

Why should we care about biodiversity?

Why does it matter?

- 1. Write one idea on your doodle sheet in the first box. (Then we'll share with a neighbor.)

What do we know is happening to
biodiversity now?

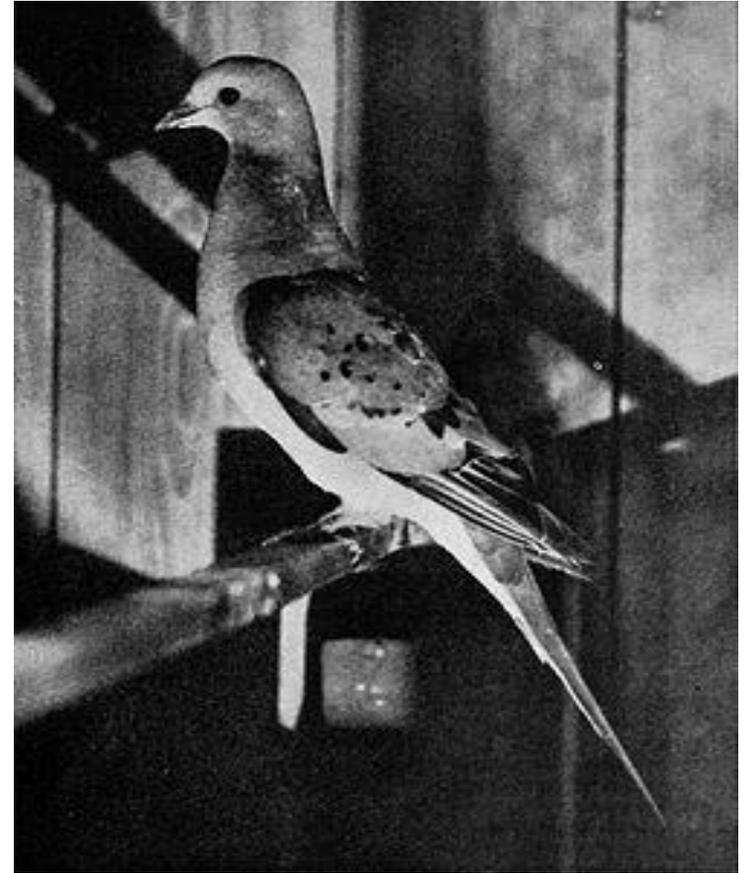
West African black rhinoceros (R.I.P. 2011)



golden toad (R.I.P. 1989)



passenger pigeon (R.I.P. 1914)



Tasmanian tiger or “thylacene” (R.I.P. 1936)



Dutch Alcon blue butterfly (R.I.P. 1979)



Pyrenean ibex (R.I.P. 1979)



Spix's macaw (R.I.P. 2004)



Carolina parakeet (R.I.P. 1918)



Steller's sea cow (R.I.P. 1768)



Yangtze River dolphin (R.I.P. 2006)



What is Extinction?

- 2. Write your best summary/ paraphrased definition of extinction on your doodle sheet.

Looking to the Past

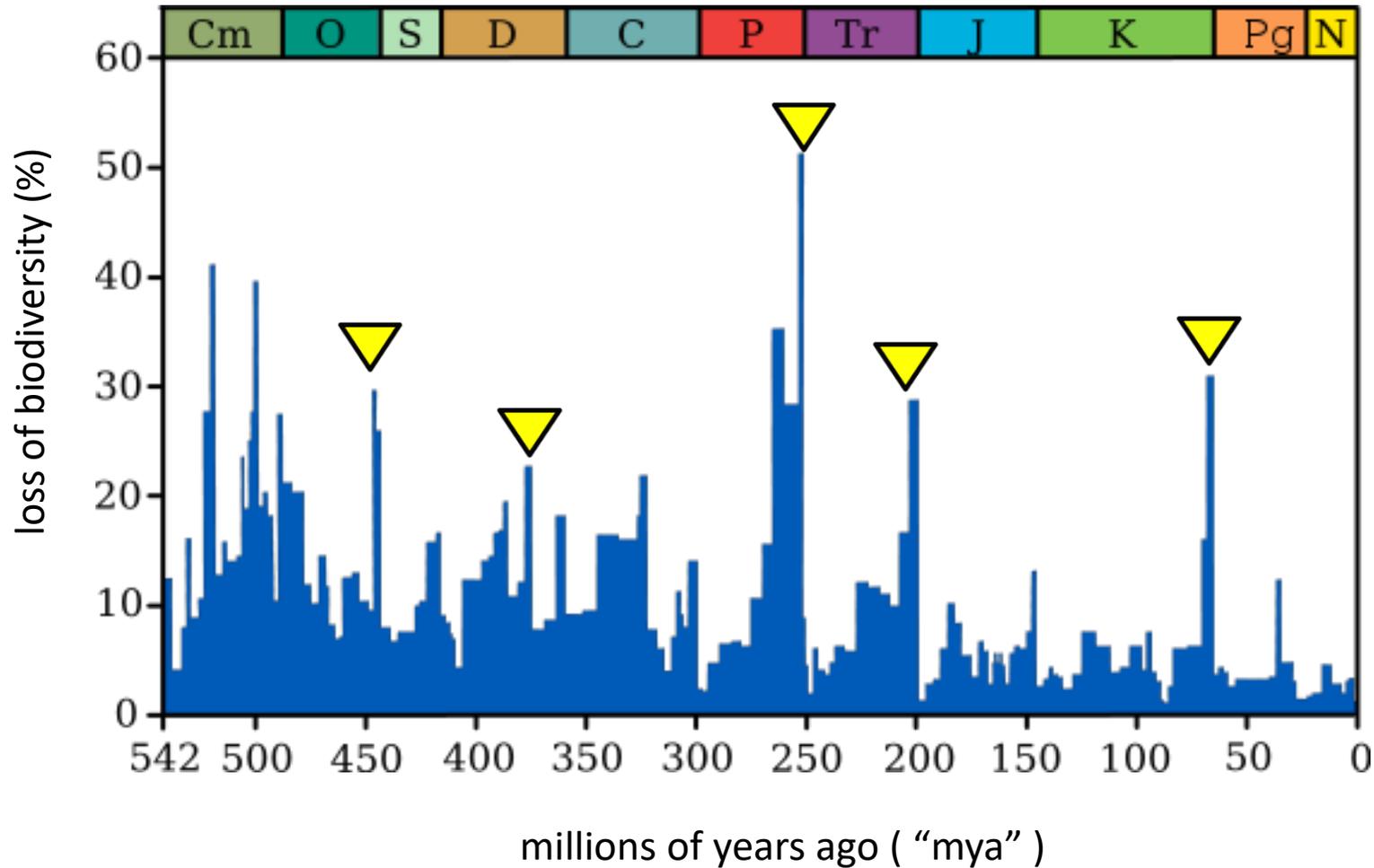
Have extinctions happened in the past?

Can you think of examples of species that existed long ago but have not been around for millions, maybe even hundreds of millions of years?

So, if we know that the same species haven't always been around, what can we infer?

Let's look at what the big pattern of extinction looks like over the history of the earth...

