

## *Real Selection in Natural Populations*

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- 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
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- Insecticide resistance Bt/Glyphosate resistance

## *Artificial selection (selected purposefully by us)*

- Domesticated crops
- Dogs, Pigeons



[www.royalalbertamuseum.ca](http://www.royalalbertamuseum.ca)

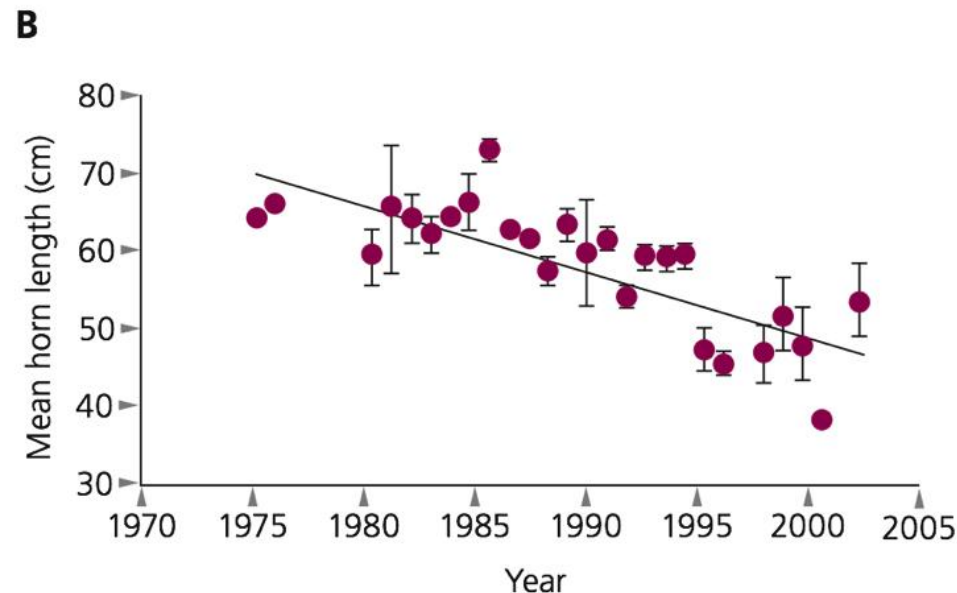
<http://www.callisto.si.usherb.ca:8080/caprinae/marco.htm>

## Ex. Bighorn sheep

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



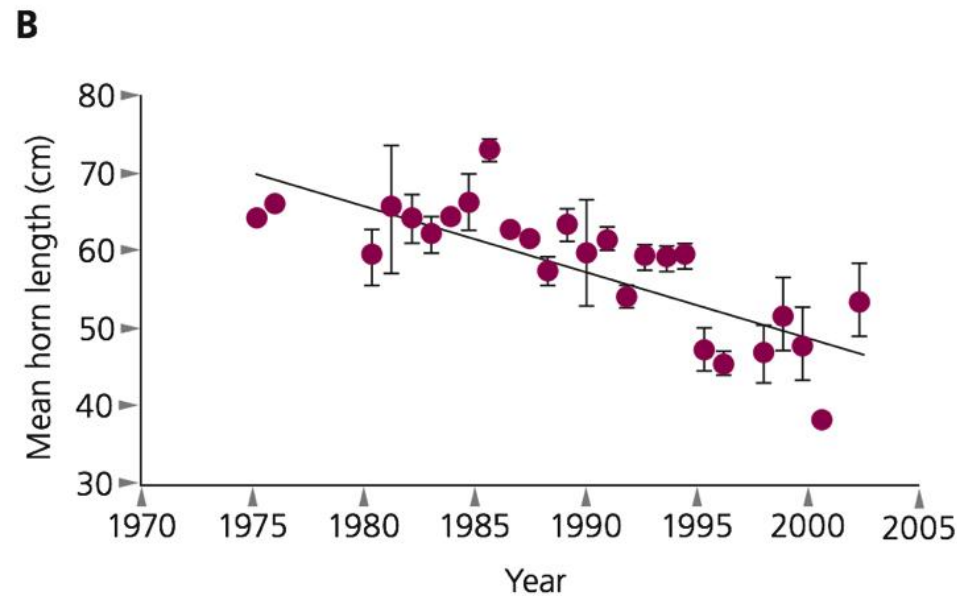
Plot of mean ( $\pm$ SE) horn length of 4-year-old rams over a 30 year period showing the decline of mean horn length in this population.



