

Real Selection in Natural Populations

- Mice (text-you)
- Galls and Gallflies (text-you)
- Galapagos Finches (class and in text)
- Clover (class not in text)
- Human lactose intolerance (class and in text BUT **Is now in CH 8.7**-Will re-connect with last part of class on human evolution.)

Incidental Selection by humans

- Bighorn sheep
- Fish - Cod (in class not in text) and Salmon (text-you)
- Insecticide resistance Bt/Glyphosate resistance

Artificial selection (selected purposefully by us)

- Domesticated crops
- Dogs, Pigeons

Decline of the fittest

Trophy hunters target gene pool

Quantum information storage
Light stops to conquer

Tectonics versus climate
Conflict in the mountains

Declining fish stocks
Cod can't take the heat

Inside this week



naturejobs join the battle against HIV

www.royalalbertamuseum.ca

<http://www.callisto.si.usherb.ca:8080/caprinae/marco.htm>

Ex. Bighorn sheep

What happens if you hunt all the sheep with big horns?

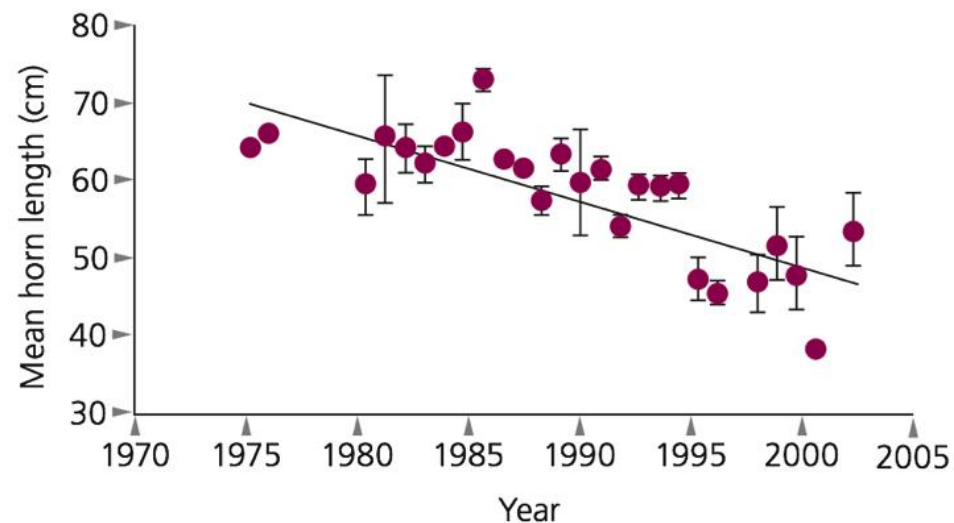
Plot of mean (\pm SE) horn length of 4-year-old rams over a 30 year period showing the decline of mean horn length in this population.



A



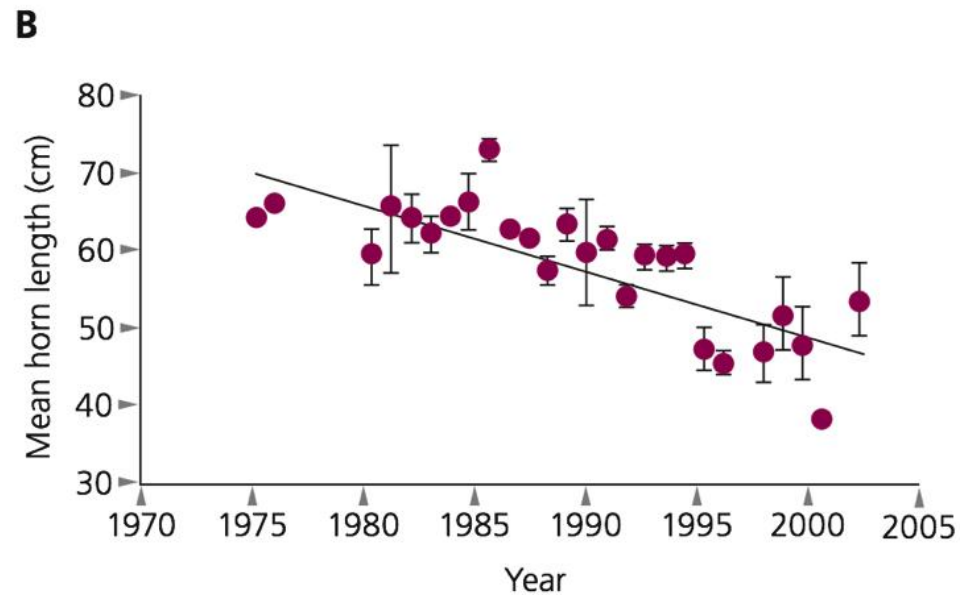
B



Genetic effects of harvest on wild animal populations

Fred W. Allendorf, Phillip R. England, Gordon Luikart, Peter A. Ritchie, Nils Ryman TREE 2008

What other factors other than selection on horn size from hunters might drive the pattern below?