5 Mass Extinctions



Recent Extinctions

(since we've been paying attention)

<u>Group</u>	<u>Extinctions since 1500</u>	<u>Est. Number Species*</u>
Birds	145	9,956
Mammals	79	5,416
Amphibians	36	6,199
Snails and Clams	324	81,000
Reptiles	22	8,240
Ray-finned Fish	71	30,000
Flowering Plants	121	258,650
Crabs and Shrimp	8	40,000
Mosses	2	15,000
Insects	58	950,000
Arachnids	9	180,000**

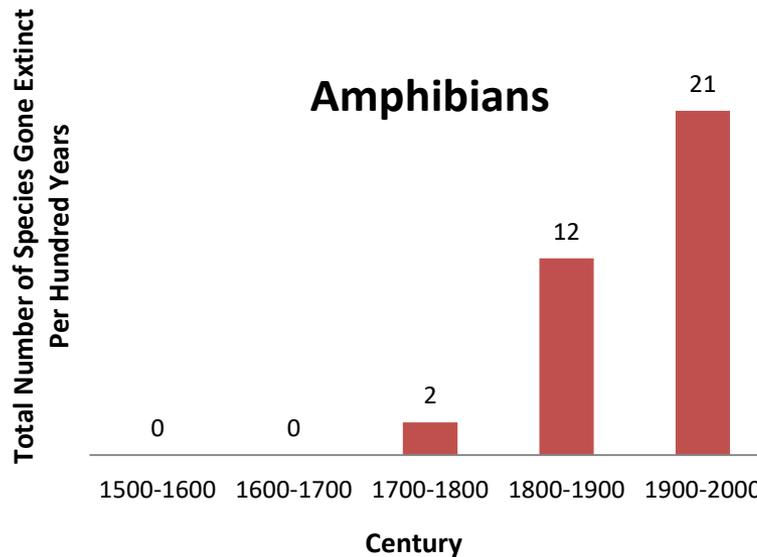
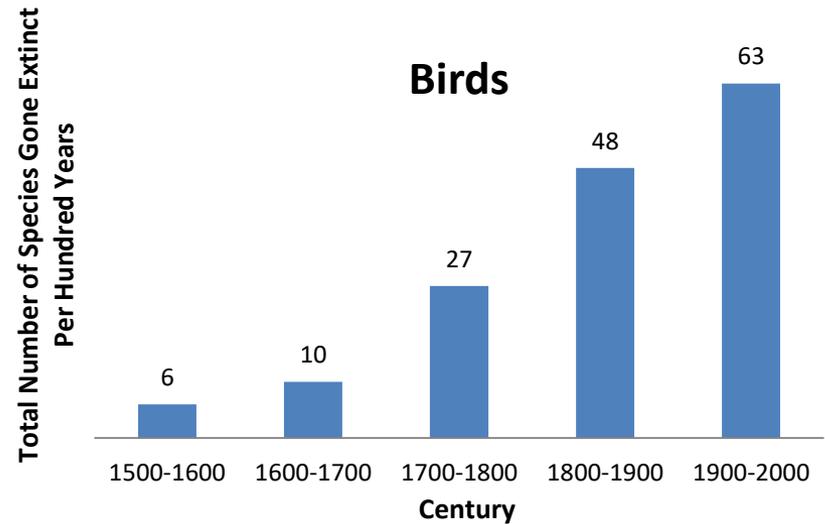
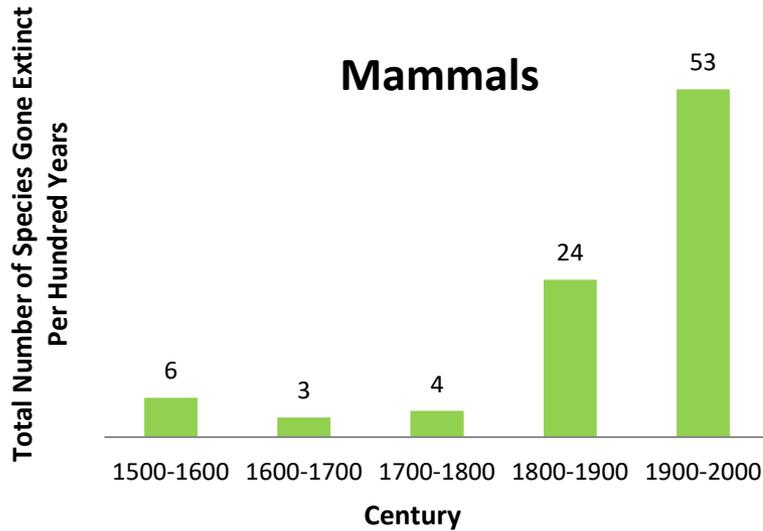
Question:

How we these
put in this
particular order?

*<http://www.factmonster.com/ipka/A0934288.html>

**Coddington & Levi (1991) Annual Review of Ecology

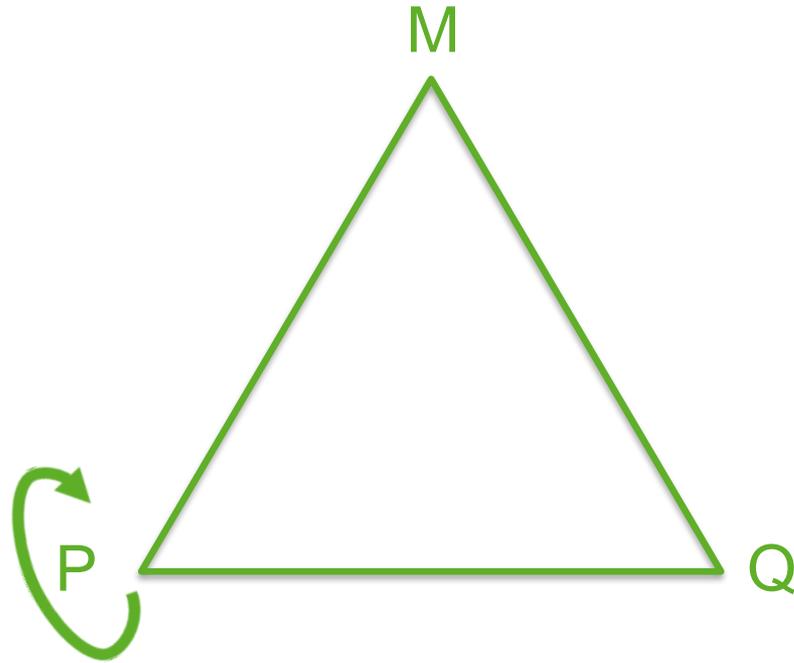
Extinctions Across Some Major Animal Groups



Graphs produced by MBERbio.

Data taken from Scientific papers:

Maas 2014, Szabo et al. 2012, Pimm 2014



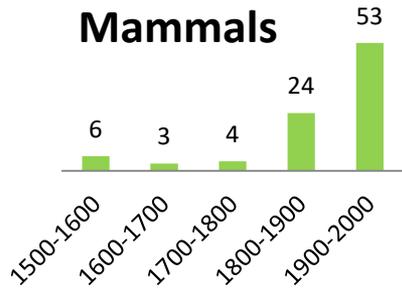
What did we learn? We learned about animals that have gone extinct and have noticed the phenomena that there have been several time in the past where a huge portion of species died. We call these mass extinctions. There also appears to be several recent extinctions. Next we work toward trying to understand the connection between past mass extinctions and the alarming increase in extinction today.

Are we in the 6th Mass Extinction?

- Read the article and highlight a couple o facts you think might be interesting to discuss with your group.
- Respond to the questions at the end of the article. (Be prepared to share your answers with your group.)

Are we in the 6th Mass Extinction?

- Use “Talking Sticks” to discuss the article:
 - The first person has 30 seconds to share their response to question #1.
 - The second has 30 seconds for question #2... and so on.
 - After everyone has shared, take one minute to discuss any points you didn’t understand or any of the responses where you didn’t all agree.
- Class discussion: What do we think?



Causes of Extinction

Let's go back to thinking about the recent extinctions from the last few centuries...

3. What might be the cause of these recent extinctions? What do we think is going on here?

Discuss your ideas with your group and come up with a group list "Causes of Extinction" on your whiteboard. Try to come up with as many ideas as you can, but make sure your ideas are clear.