**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>

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



Figure 1 is a combined bar and line chart showing the spawning stock biomass and fishing mortality for the North Sea haddock stock from 1950 to 2000. The left y-axis represents spawning stock biomass in thousands of tonnes (0 to 1500), shown as grey bars. The right y-axis represents fishing mortality (0.0 to 0.8), shown as a black line. The x-axis represents the year (1950 to 2000). Spawning stock biomass peaks around 1953 at approximately 1600 thousand tonnes and then generally declines, with a sharp drop after 1960. Fishing mortality starts around 0.25 in 1950, peaks around 0.75 in 1953, and then fluctuates between 0.4 and 0.8 for the remainder of the period.

[Volume 4, Issue 4](http://onlinelibrary.wiley.com/doi/10.1111/j.1752-4571.2010.00176.x), 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**

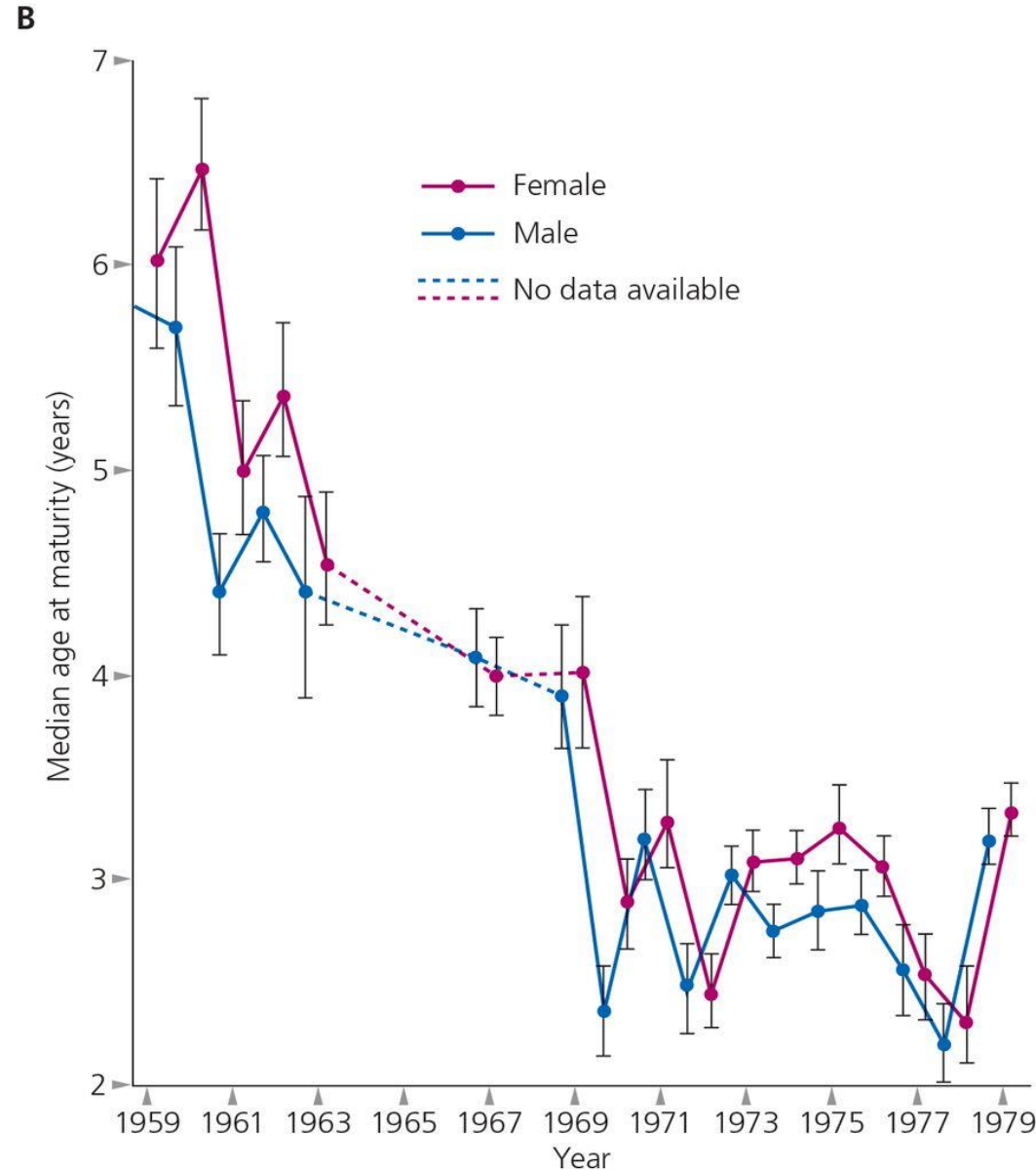
FYI Age at maturity = age at which they start reproducing.



