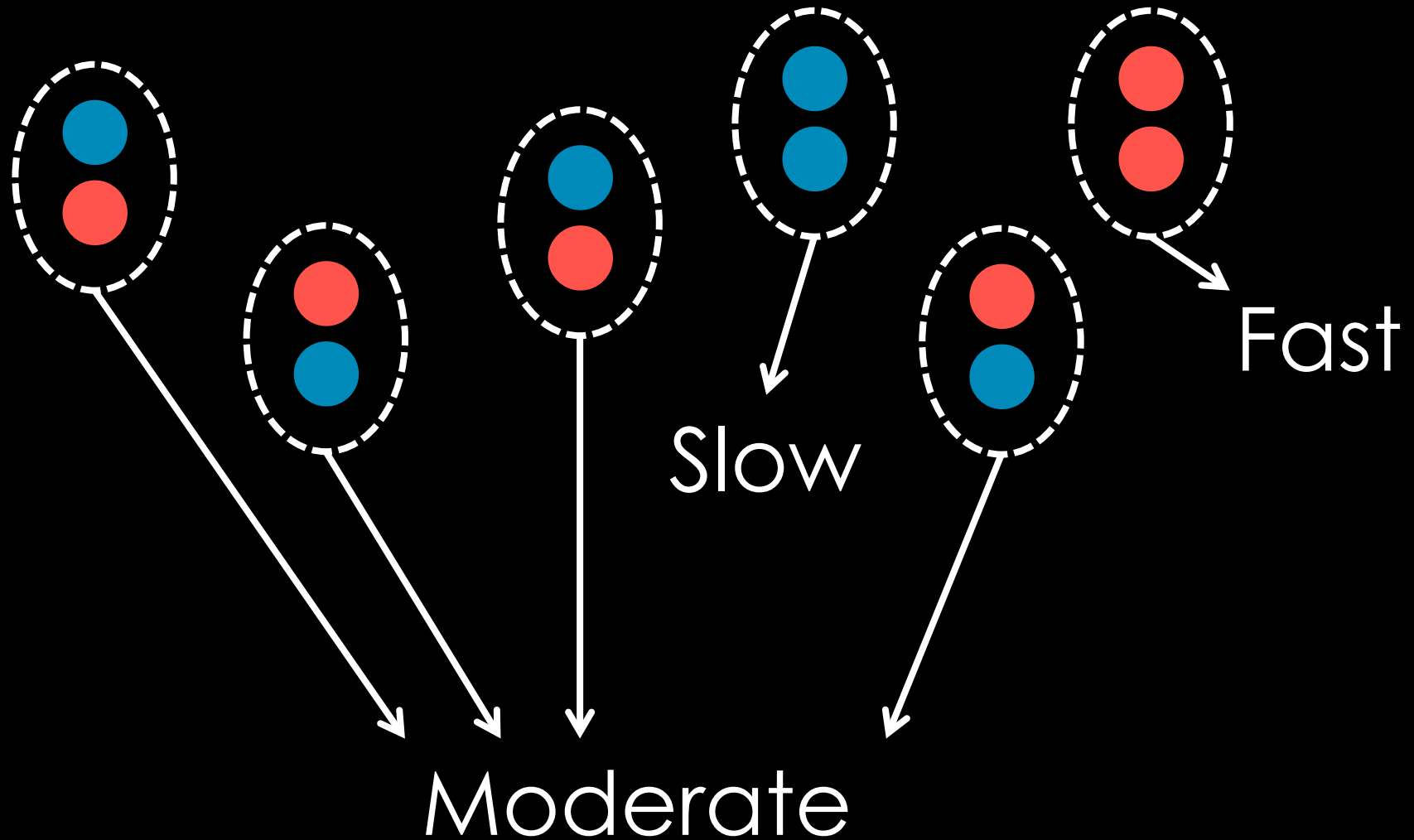


- Allele frequencies
 - 50% blue
 - 50% red

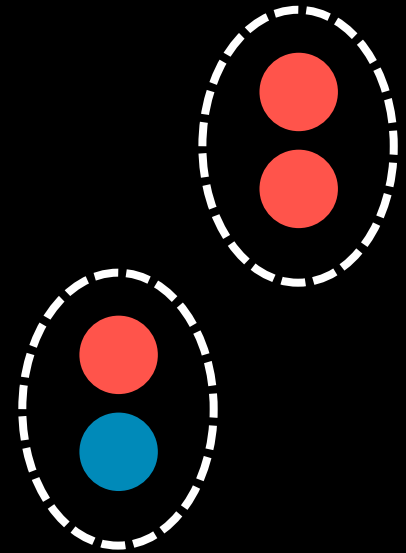
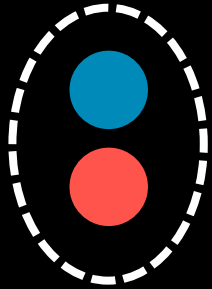
Phenotype: running speed



Phenotype: running speed



Population



- Fitness: ability to pass genes on to future generations

Population



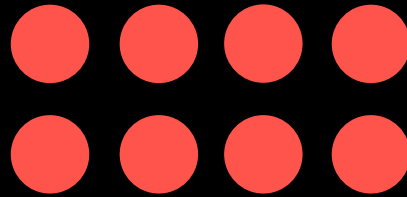
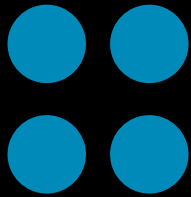
- Fitness: ability to pass genes on to future generations

Population



- Fitness: ability to pass genes on to future generations

Population



33% blue
67% red

- Fitness: ability to pass genes on to future generations

Evolution

1. Heritable variation

Evolution

1. Heritable variation
2. More offspring than can survive

Evolution

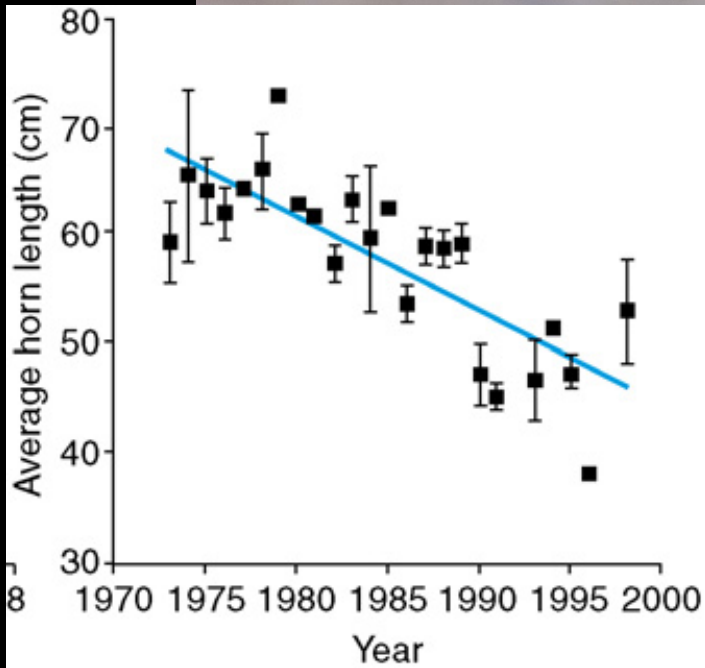
1. Heritable variation
2. More offspring than can survive
3. Offspring vary in ability to survive and reproduce