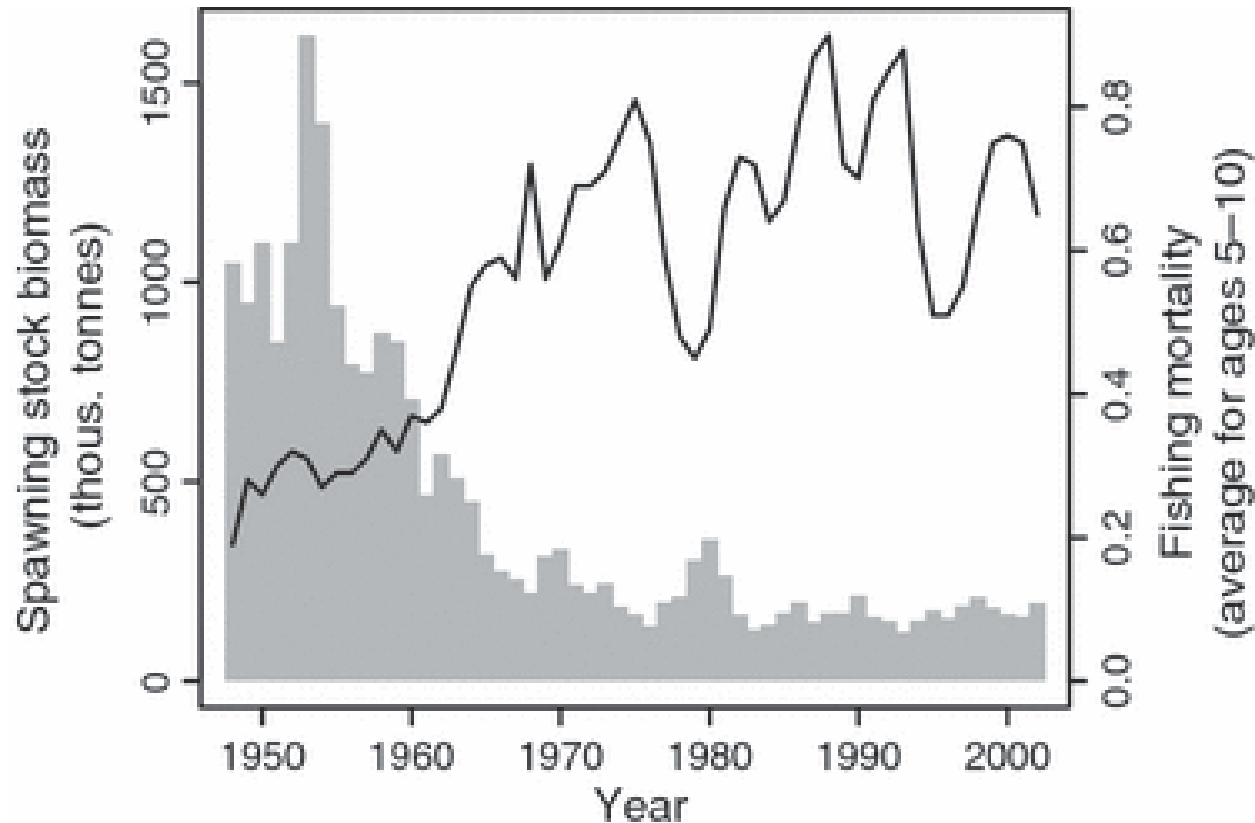
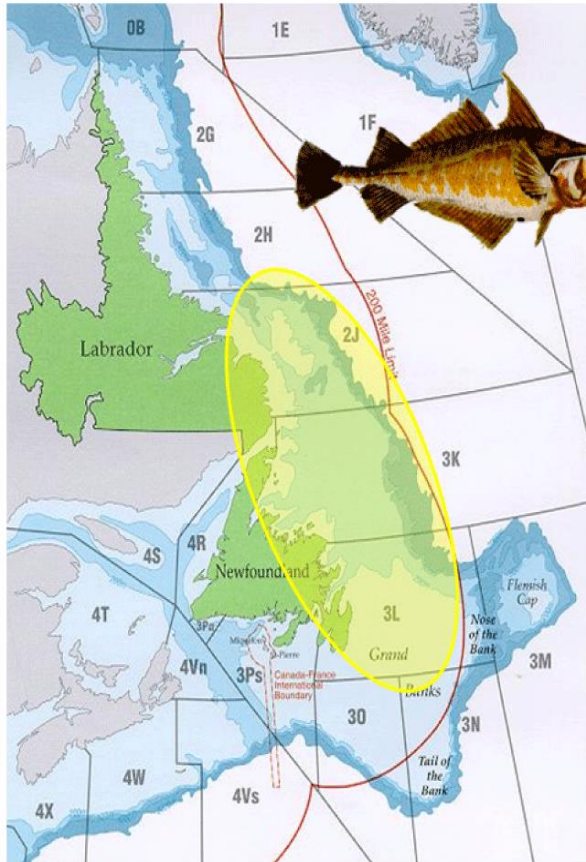


We....need to re-examine “size requirements. If we stop hunting based on horn size, the horn size will increase, albeit slowly. We have to be more **evolutionarily enlightened** about how we manage and conserve animal populations."