Causes of Extinction

4. Are there commonalities among these causes?

Is there a way to shorten our class list?

Are there general patterns or themes?

Human Impacts

- One commonality among our ideas about the causes of extinction is the role of humans.
- 5. Record one specific way in which you think humans have caused other species to go extinct.
- Humans (for example) have hunted several animal species to extinction.

Human Impacts



Dodo Bird: Skeleton cast and model of dodo at the Oxford University Museum of Natural History, based on modern research.

(Photo/Caption: Wikipedia)

Human Impacts



Comparison of a woolly mammoth (left) and an American mastodon (right).

(Photo/Caption: Wikipedia)

Human Impacts

Canis lupus,
the gray wolf



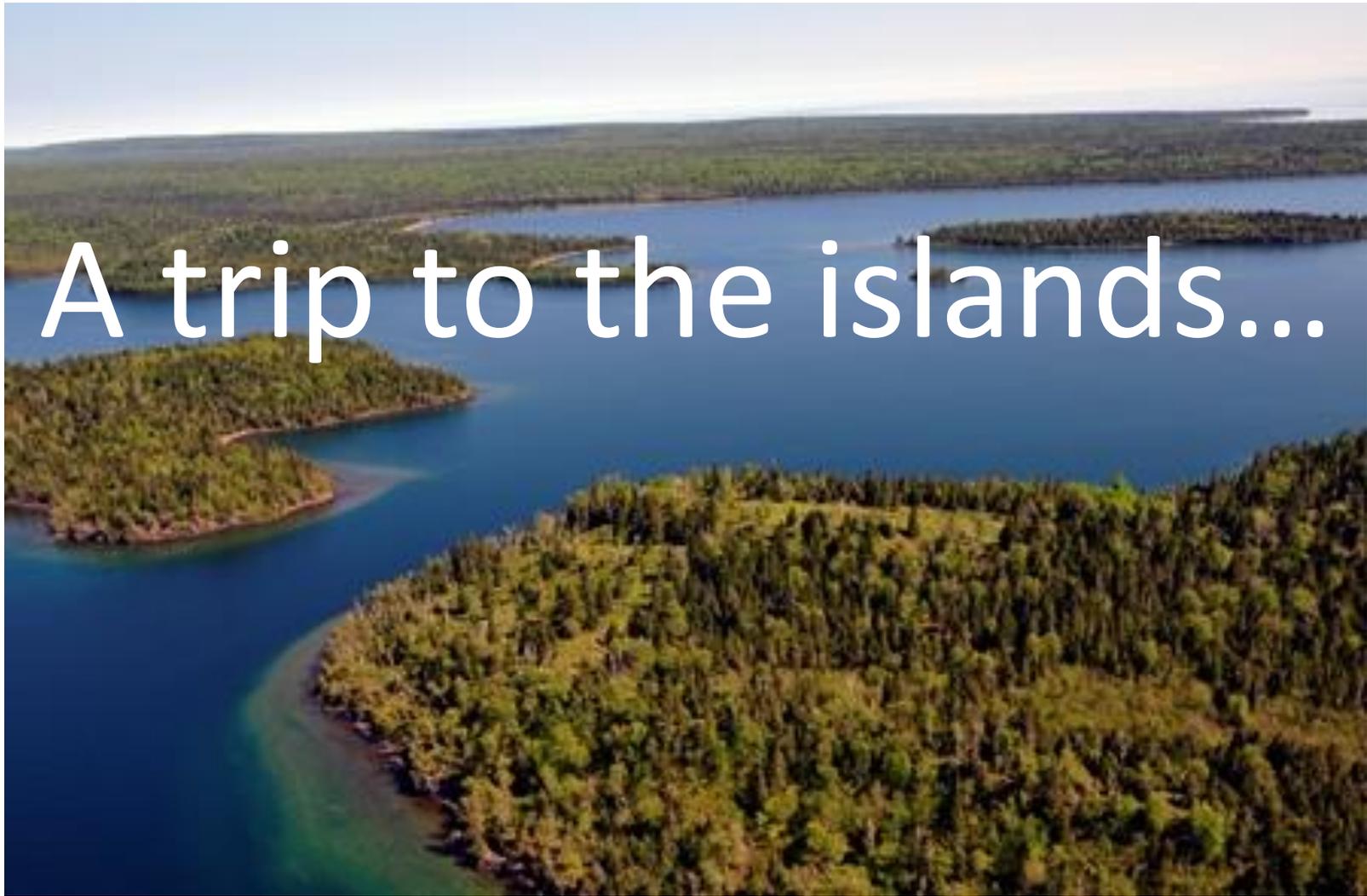
– nearly hunted to extinction in the United States during the 19th and 20th centuries.

Human Impacts: Saving Species in Trouble

- What have humans done to protect species?

6. Record one way you know humans have or can work to protect species.

- Let's look at one species' story to learn more about the factors that affect populations of wildlife, what might make them go extinct, and some of the ways in which humans may have prevented their loss.



A trip to the islands...



The Case of the Gray Wolf in North America

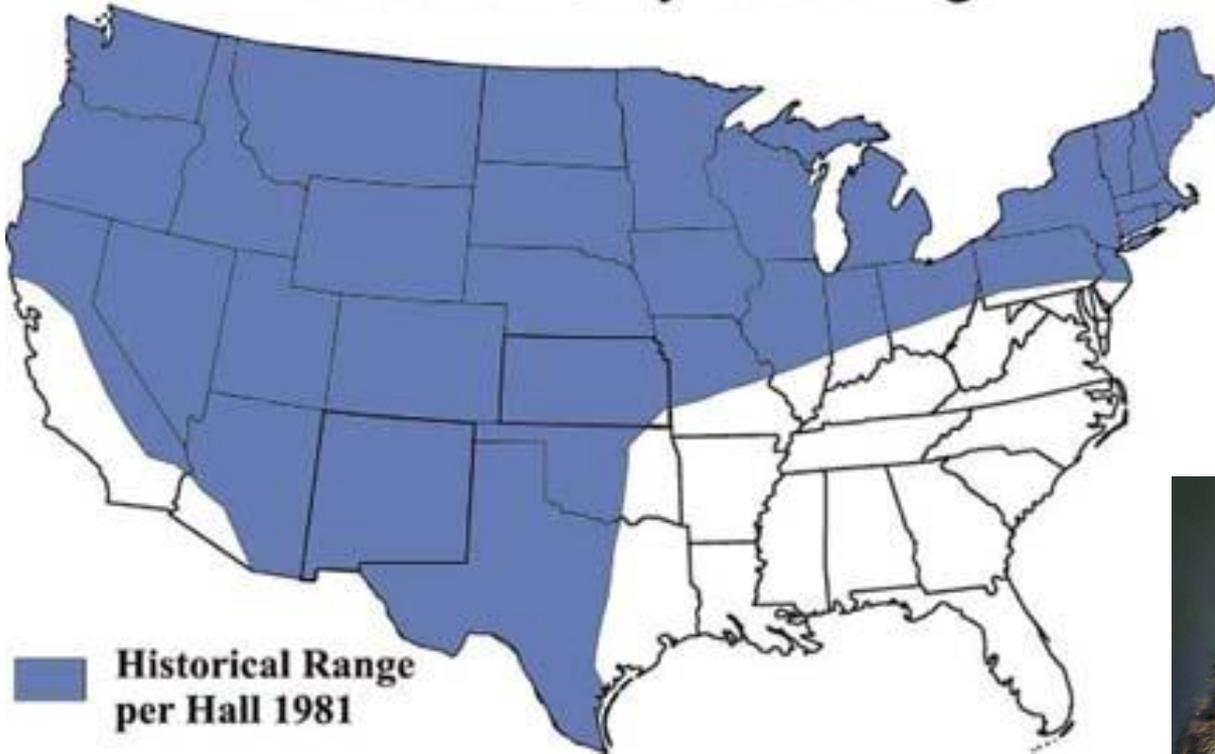
- *Canis lupus*, the gray wolf – one of the few large predators native to our continent.