Bighorn sheep



Coltman et al. 2003 Nature

Bighorn sheep



Coltman et al. 2003 Nature

Fisheries effects



1957

Fisheries effects



1957



2007

Importance of diversity in populations

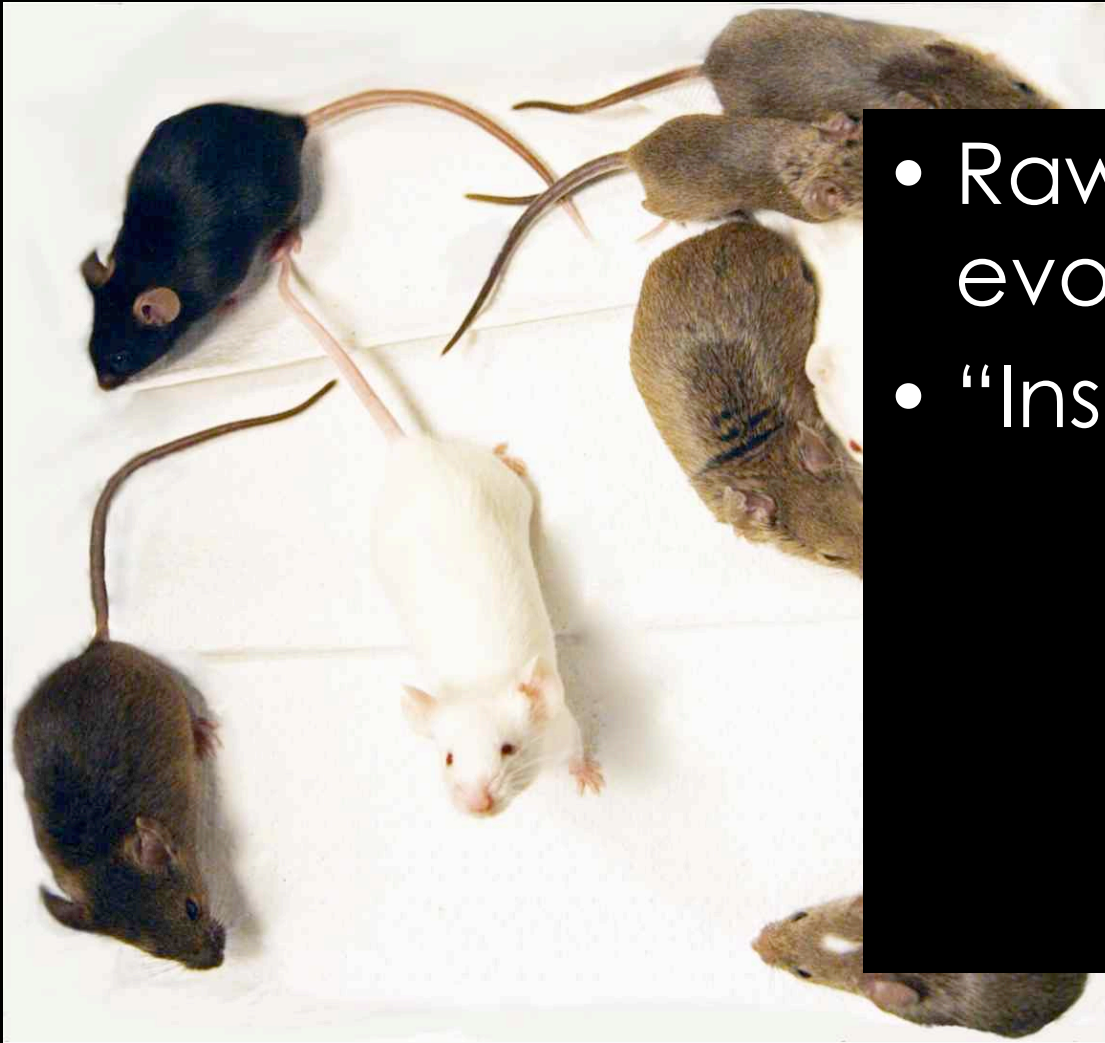


Importance of diversity in populations



- Raw material for evolution

Importance of diversity in populations



- Raw material for evolution
- “Insurance policy”

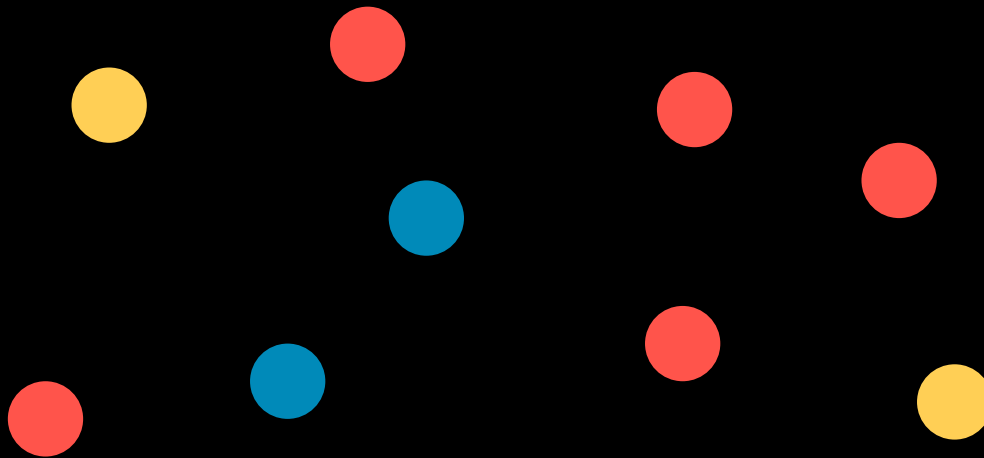
Importance of diversity in populations



- Raw material for evolution
- “Insurance policy”
- Avoid inbreeding

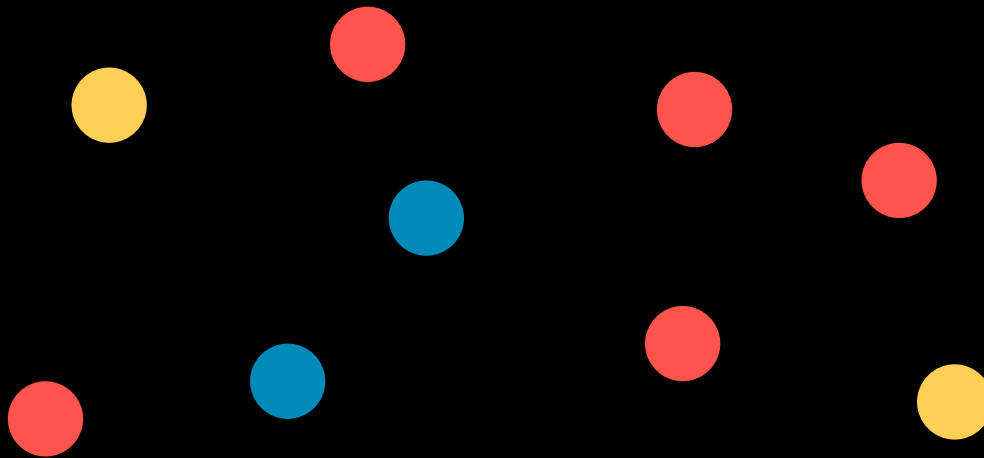
Measuring molecular diversity

- Number of alleles

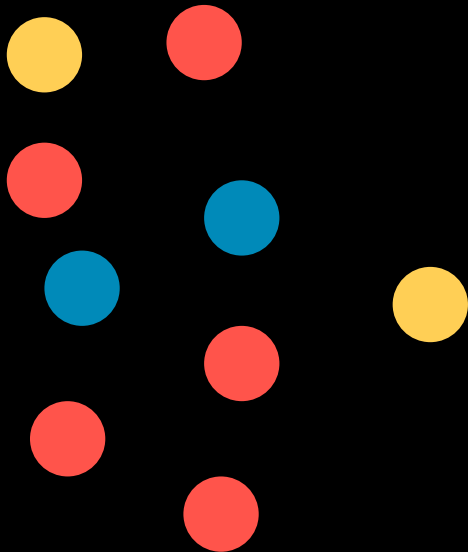


Measuring molecular diversity

- Number of alleles
- Heterozygosity
 - probability of picking two different alleles

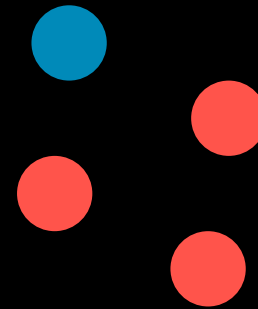
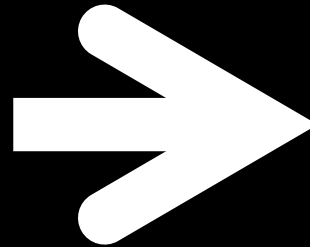
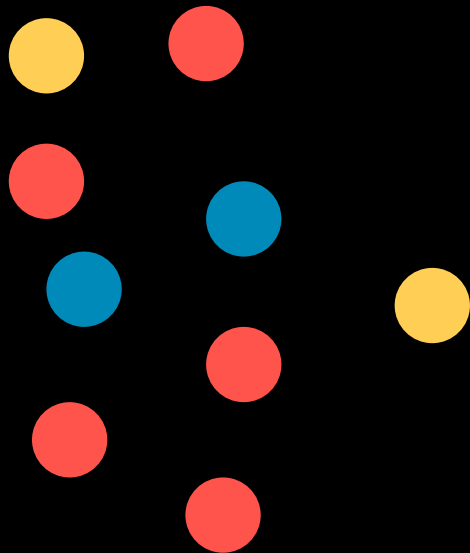