Read more at: <http://phys.org/news/2016-01-intense-trophy-artificial-evolution-horn.html#jCp>

Ex. Cod

What happens if you keep catching and keeping all the big fish for 50 yrs?



Location where this population of cod lives
Outer Banks (Off the coast of Newfoundland)

Evolutionary Applications

Volume 4, Issue 4, pages 562-573, 5 JAN 2011 DOI: 10.1111/j.1752-4571.2010.00176.x
<http://onlinelibrary.wiley.com/doi/10.1111/j.1752-4571.2010.00176.x/full#f1>

Cod fishing has influenced **life-history evolution**

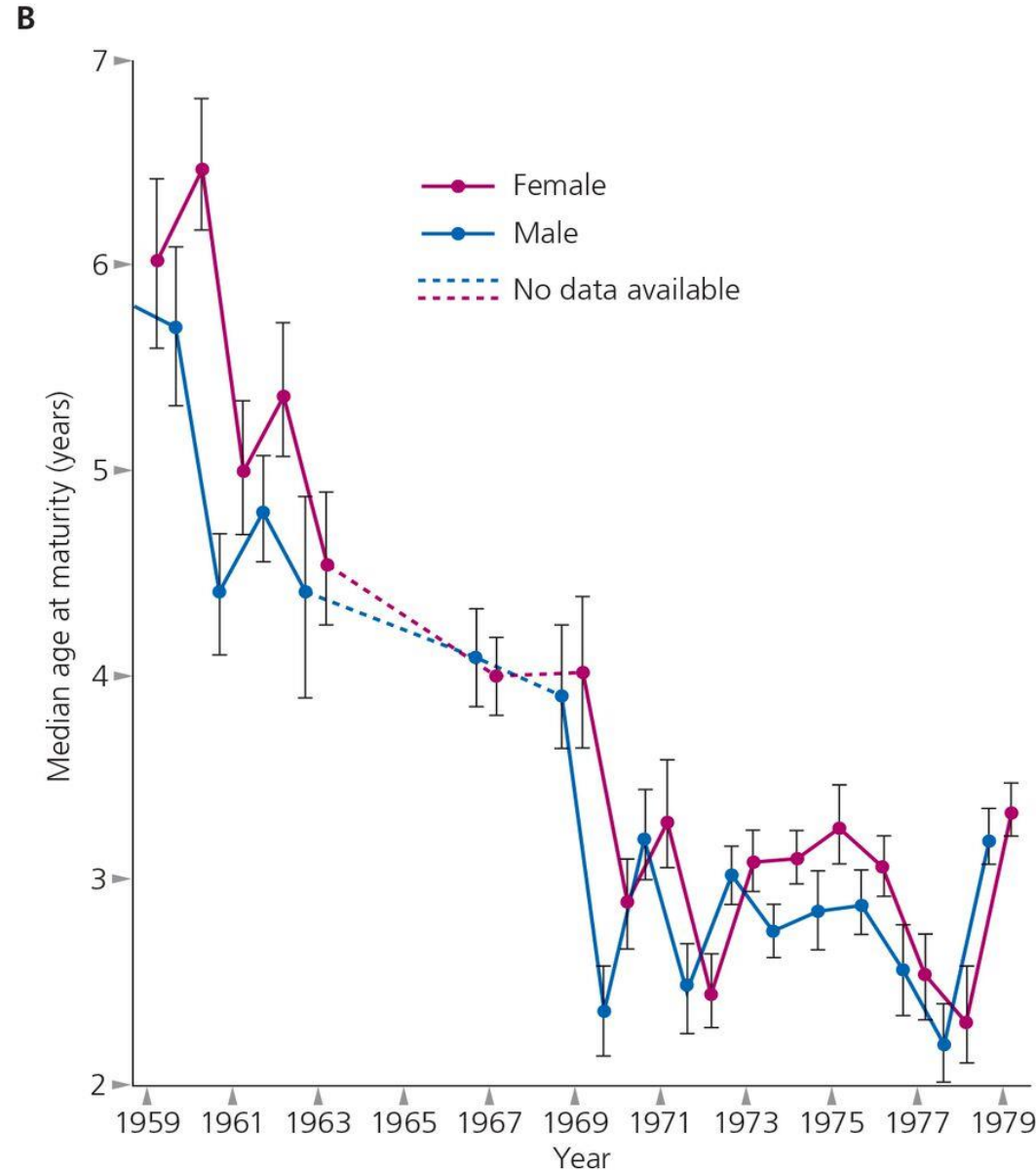
FYI Age at maturity = age at which they start reproducing.



Articles about current situation...