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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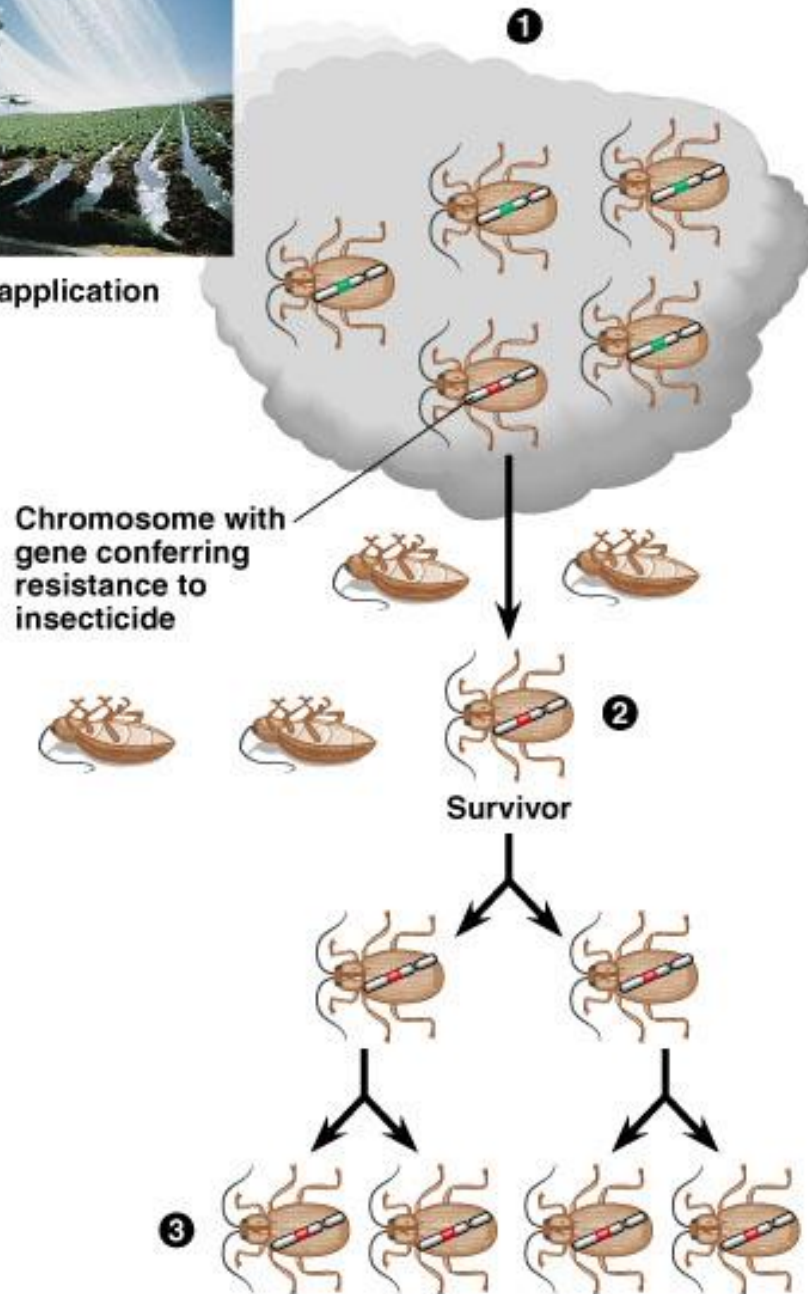
## Ex. Insecticide/pesticide/herbicide resistance