Genetic bottlenecks



Alleles: 3
Heterozygosity: 60%

Genetic bottlenecks



Alleles: 3
Heterozygosity: 60%

Alleles: 2
Heterozygosity: 40%

Bottleneck examples



Northern elephant seal

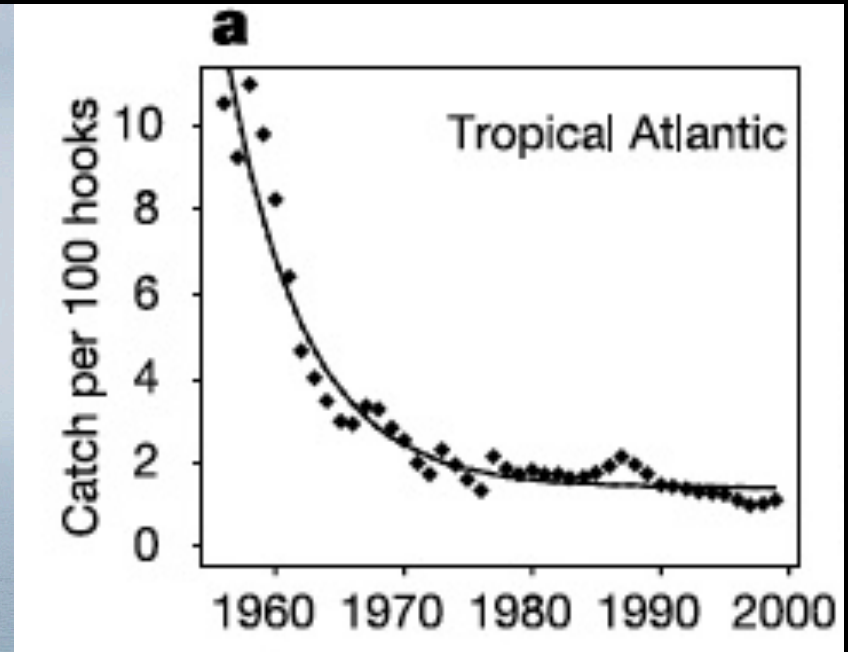


Florida panther

Can fisheries cause bottlenecks?

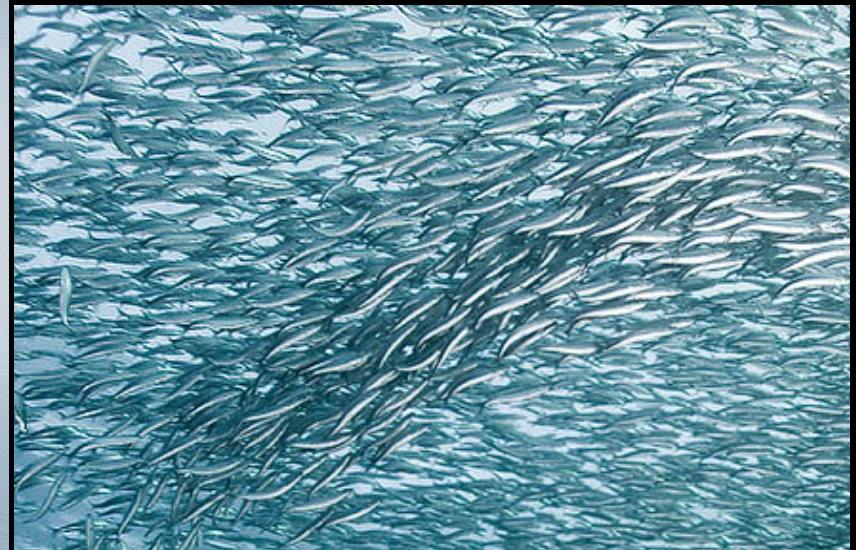


Purse seiner for salmon



Tuna, billfishes, swordfish
Myers & Worm 2003 Nature

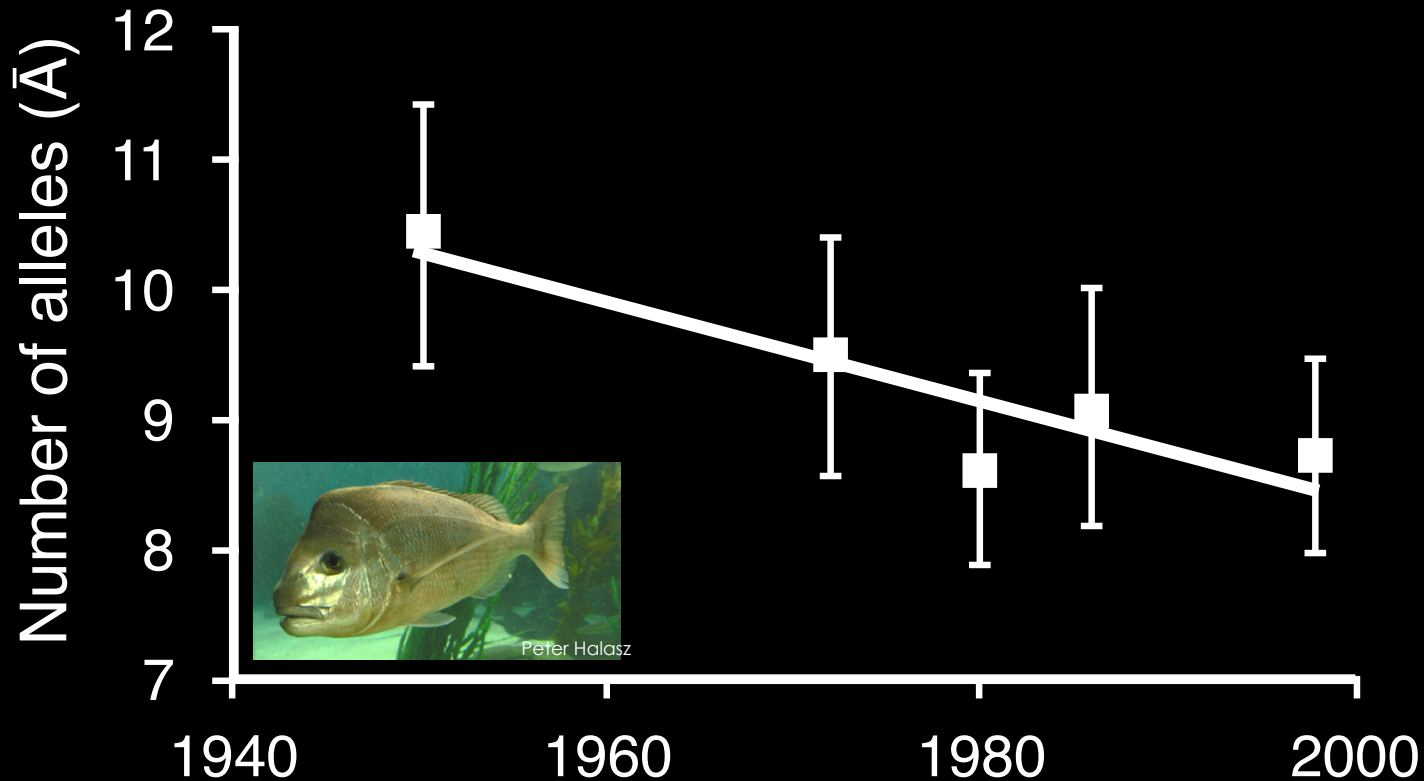
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Collapsed
populations still
abundant!