A. What do you know about gray wolves?

What's Up With Wolves?

Historical Gray Wolf Range

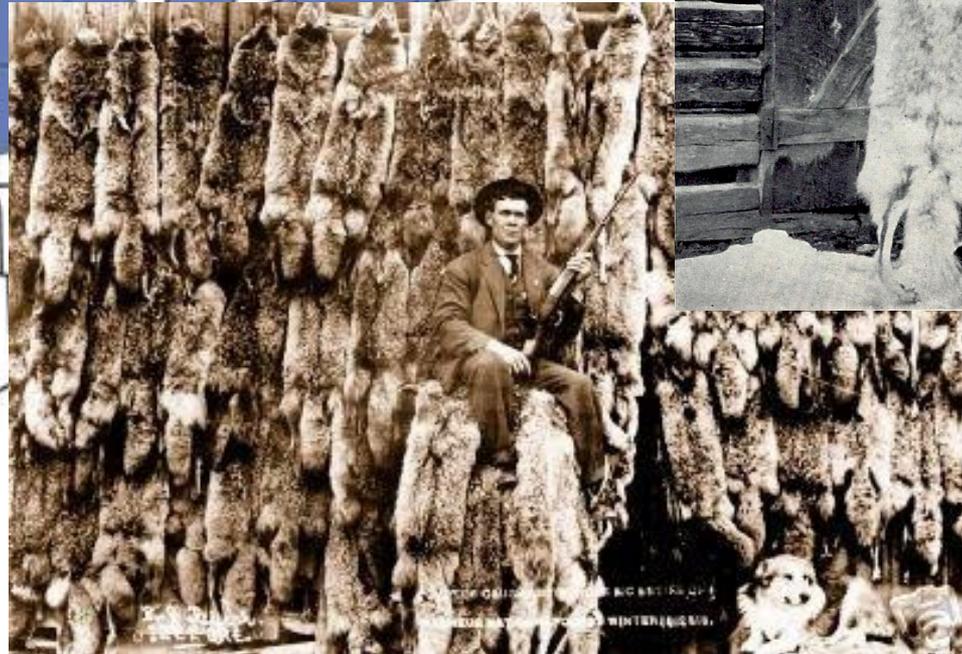


Before European settlement

≈ 250,000 - 500,000

By 1960 < 300 wolves were left in the entire continental U.S.

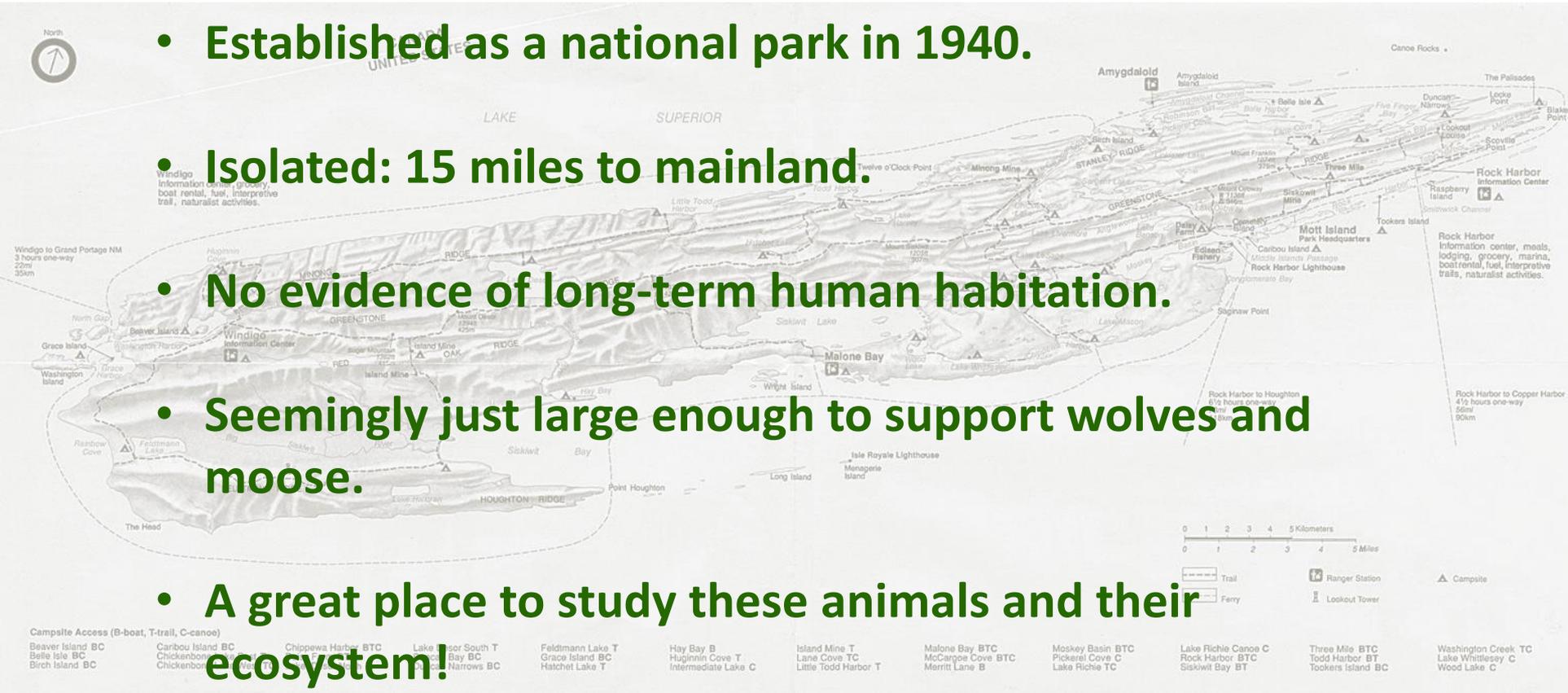
Historical Gray Wolf Range



Wolves only lived in Minnesota and in one other place...

Isle Royale National Park

- Established as a national park in 1940.
- Isolated: 15 miles to mainland.
- No evidence of long-term human habitation.
- Seemingly just large enough to support wolves and moose.
- A great place to study these animals and their ecosystem!



Wildlife Conservation Biologists

Rolf O. Peterson



Research Professor

PhD, Wildlife Ecology, Purdue University
BA, Zoology, University of Minnesota

"The challenge of wild carnivore restoration."