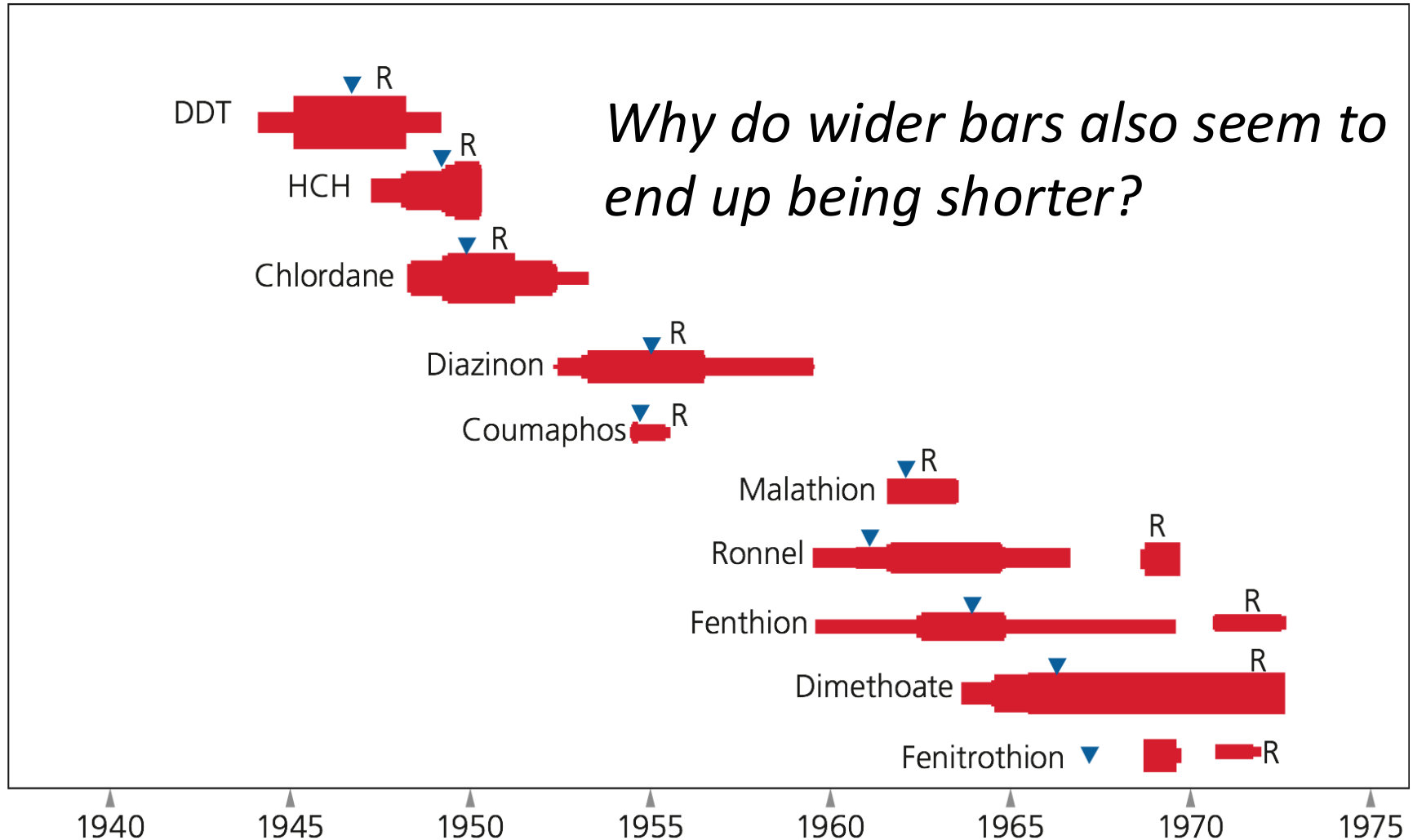
Insecticide application



**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)