<http://www.bbc.com/news/world-us-canada-40252481>

<https://www.theglobeandmail.com/canada/article-newfoundland-cod-stocks-suffer-serious-decline-report/>



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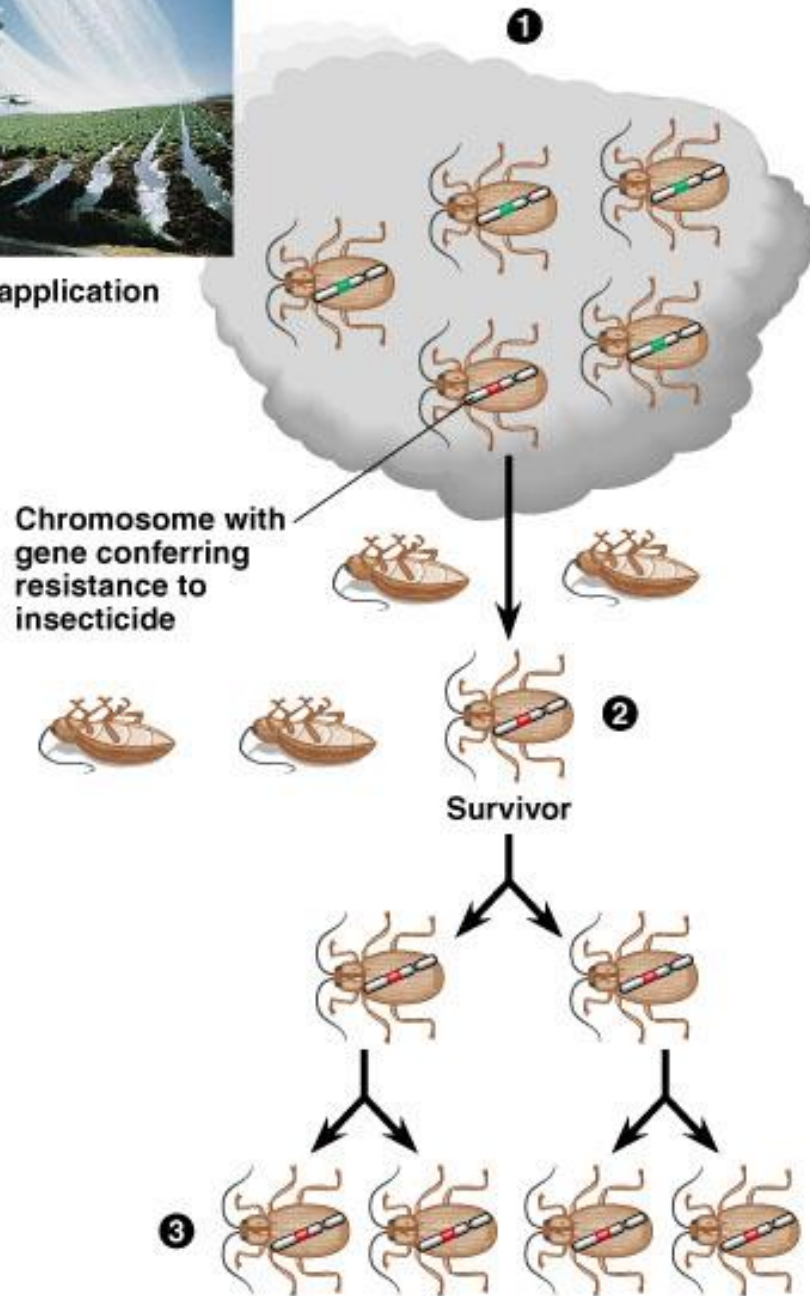
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- Dogs, Pigeons