John A. Vucetich



Professor, School of Forest Resources and Environmental Science

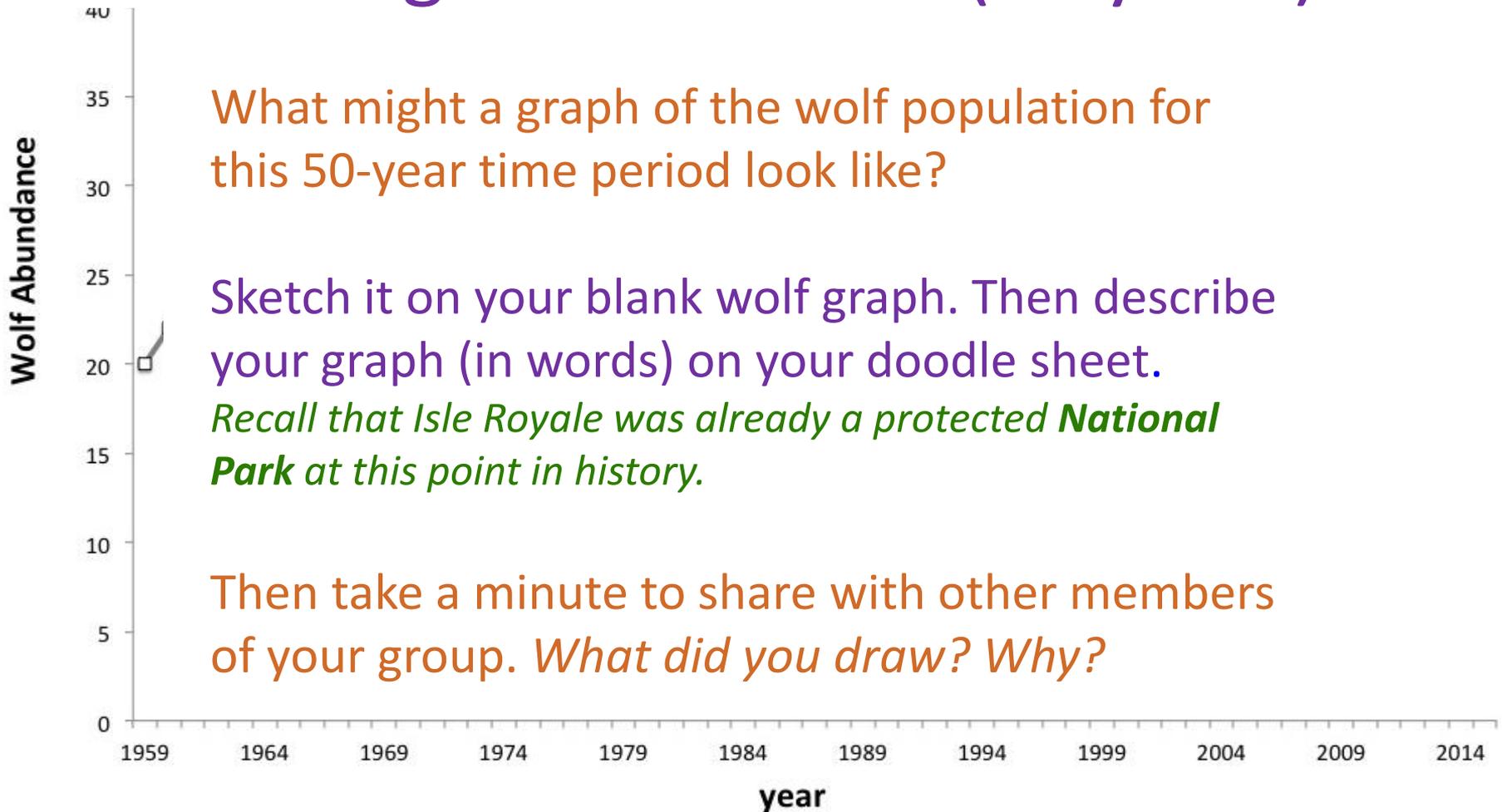
PhD, Forest Science, Michigan Technological University
BS, Biology, Michigan Technological University

"I am a population biologist. I spend most of my time studying the wolves and moose of Isle Royale. I am also interested in the philosophy and ethics of ecological and conservation science."

These scientists are *part of a team* that has collected more than 50 years of data on the ecosystems of Isle Royale.



B. How has the wolf population changed over time? (50 years)



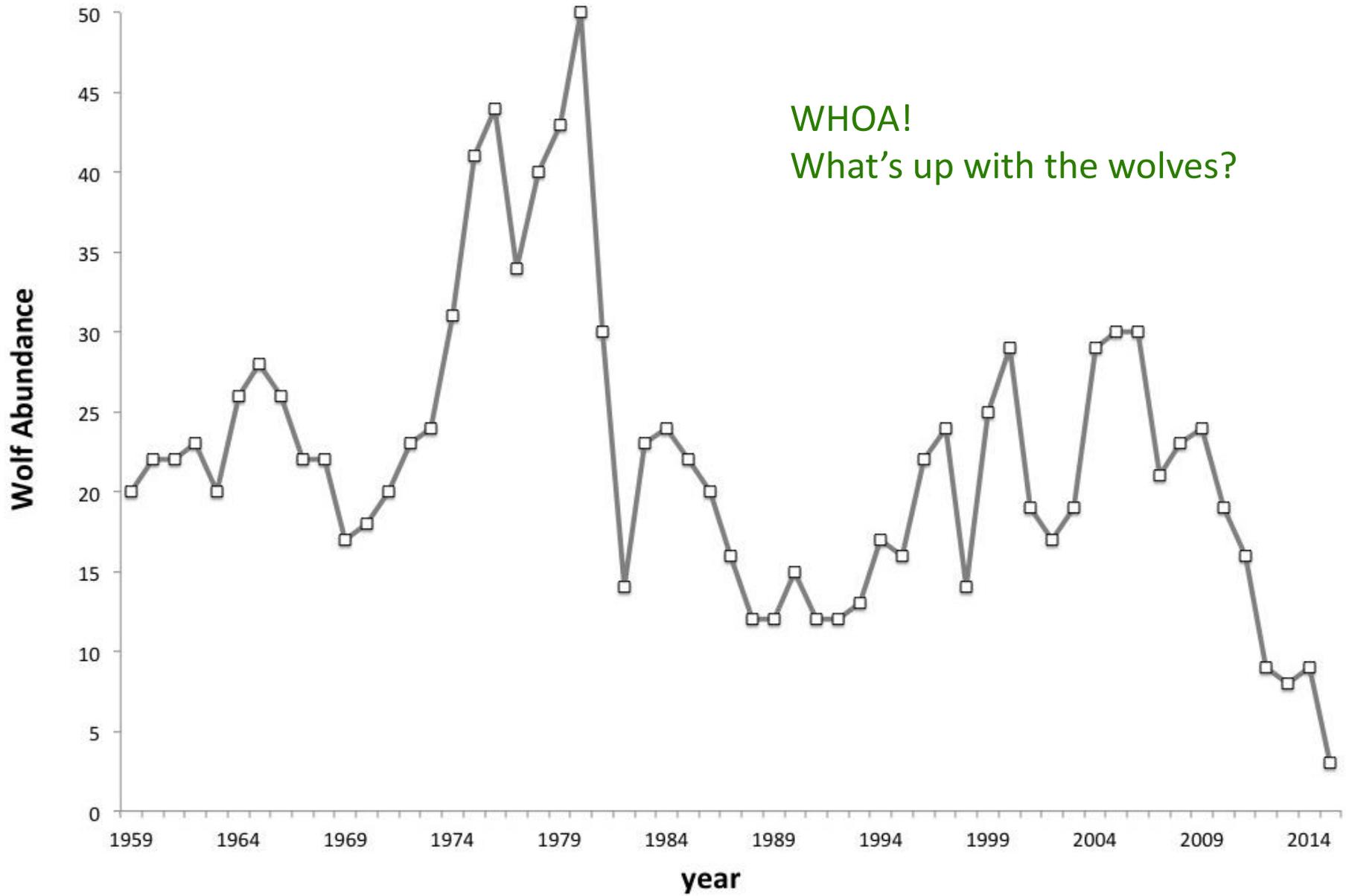
What might a graph of the wolf population for this 50-year time period look like?

Sketch it on your blank wolf graph. Then describe your graph (in words) on your doodle sheet.

*Recall that Isle Royale was already a protected **National Park** at this point in history.*

Then take a minute to share with other members of your group. *What did you draw? Why?*

WARNING: next slide reveals wolf data!