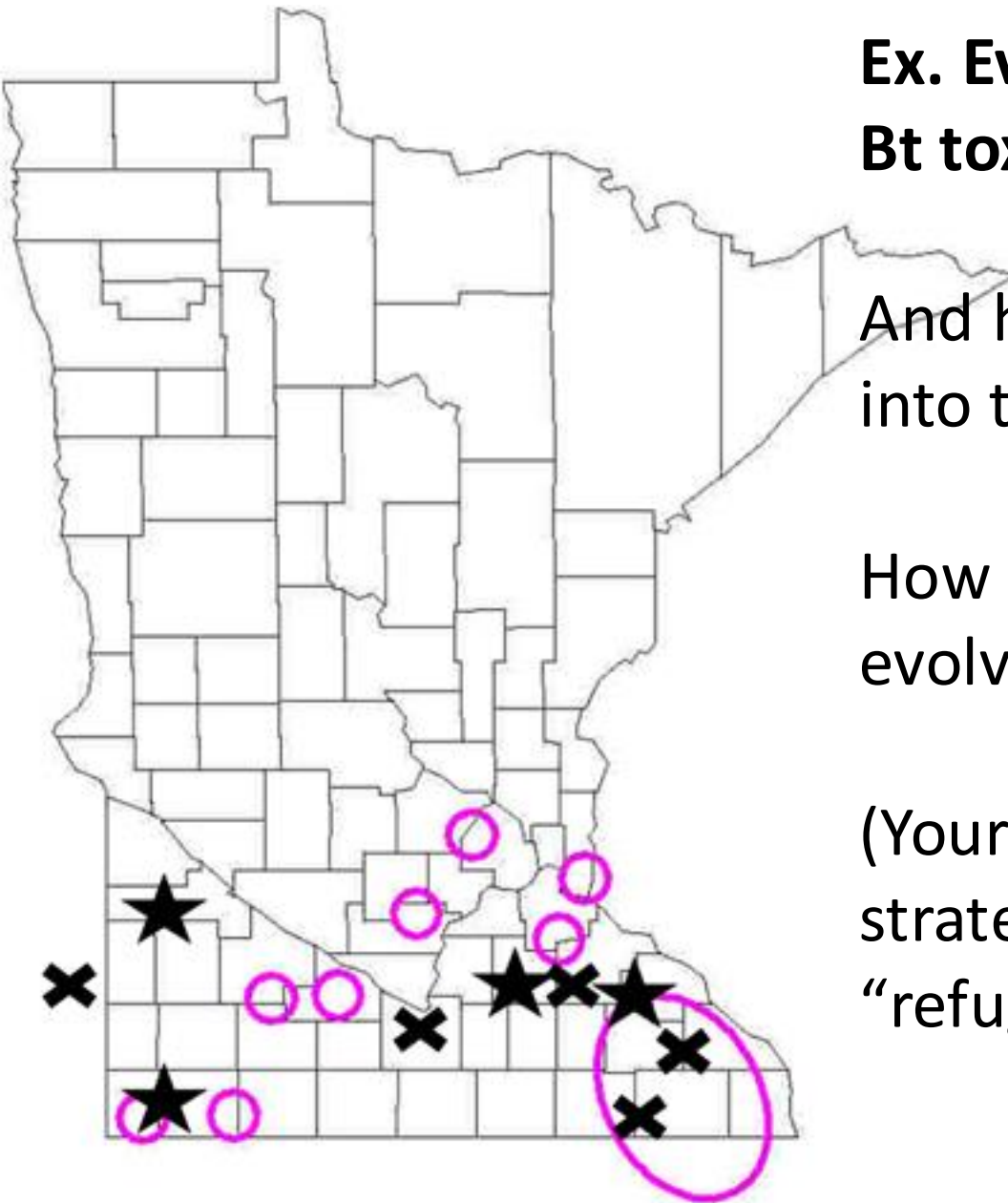


## Ex. Evolution of resistance to Bt toxin in corn rootworms.

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.