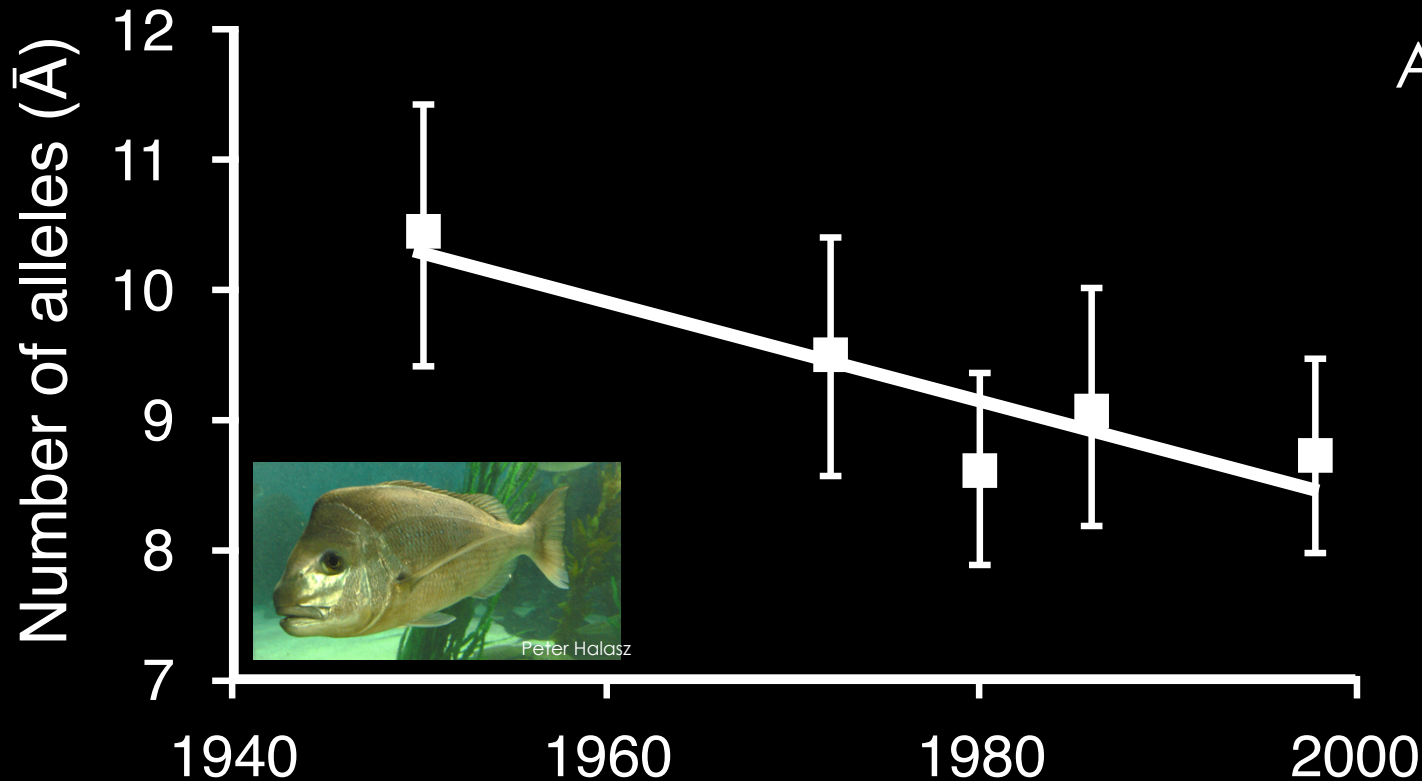
A few examples?

New Zealand snapper (*Pagrus auratus*)
after Hauser *et al.* 2002 PNAS



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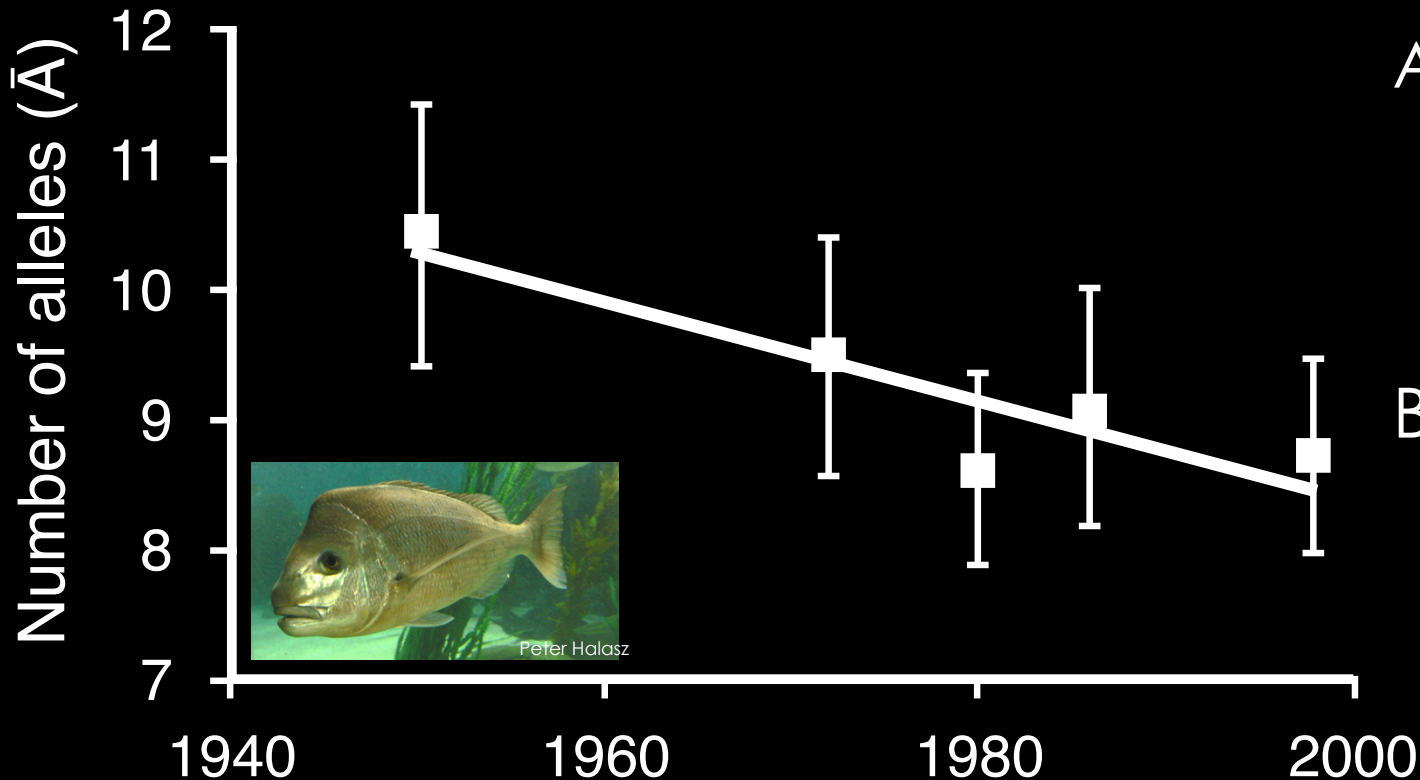


Also:

- Atlantic cod
- European plaice

A few examples?

New Zealand snapper (*Pagrus auratus*)
after Hauser *et al.* 2002 PNAS



Also:

- Atlantic cod
- European plaice

But not:

- Atlantic cod
- Bluefin tuna
- Canary rockfish

Data

- Microsatellite diversity
 - 202 studies of 140 species

PRIMER NOTES 897

Characterization of six polymorphic microsatellite markers in gilthead seabream, *Sparus aurata* (Linnaeus 1758)

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*University of Crete, Department of Biology, GR 714 09 Iraklio, Greece.
†Institute of Marine Biology of Crete, Genetics Department, GR 710 03 Iraklio, Greece

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Mar Biol
DOI 10.1007/s00227-010-1419-3

Giulia Riccioni
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M. O. BURFORD

Department of Ecology and Evolutionary Biology, University of California Santa Cruz, Santa Cruz, CA, USA

Aquaculture

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European comparison of wild and cultivated populations of the gilthead sea bream (*Sparus aurata*)