In your groups, consider the following three questions:

- (1) What patterns do you notice?
- (2) Any ideas about what factors might explain the patterns?
- (3) Talk about what other information might be helpful to have?

Record your ideas in Doodle Box C.

Would it be helpful to know more about the wolves?



Would it be helpful to know about the moose?



Each member of your group will read a different story.

D. When everyone is done, each person will share the main ideas from their reading.

Readings: Island Overview, Moose, & Wolves

- Read over the provided handouts.
 - Highlight or underline key points.
 - Be ready to share out the key points to your group.
- “Say Something”
 - One person talks at a time. When the first person is done, then...
 - The “responder”
 - **Makes an observation or comment**
 - **Clarifies something**
 - **Makes an inference**
 - **Makes a connection**
 - **Asks a question**
 - **(Examples on the Next Slide)**

“Say Something” in response... (some ideas)

Observation/Comment	Clarify	Inference	Connect	Questions
I noticed that...	Now I understand...	I predict that...	This reminds me of...	How did...
I think that... I saw (heard, smelled)...	No, I think it means...	I bet that...	This process is like...	In what ways are...like...
This is good because...	At first I thought..., but now...	Based on these data I think...	This is similar to...	What might happen if...
This is hard because...	I agree with you, and...	One thing I think is...	This...makes me think of...	Do you think that...
This is confusing because...	What this means is...	I wonder if...	It also...	What evidence supports...
This makes sense because...			This...is like...because...	In other words, are you saying...

From “Success in Science Through Dialogue, Reading and Writing”
By Beauchamp, Kusnick McCallum 2011

What's Up With Wolves?

Wolves are highly social – live and hunt in packs of 7-8 adults, usually led by one breeding pair.

Annual litters of 4-7 pups.
Pups cared for collectively by the pack for about the first 10 months of their lives.

Prey to no other animal.



- Any changes / additions to our initial ideas about what might be contributing to the wolf population numbers?

What's up with moose?

- Let's look a little more closely at the moose population to see if it can shed more light on what might be happening.



E. What factors do you might affect the size of the moose population on Isle Royale?



You know some things from your readings, but let's explore further with a game...

Moose Population Simulation

MOOSE

	1	2	3	4	5	6	7	8	9	10
FALL	MOOSE SURVIVAL									
	NO. OF MOOSE IN POPULATION									
WINTER	MOOSE SURVIVAL									
	NO. OF MOOSE IN POPULATION									
SPRING	MOOSE SURVIVAL									
	NO. OF MOOSE IN POPULATION									
SUMMER	MOOSE SURVIVAL									
	NO. OF MOOSE IN POPULATION									

MOOSE

FALL

WINTER

SPRING

SUMMER

biology mber

RESULTS

Group	Starting Moose	Births	Deaths	Ending Moose
1	10			
2	10			
3	10			
4	10			
5	10			
6	10			
7	10			
8	10			

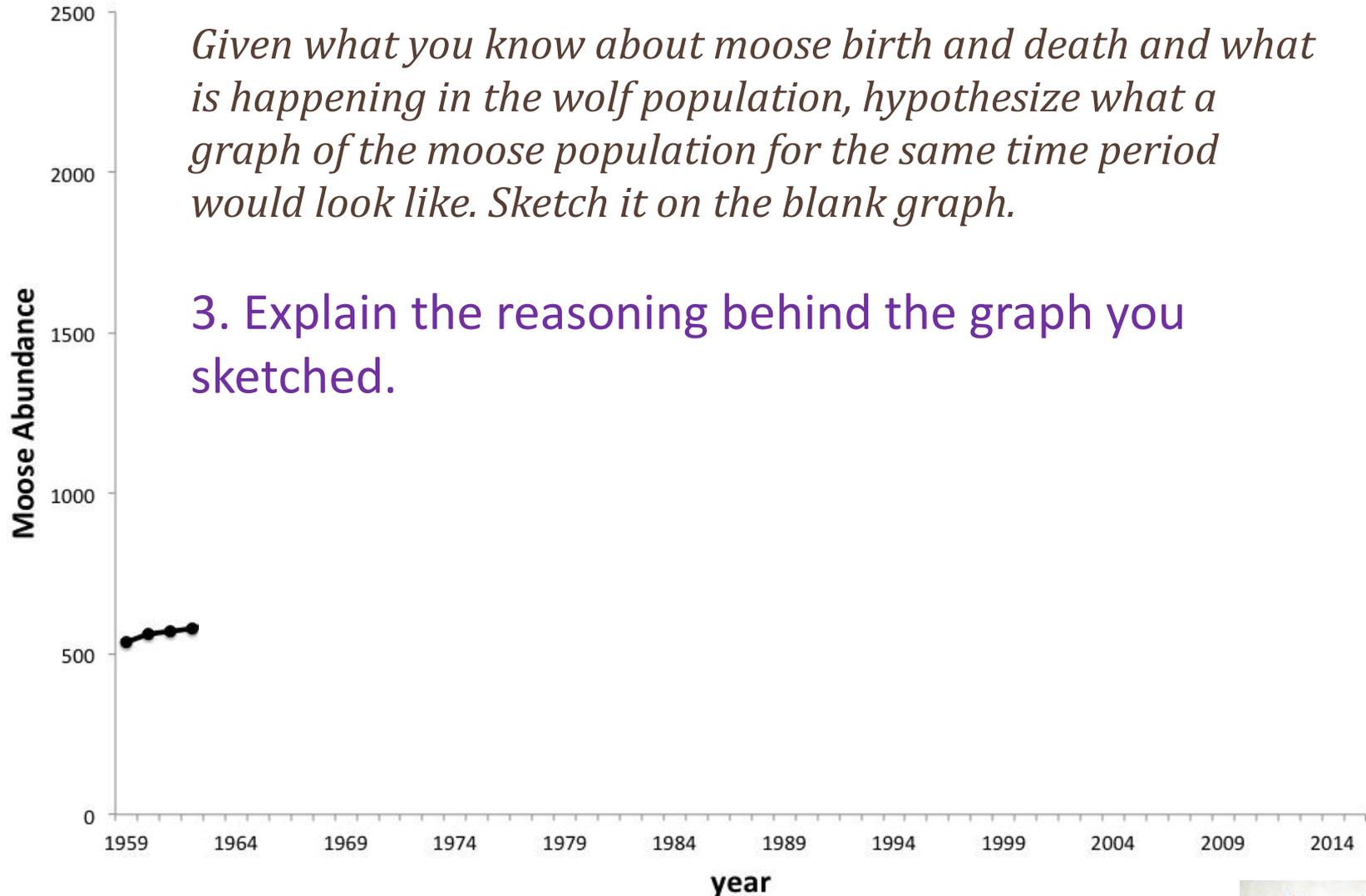
ANALYSIS

1. Looking at this data, what determines whether the moose population increases or decreases?
2. What factors can possibly affect each of these?
 - a. Death rate:
 - b. Birth rate:

What's up with moose?