### 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.>

How do  
we  
prevent  
this??



## **Ex. How does resistance to the herbicide Roundup (glyphosate) evolve?**

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!

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



Brussels sprouts



Cabbage



Kale



Kohlrabi

ARTIFICIAL SELECTION



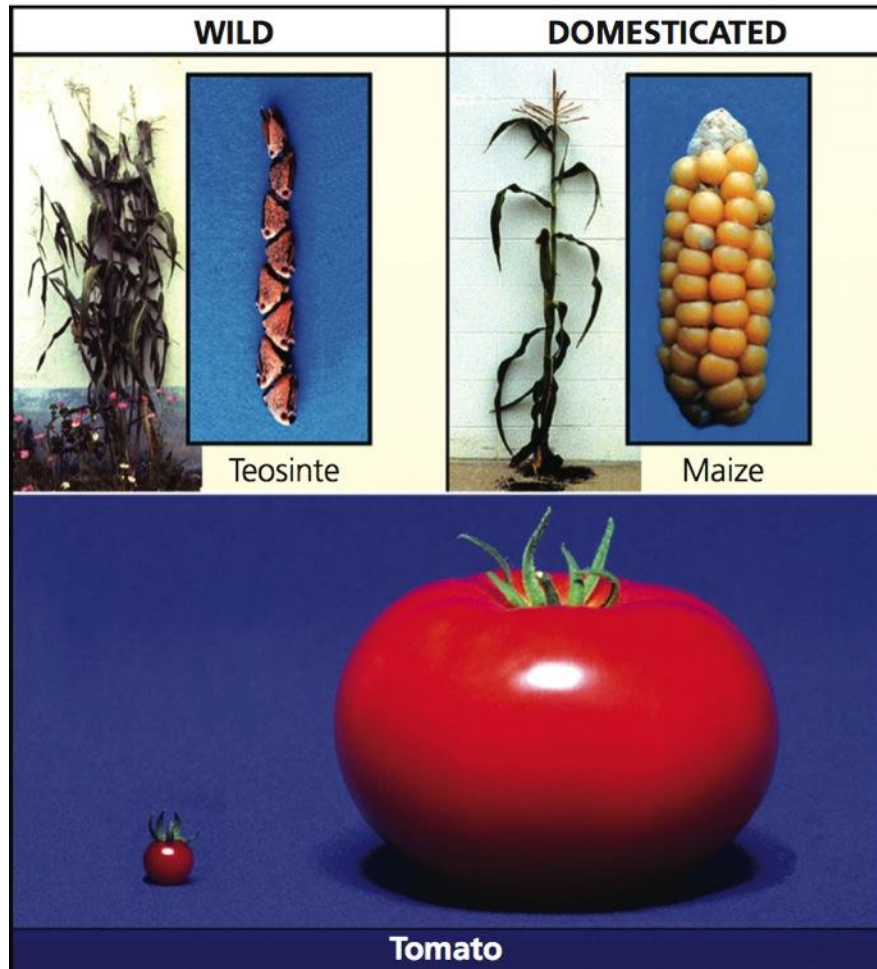


# Domesticated crops

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....

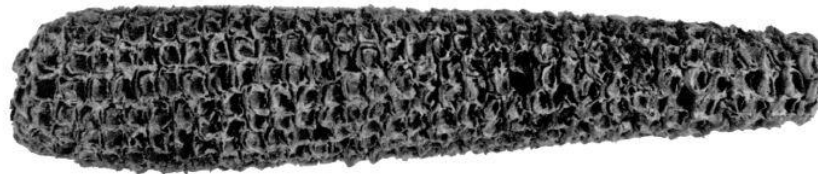
The hardy plants may harbor valuable genes not found in other Chilean specimens at Davis. Those genes may enrich the nutritional value of tomorrow's supermarket and backyard garden tomatoes.