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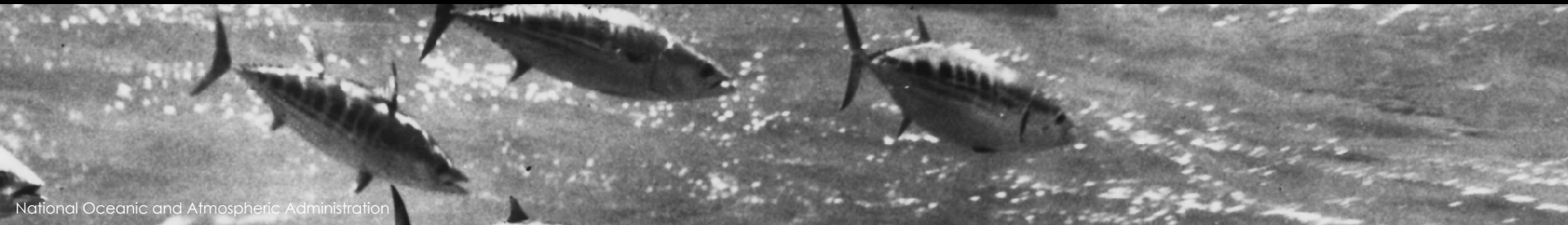
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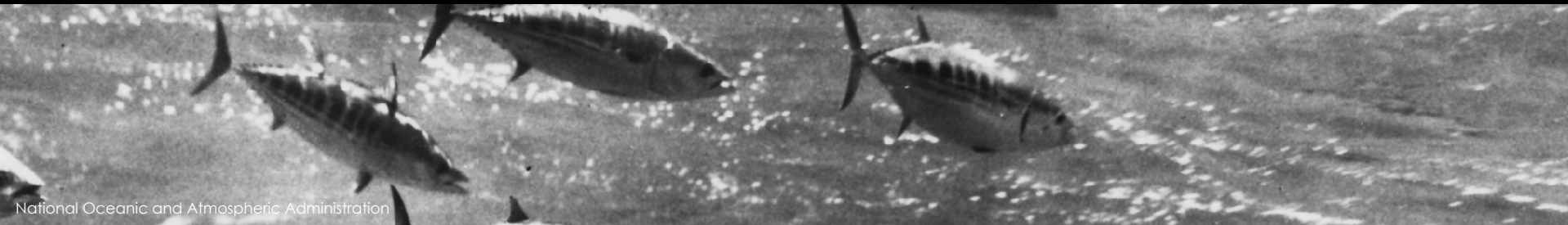
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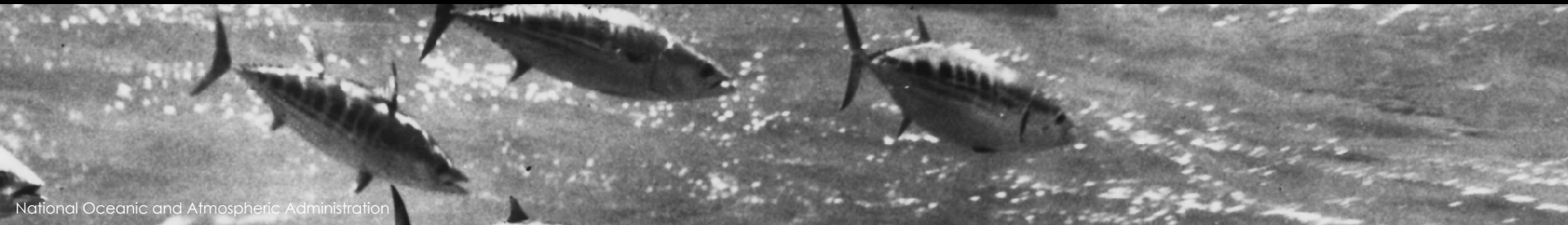
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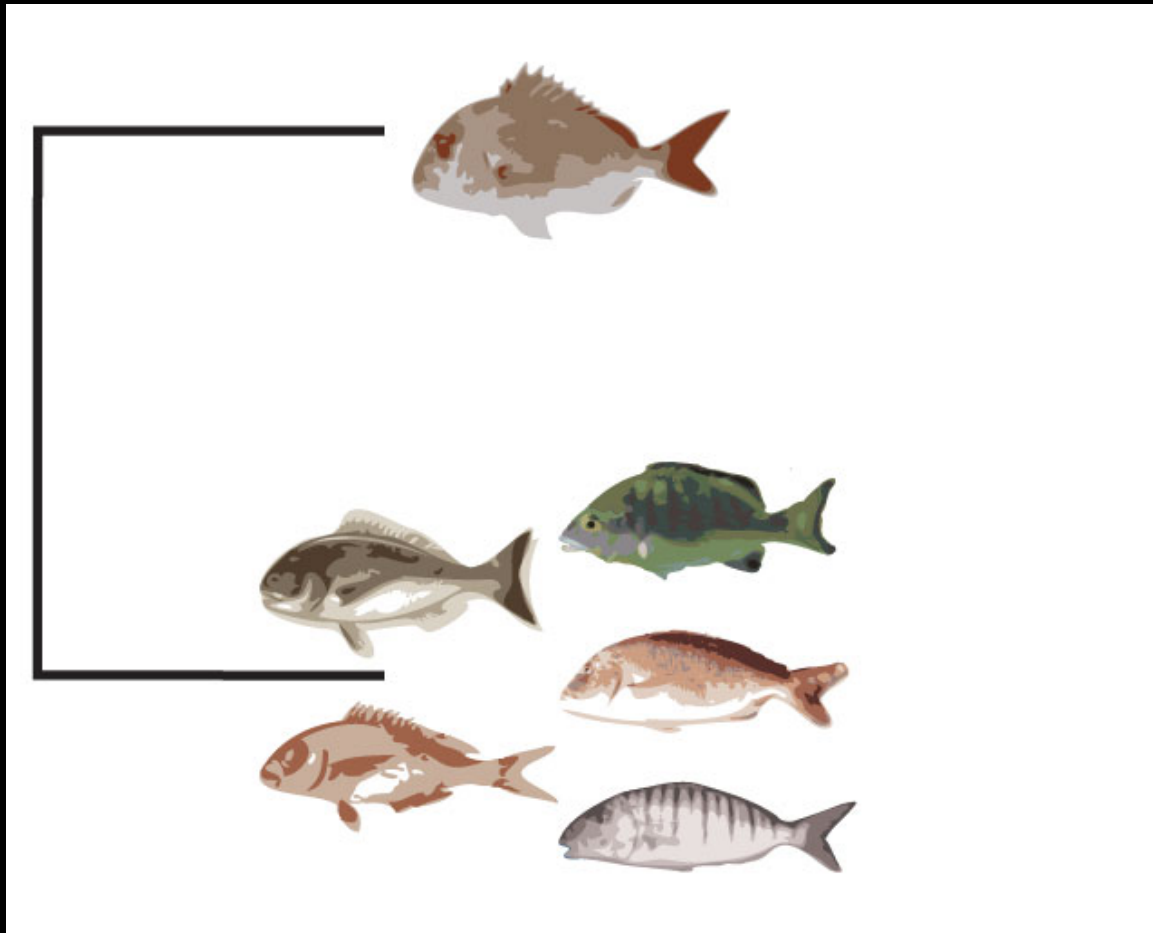
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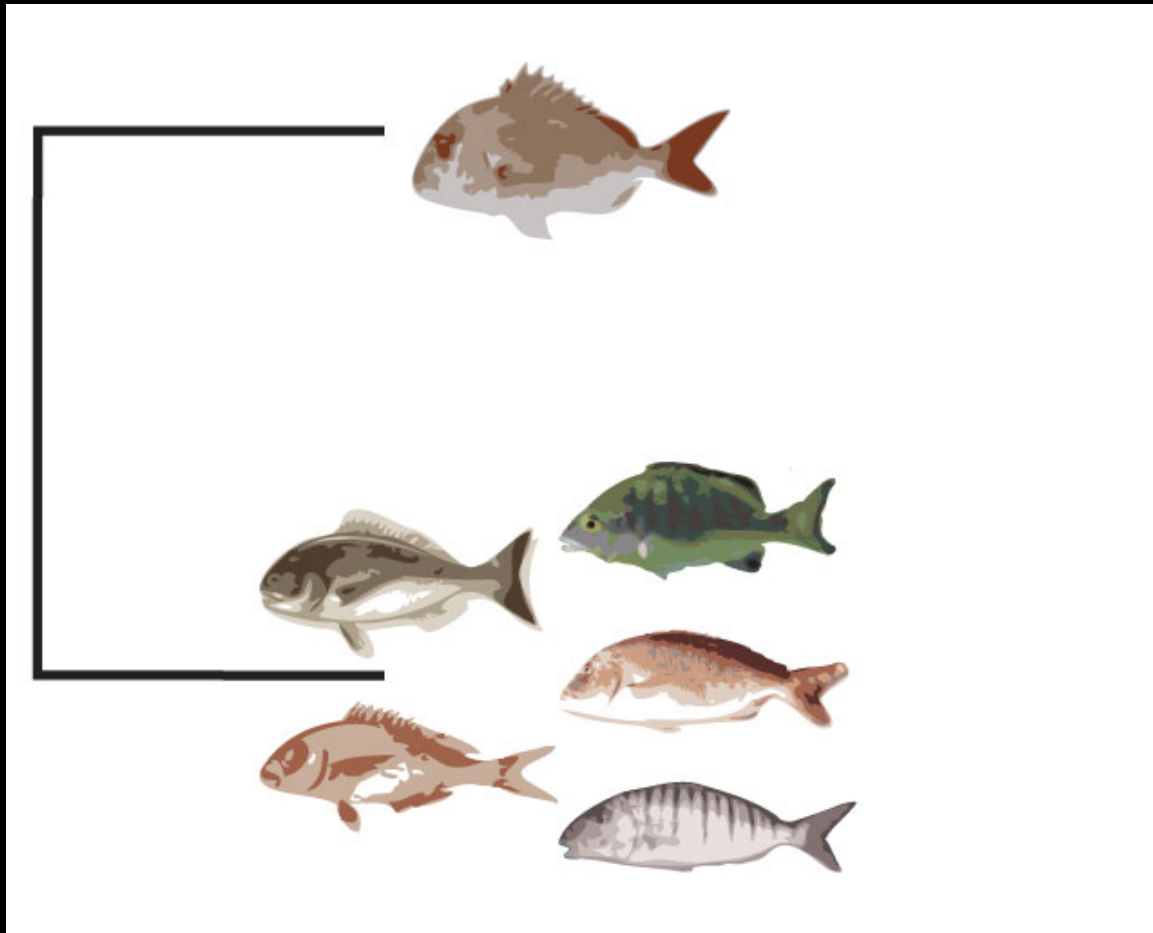
Paired comparisons