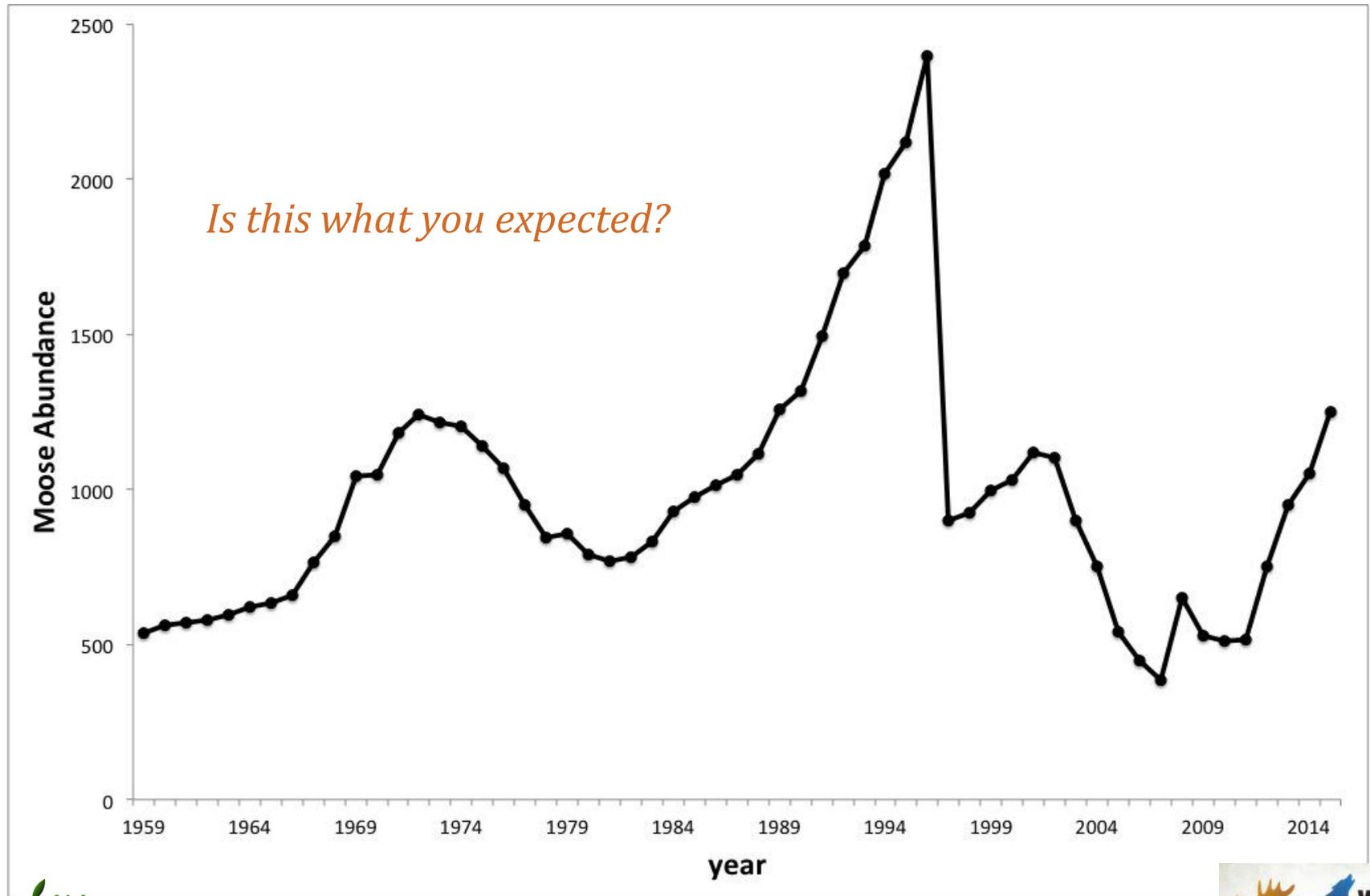
Given what you know about moose birth and death and what is happening in the wolf population, hypothesize what a graph of the moose population for the same time period would look like. Sketch it on the blank graph.

3. Explain the reasoning behind the graph you sketched.

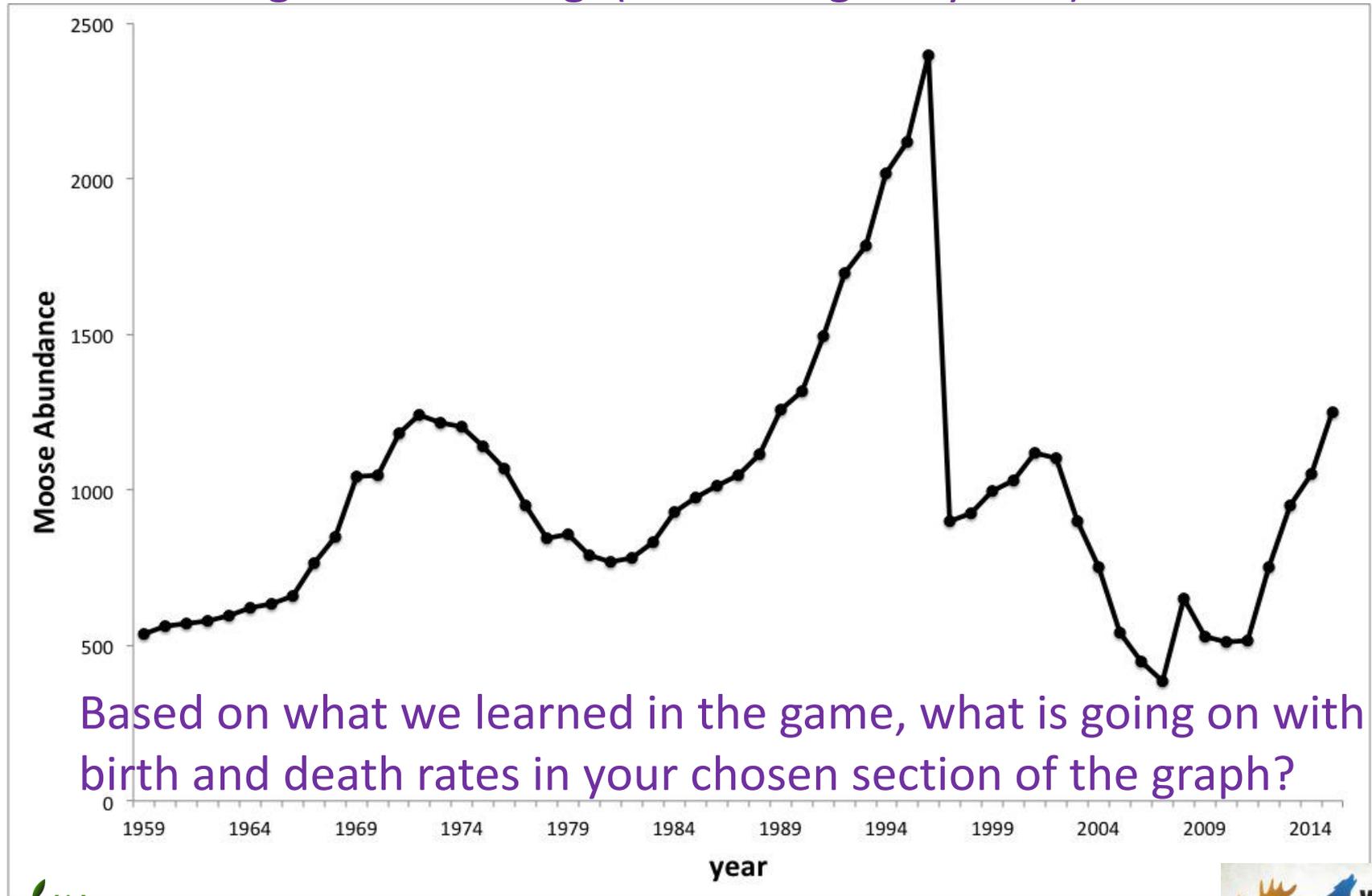


WARNING: next slide reveals moose data!

What's up with moose?