USDA ARS (Ag Research Service)

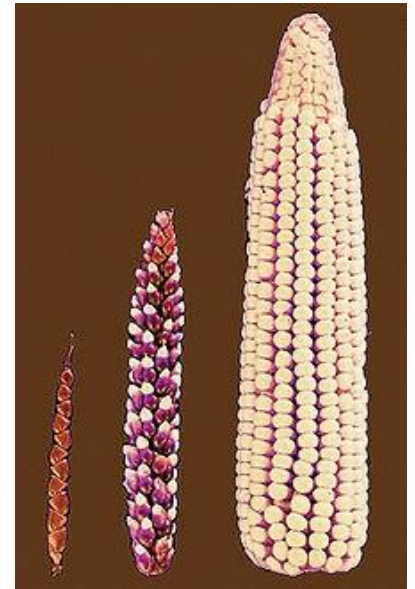


# Ex. Corn (more pictures)

5500 years ago



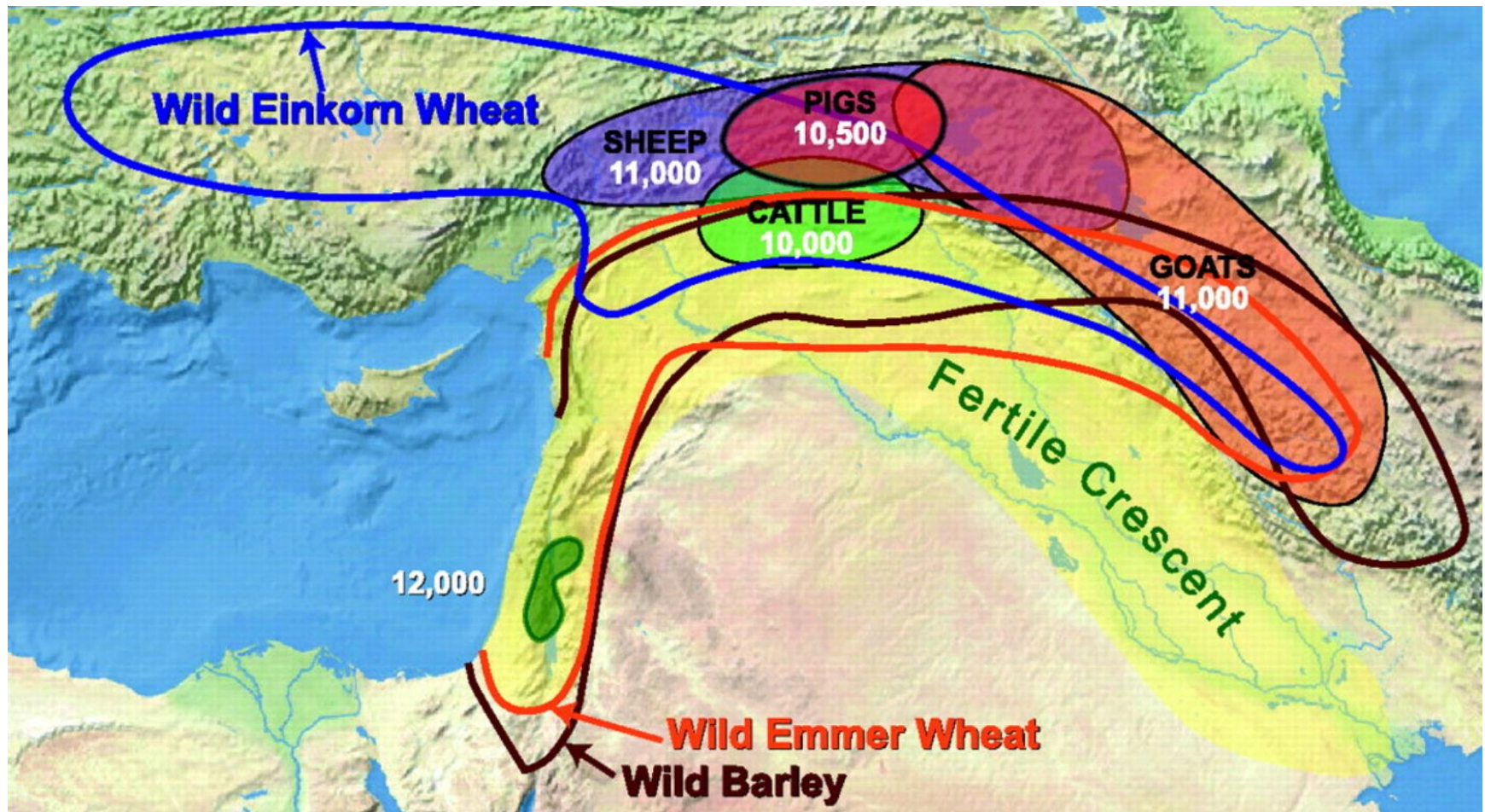
4400 years ago





We have domesticated lots of species.

Where in the world were they domesticated?