Ex. Insecticide/pesticide/herbicide resistance





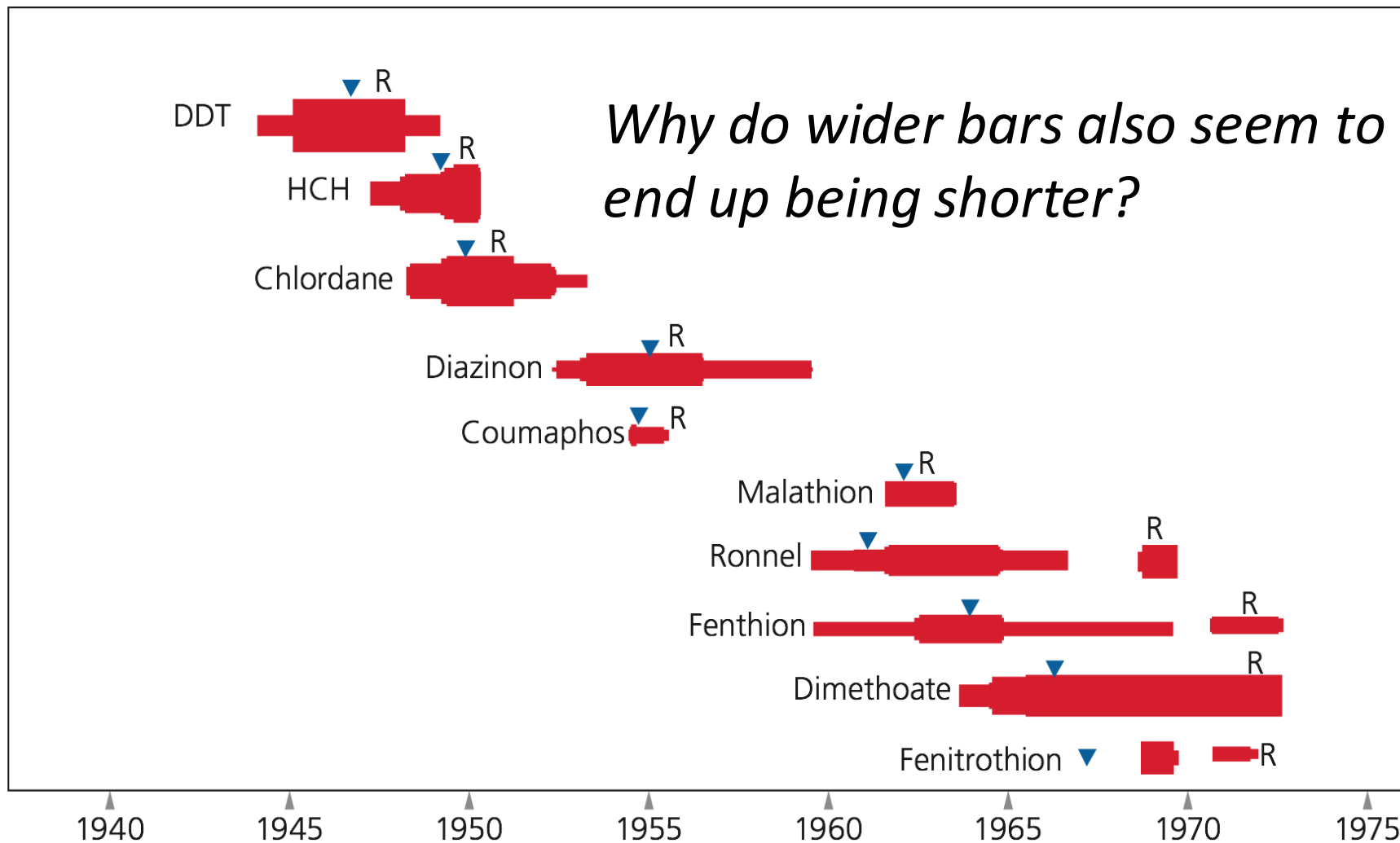
Insecticide application



**General scenario
for how insects
evolve resistance**

Ex. Evolution of Resistance to pesticides in houseflies in Europe

(width=level of use, triangle=first resistance, R= time when most populations resistant)