Overfished
populations

Healthy species
and population
in same genus
or family

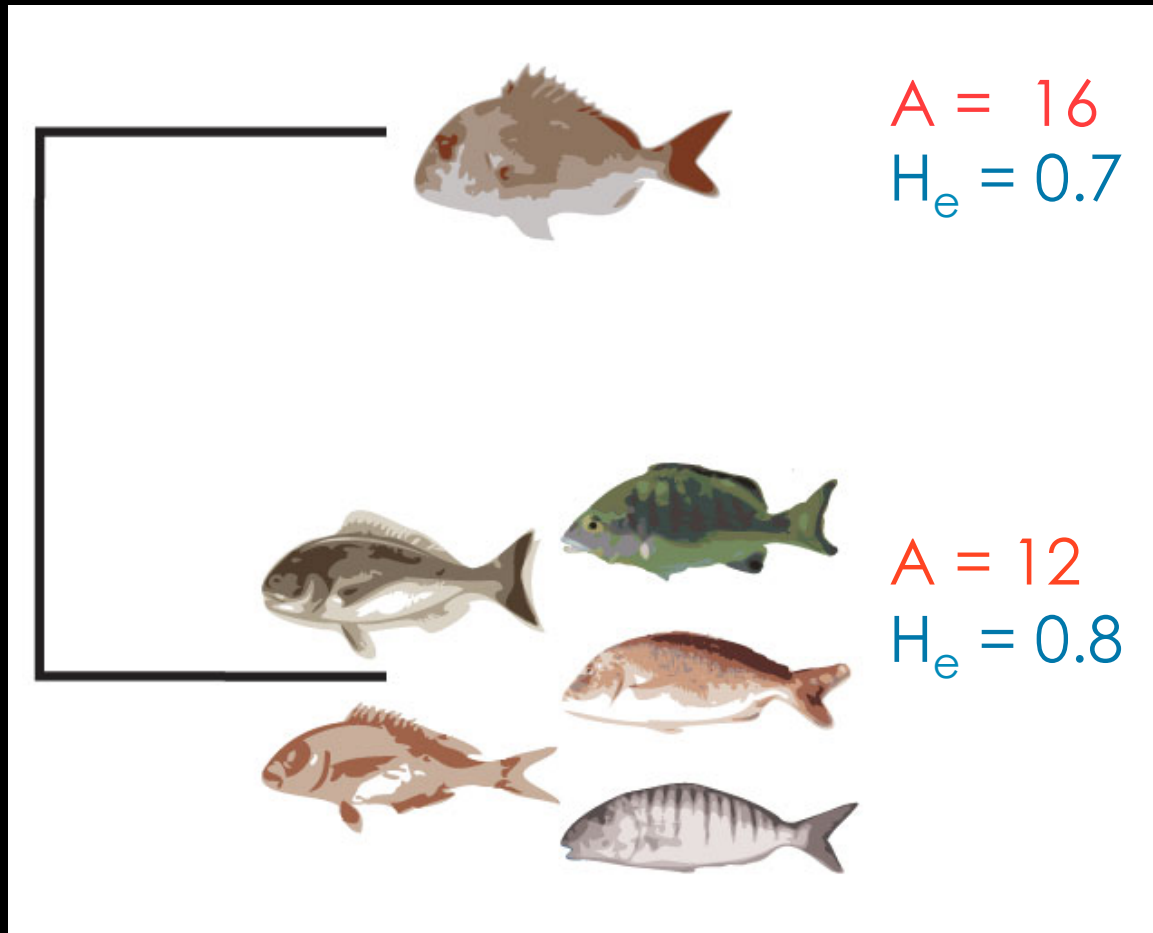
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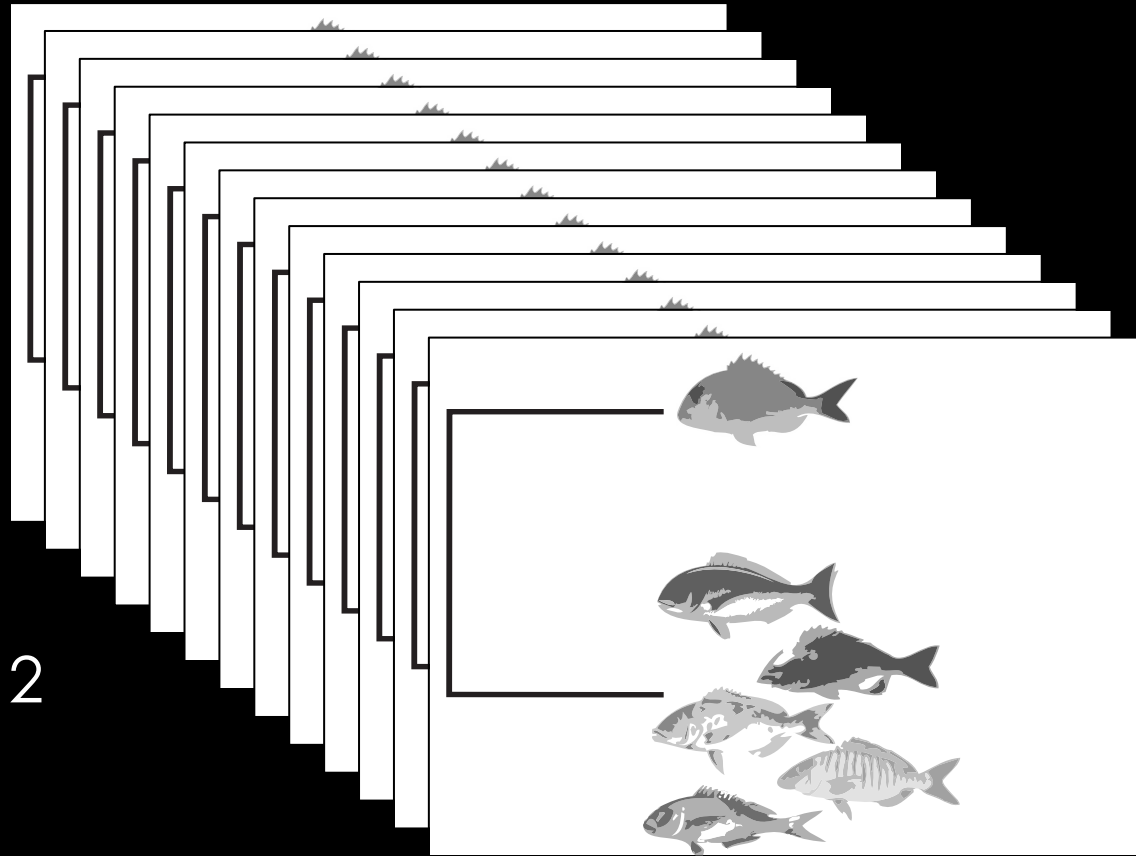


New Zealand
snapper
(*Pagrus auratus*)