[http://www.pnas.org/content/106/Supplement\\_1/9971](http://www.pnas.org/content/106/Supplement_1/9971)



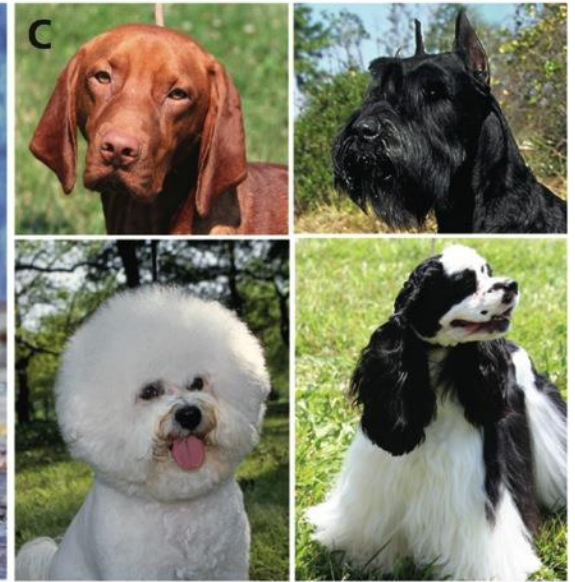
A



B

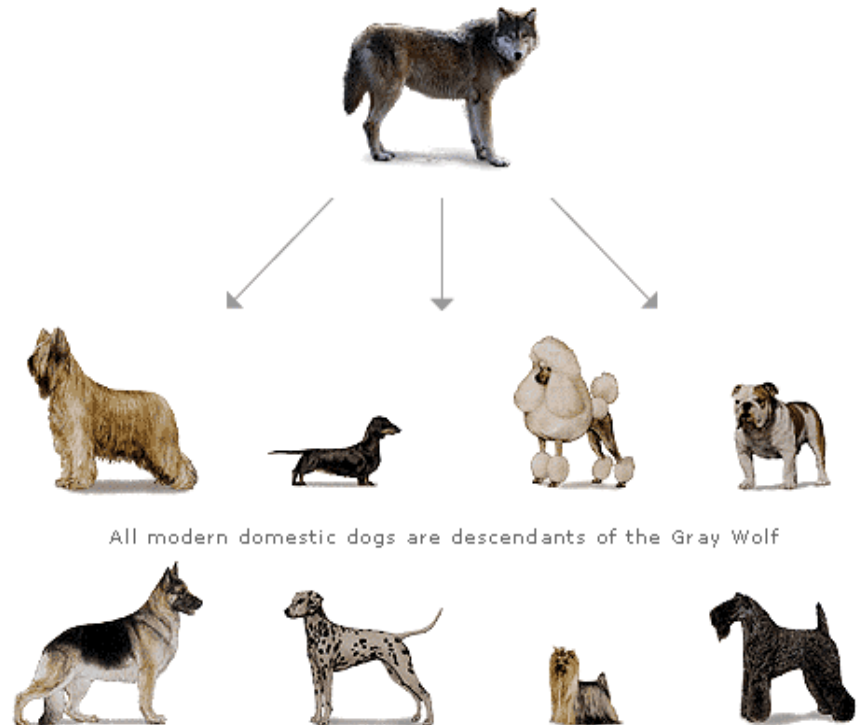


C



## 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>