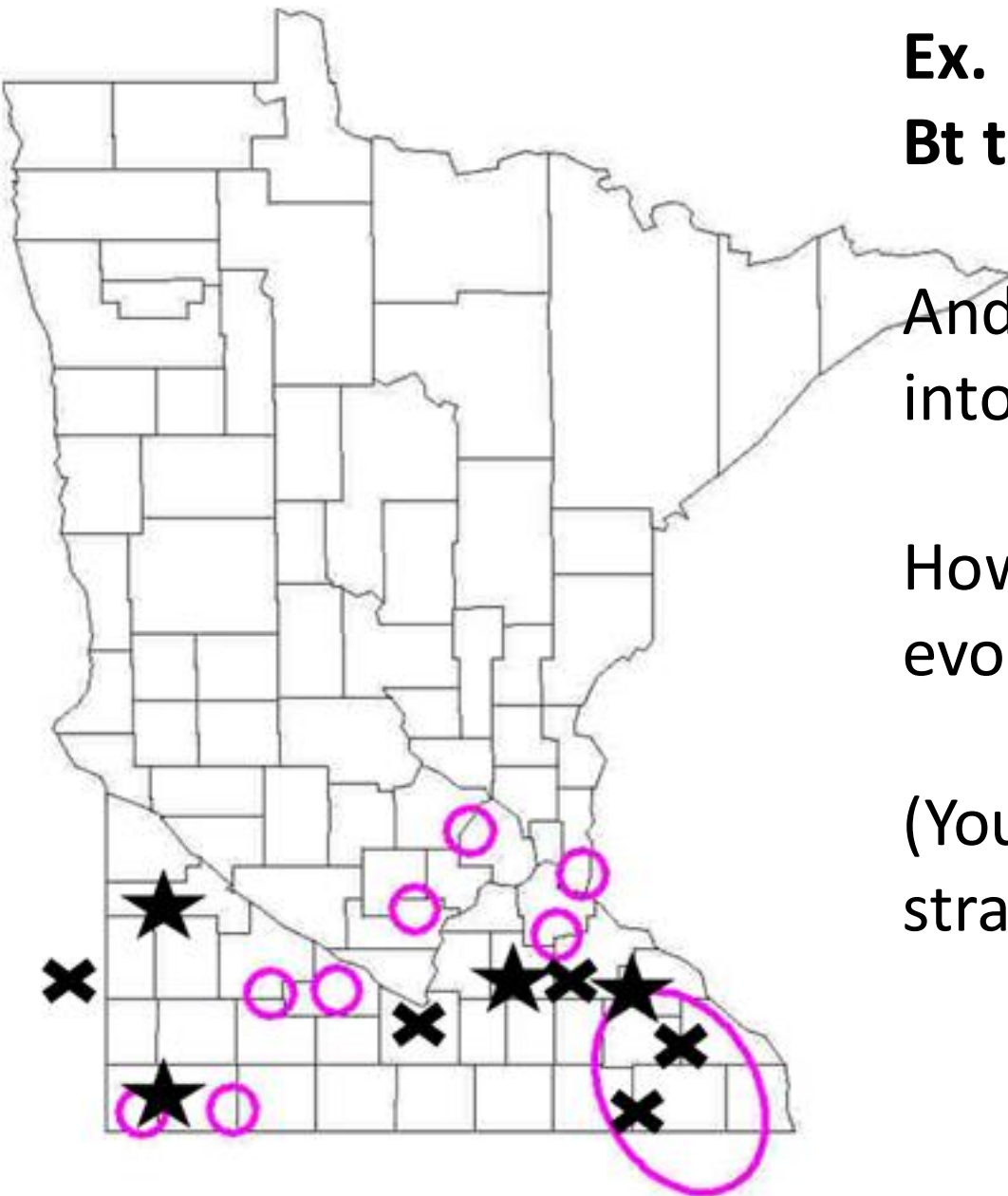


Ex. Evolution of resistance to Bt toxin in corn rootworms.

And how did that Bt toxin get into the corn we plant?

How can you slow resistance evolving?

(Your text describes the strategy of creating “refuges”.)



Corn Rootworm outbreaks in Bt corn

<http://blog.lib.umn.edu/efans/cropnews/2012/07/performance-problems-surface-a.html>

EPA Requirements 2024

<https://www.epa.gov/regulation-biotechnology-under-tsca-and-fifra/framework-delay-corn-rootworm-resistance>

○ 2009 × 2010 ★ 2011

Overplanting Bt Corn Fuels Pest Resistance and Costs U.S. Farmers \$1.6 Billion, Study Says

Compiled by Staff | February 28, 2025 | Featured - U.S., Gene-Editing, News, Seed World U.S.



How do we prevent this??

Researchers say overuse of rootworm-resistant Bt corn threatens long-term crop viability.

A new study warns that the widespread planting of genetically engineered Bt maize in the U.S. Corn Belt has accelerated corn rootworm resistance reducing the crop's long-

<https://www.seedworld.com/us/2025/02/28/overplanting-bt-corn-fuels-pest-resistance-and-costs-u-s-farmers-1-6-billion-study-says/#:~:text=Bt%20crops%20which%20contain%20insecticidal%20proteins%20from,to%20the%20depletion%20of%20a%20shared%20resource.>

Ex. How does resistance to the herbicide Roundup (glyphosate) evolve? (Your Text “Evol in Age of GMO”)

Roundup disables (breaks apart) an enzyme (EPSPS) that helps cells make amino acids.

There are 3 different species that have evolved resistance to Roundup...

How did they do this?

- 2 of them have the SAME single nucleotide point mutation that changed the structure of the enzyme so the herbicide no longer affected its function.
- 1 of them simply duplicated the gene that encodes the enzyme many times (so it has lots of copies of it). This means it makes LOTS of the enzyme so if the herbicide affects some of the enzyme, it doesn't matter because there is extra!

<https://www.npr.org/sections/thesalt/2019/04/11/710229186/as-weeds-outsmart-the-latest-weedkillers-farmers-are-running-out-of-options>

Lots of cool research being done on one of those species-Palmer Amaranth which is invading MN!



Chandrima Shyam, a graduate student at Kansas State, is hoping to learn how these Palmer amaranth plants survive 2,4-D and other herbicides.

Dan Charles

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- **Domesticated crops**
- **Dogs, Pigeons**

Domesticated crops

Ex. *Brassica* or mustard family!

We have selected for lots of different traits!