Other *Pagrus*

Paired comparisons overfished vs. control

$n = 12$



Drum

Tunas

Flounders

Seabream

Herrings

Turbots

Cods

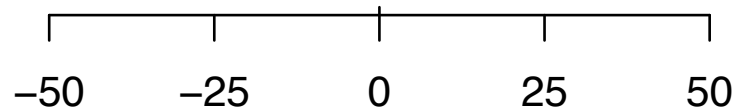
Rockfishes

Groupers

Snappers

Jack mackerels

Smelts



% difference in allelic richness

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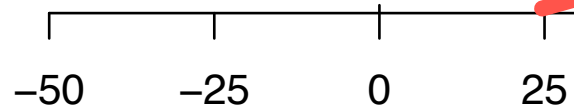
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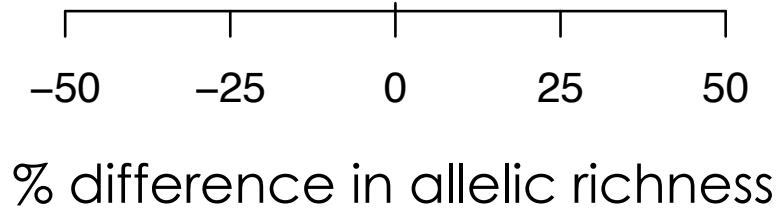
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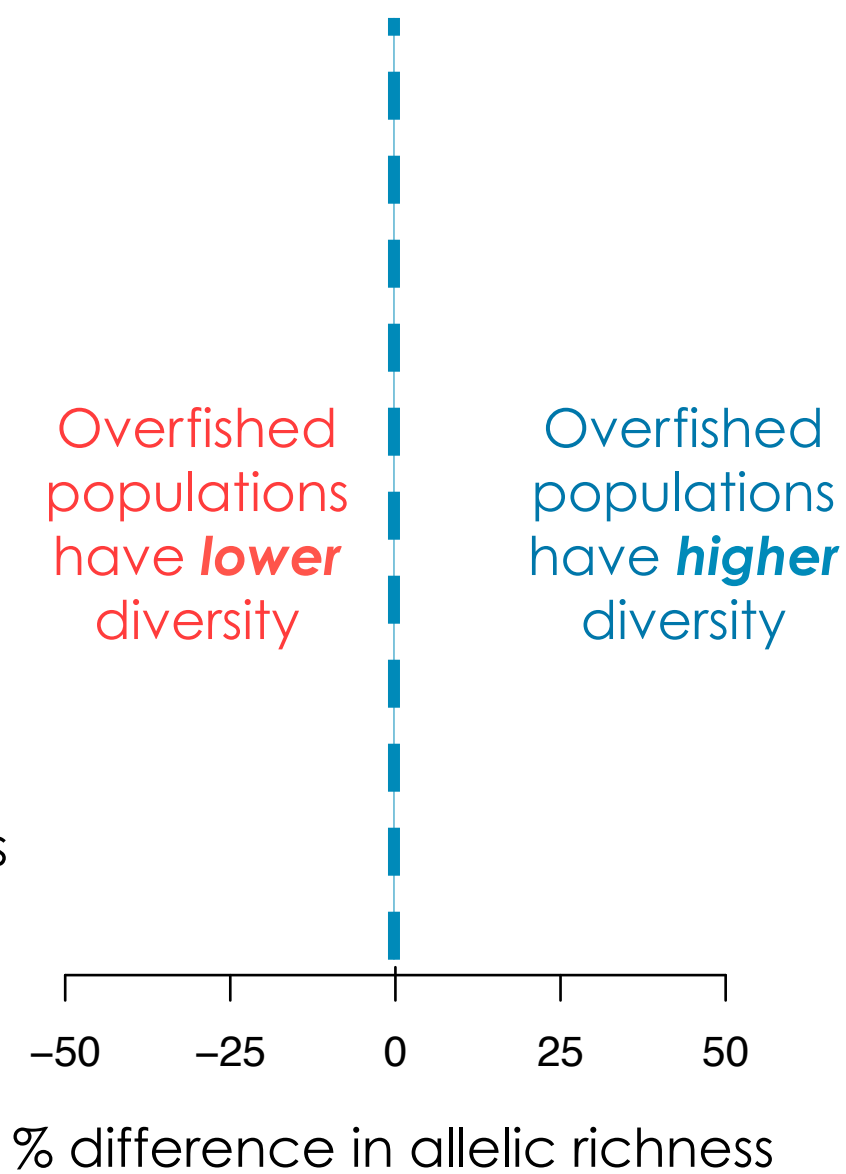