Brassica oleracea



Broccoli



Cauliflower



Collard greens

ARTIFICIAL SELECTION



Brussels sprouts



Cabbage



Kale



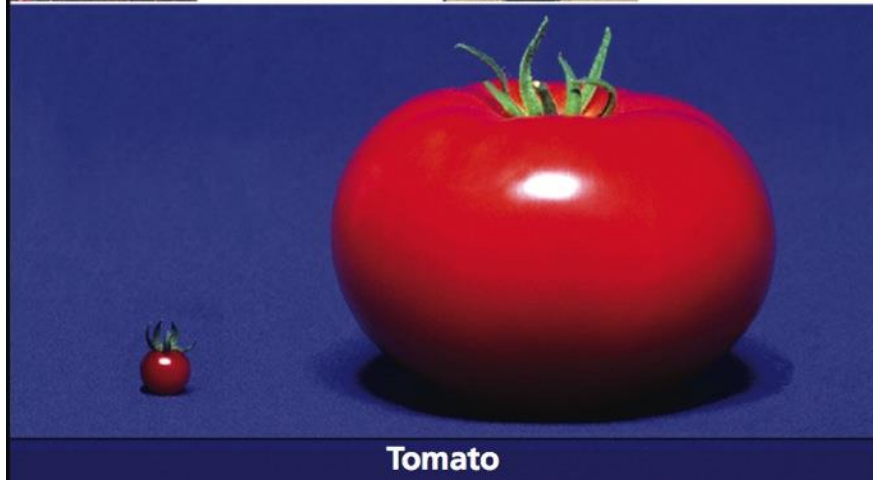
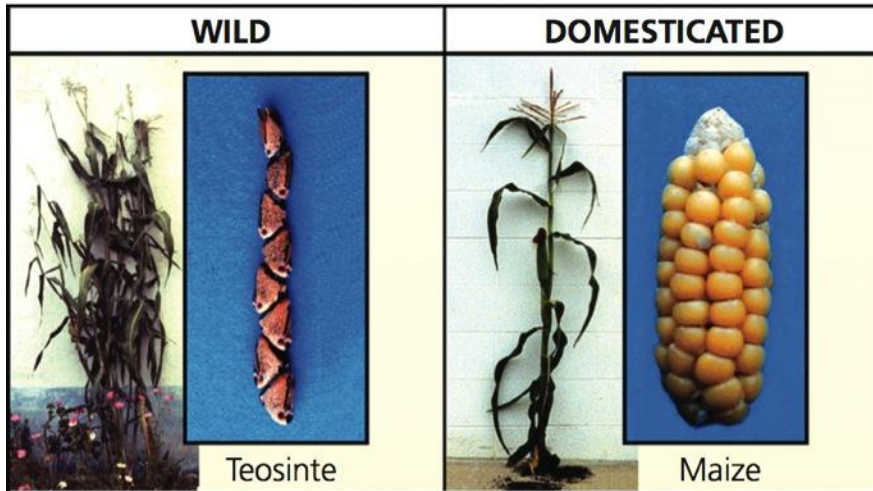
Kohlrabi

Domesticated crops

Ex. corn, tomatoes, rice and sunflowers

What traits did we select for in each of these species?

Text goes over wheat!



Ex. Tomatoes

The Chilean specimens....are smaller than a typical cherry tomato, are unappetizing except to grazers like llamas, alpacas, vicuñas, guanacos....

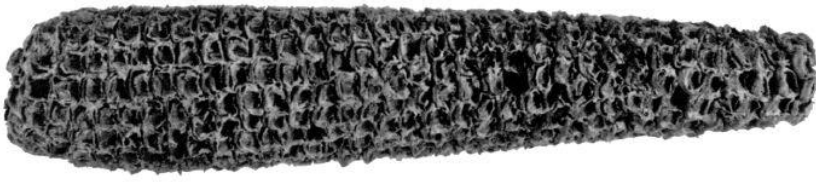
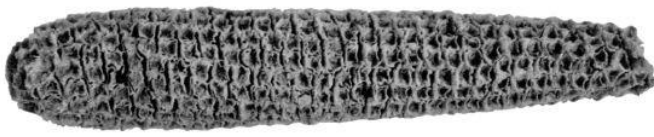
The hardy plants may harbor valuable genes not found in other Chilean specimens at Davis. Those genes may enrich the nutritional value of tomorrow's supermarket and backyard garden tomatoes.

USDA ARS (Ag Research Service)

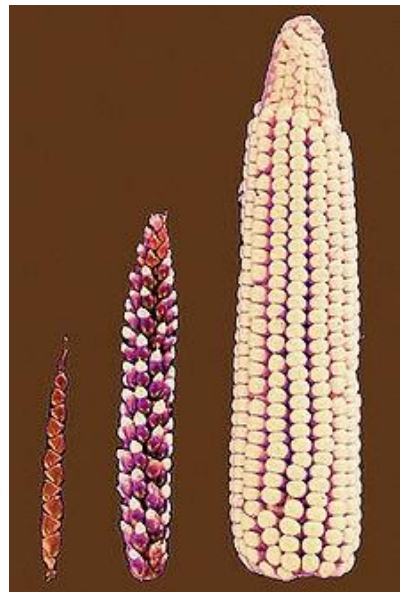


Ex. Corn (more pictures)

5500 years ago

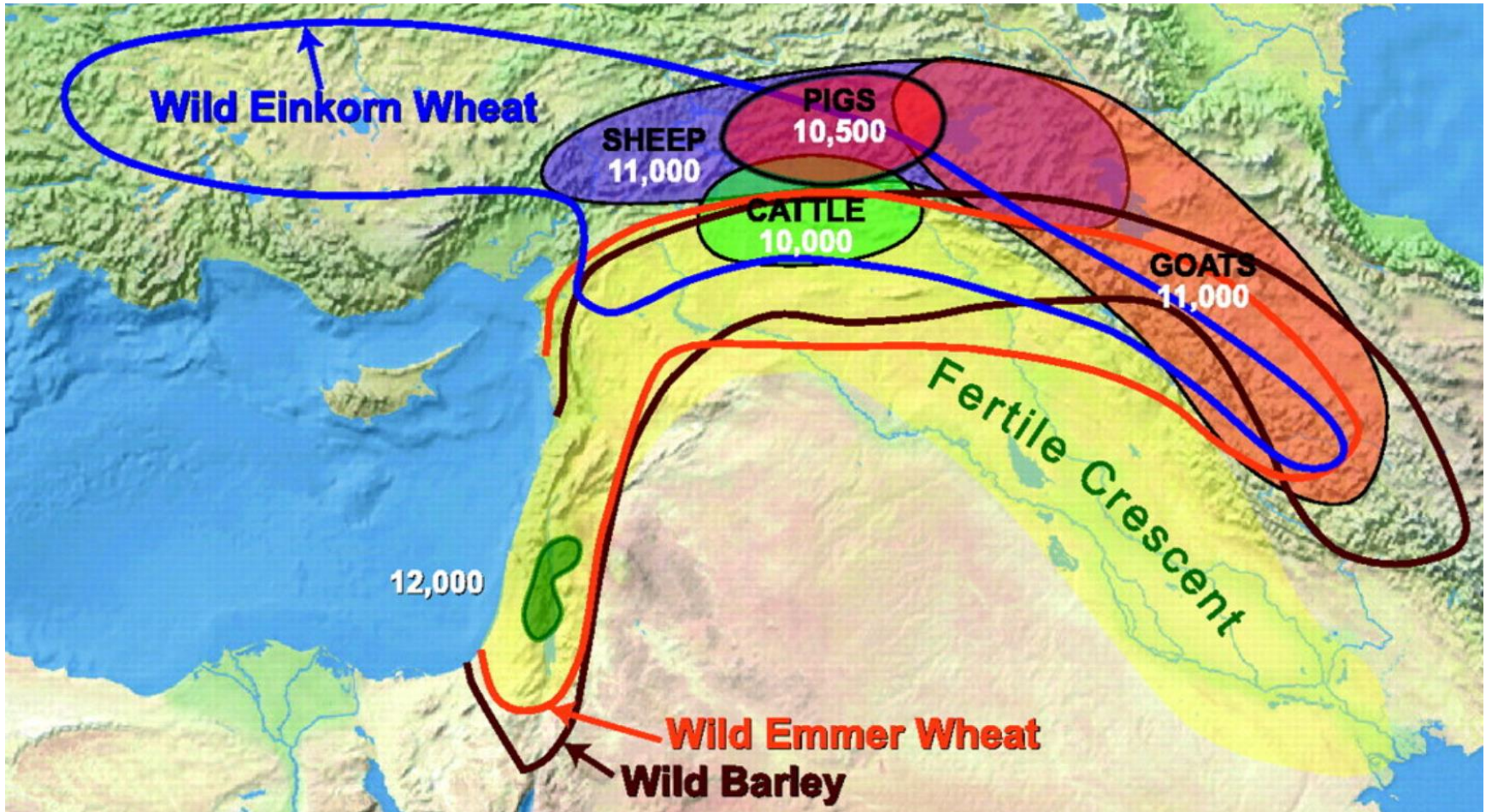


4400 years ago



We have domesticated lots of species.

Where in the world were they domesticated?

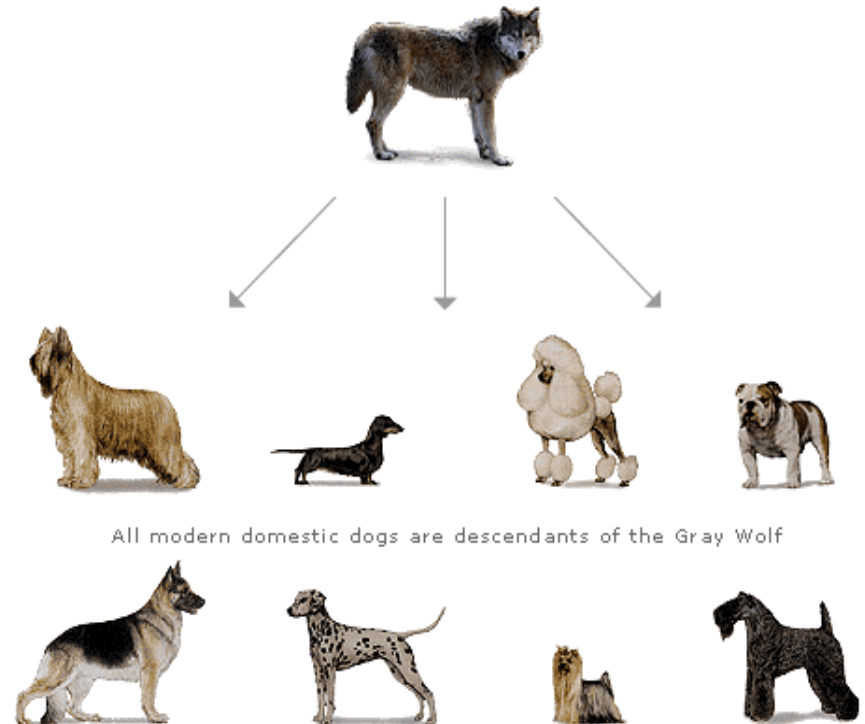


http://www.pnas.org/content/106/Supplement_1/9971



Ex. Dogs

- Domesticated about 15,000 yrs ago (well....this is changing lots of research)
- 400 breeds but all one “species”





Ex. Crazy pigeons (Darwin loved pigeons)

<http://www.nytimes.com/2013/02/05/science/pigeons-a-darwin-favorite-carry-new-clues-to-evolutio>