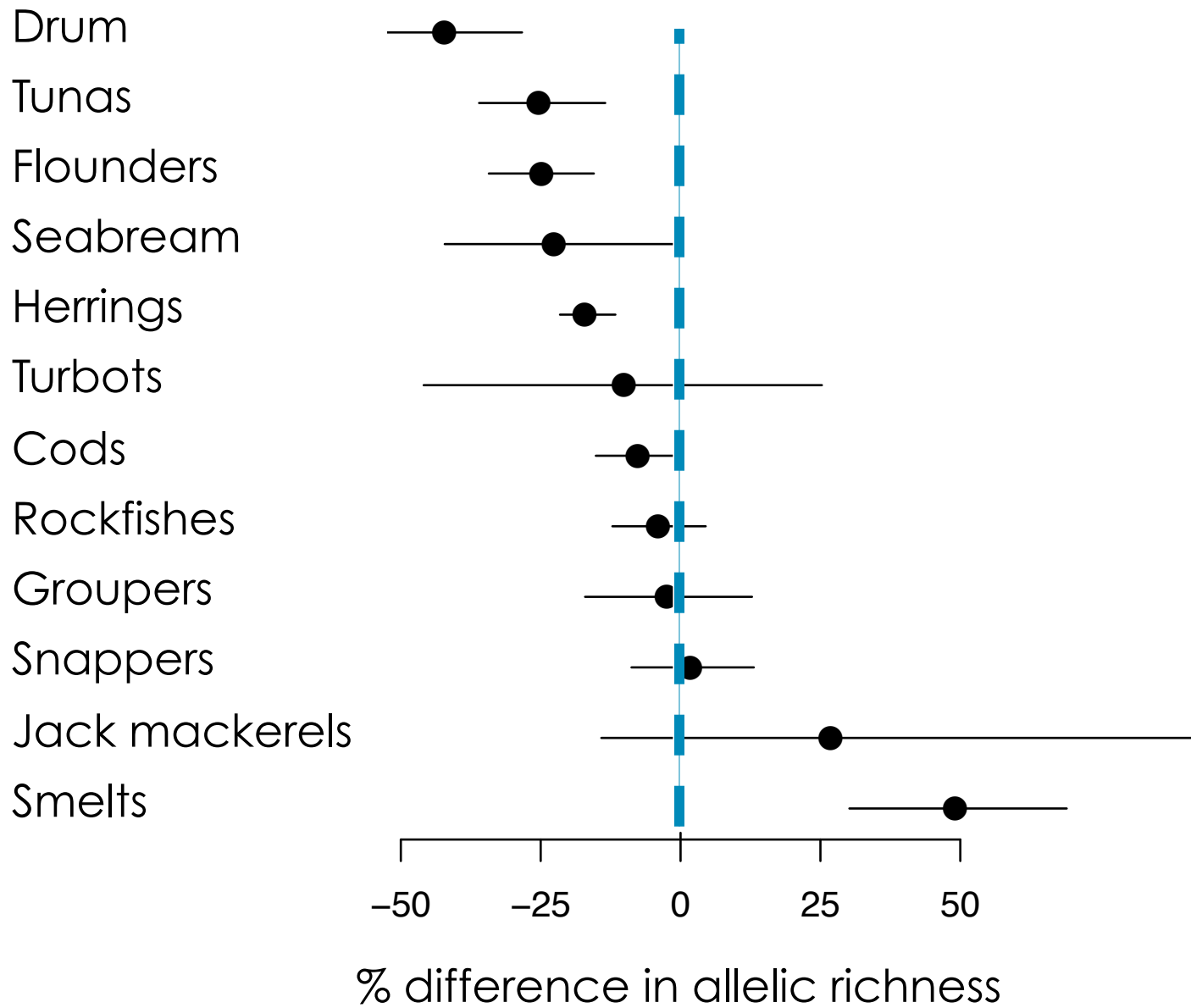
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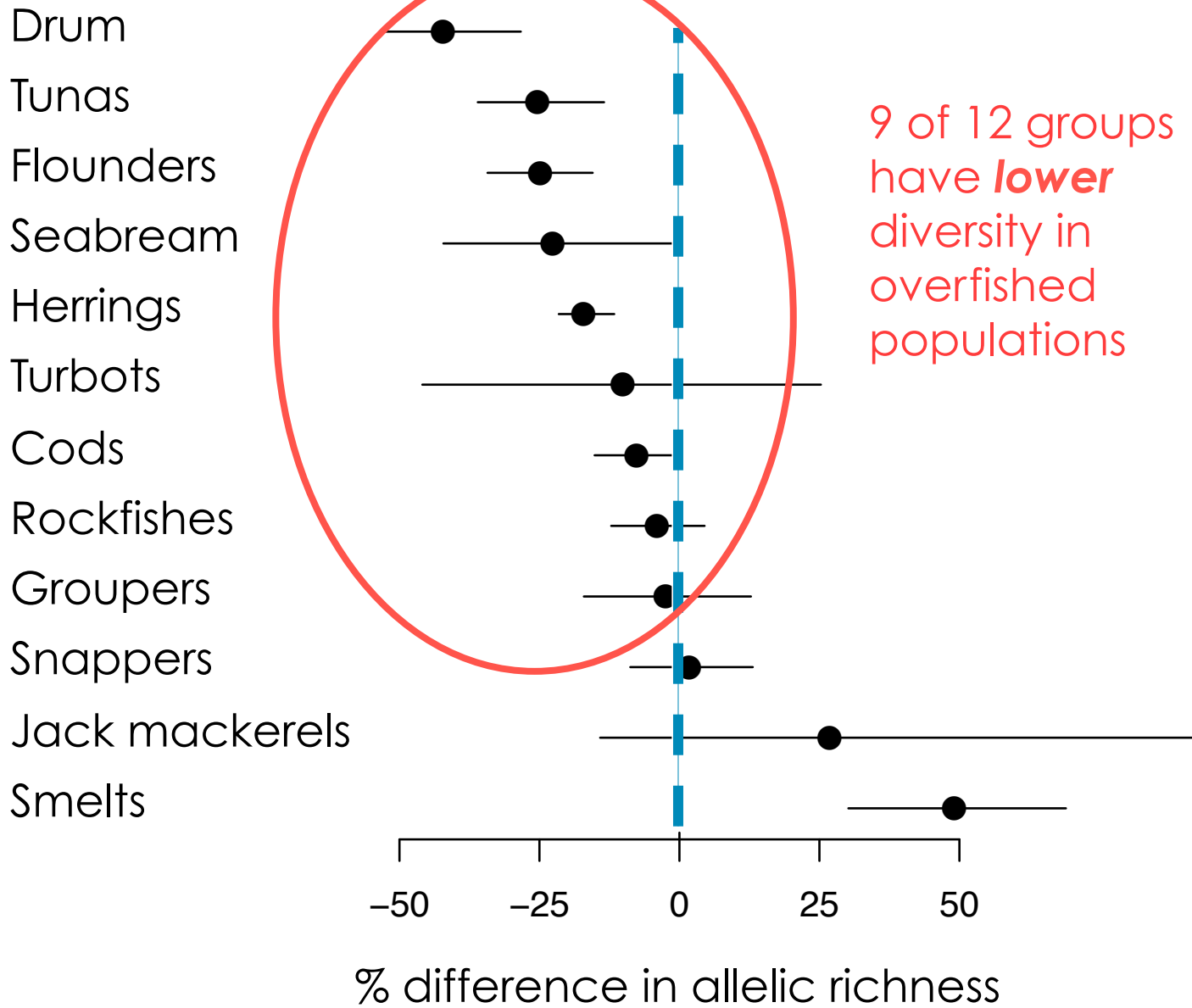
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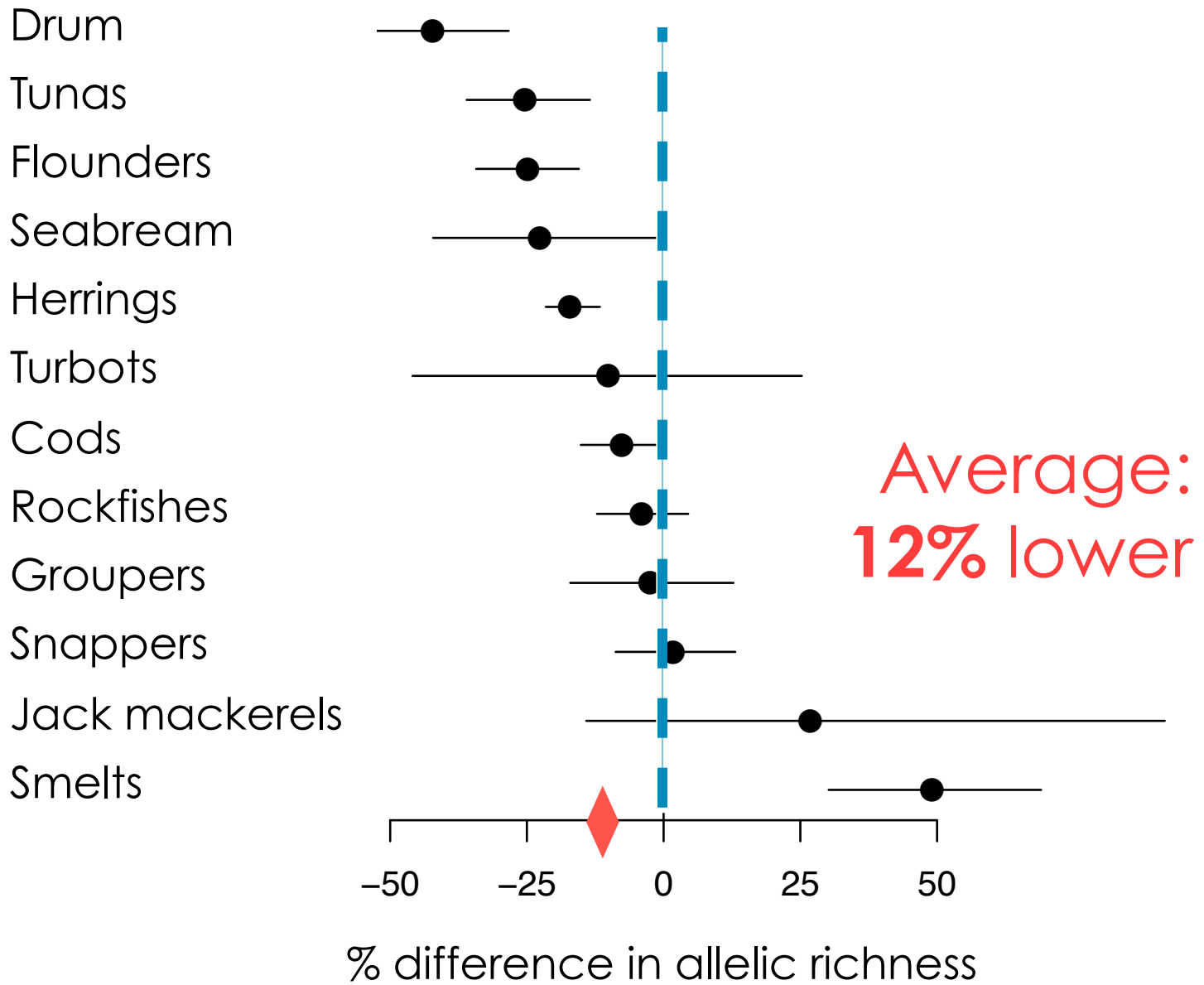


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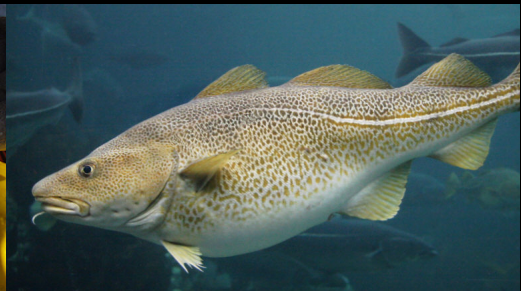






Findings

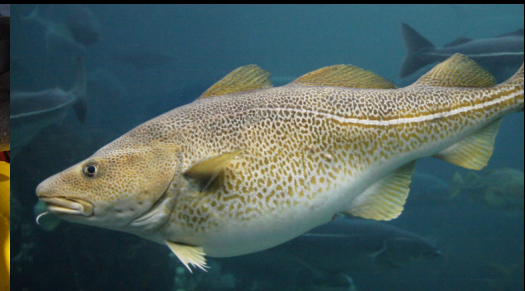
- Weak bottleneck now



Findings



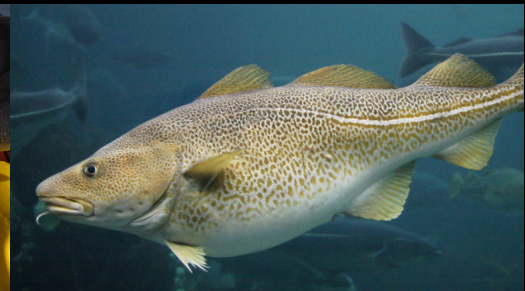
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- Impacts likely started ~1950s: rapid!



Findings



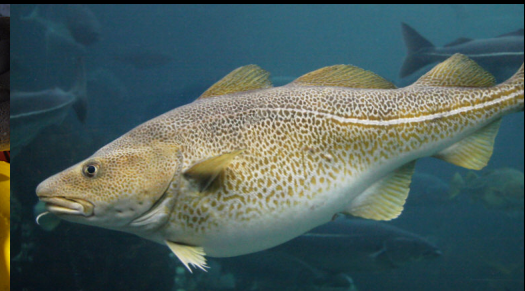
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- Becoming stronger with time



Findings



- Weak bottleneck now
- Impacts likely started ~1950s: rapid!
- Becoming stronger with time
- Lower ability to adapt in the future



Summary

- Genetic diversity provides the raw material for evolution



Summary

- Genetic diversity provides the raw material for evolution
- Evolution is happening all around us



Summary

- Genetic diversity provides the raw material for evolution
- Evolution is happening all around us
- Humans can influence the course of evolution