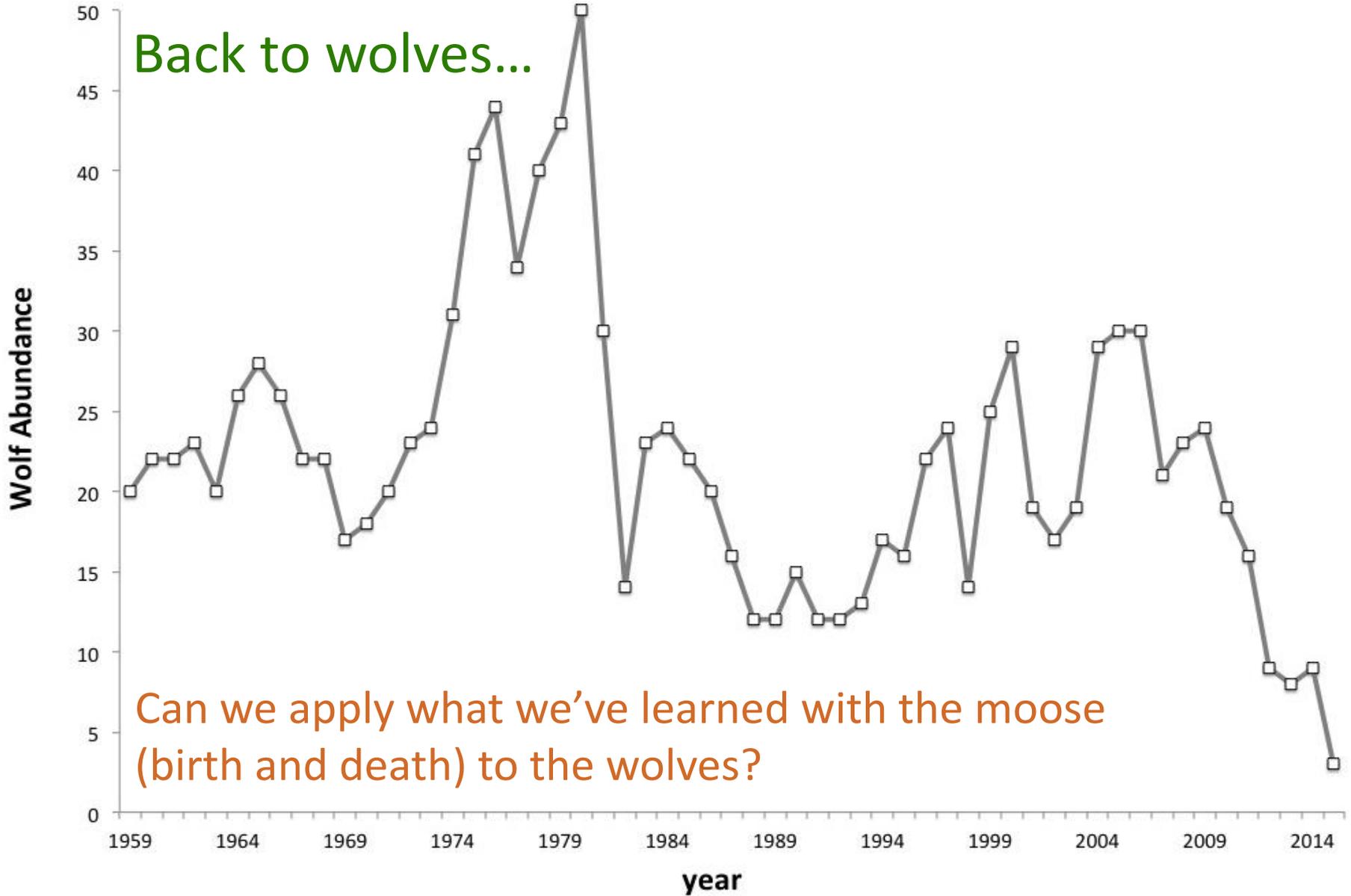


4. Focus on a part of the graph where the population is either increasing or decreasing. (Pick a range of years.)

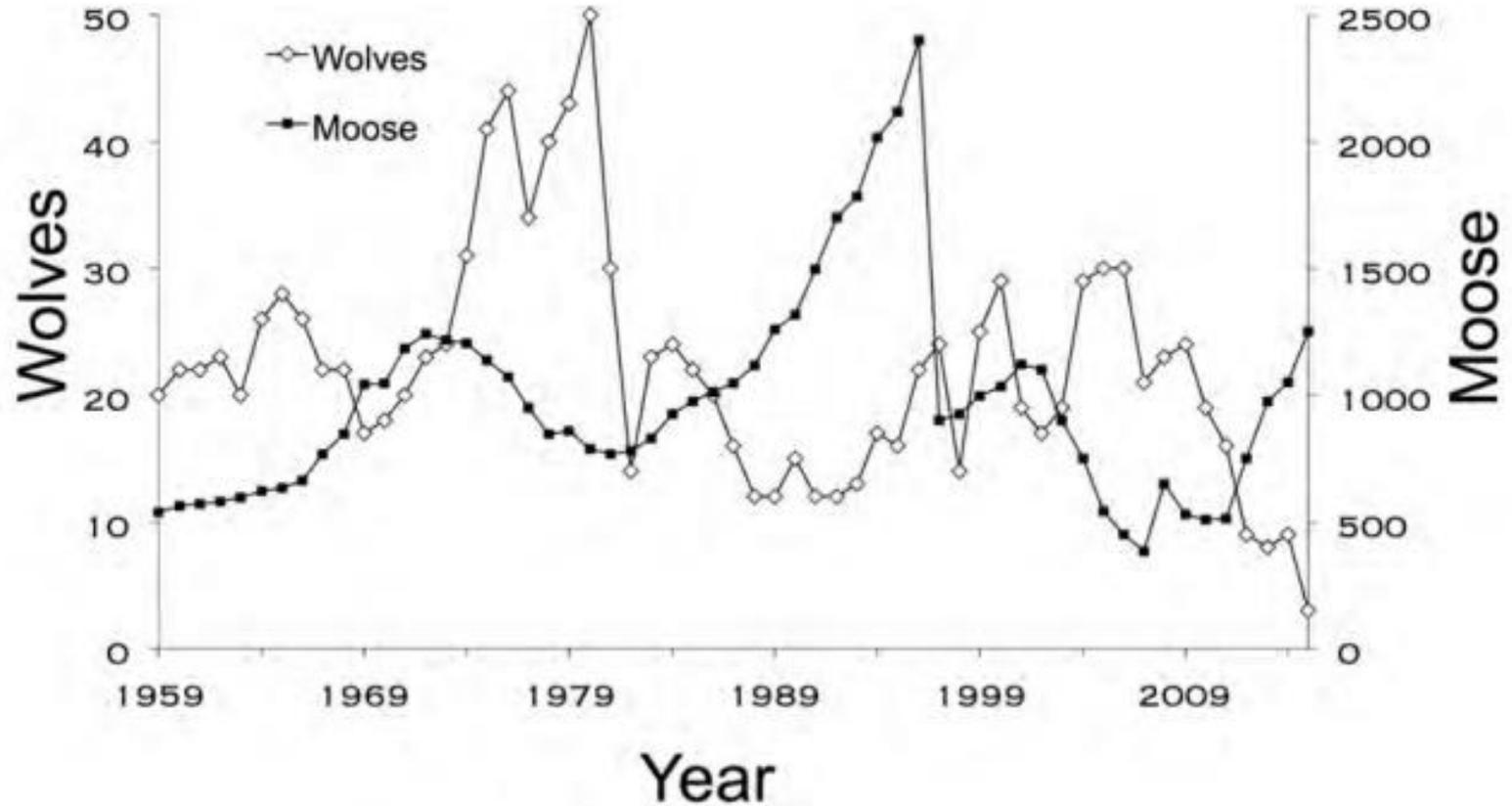


Based on what we learned in the game, what is going on with birth and death rates in your chosen section of the graph?

Back to wolves...

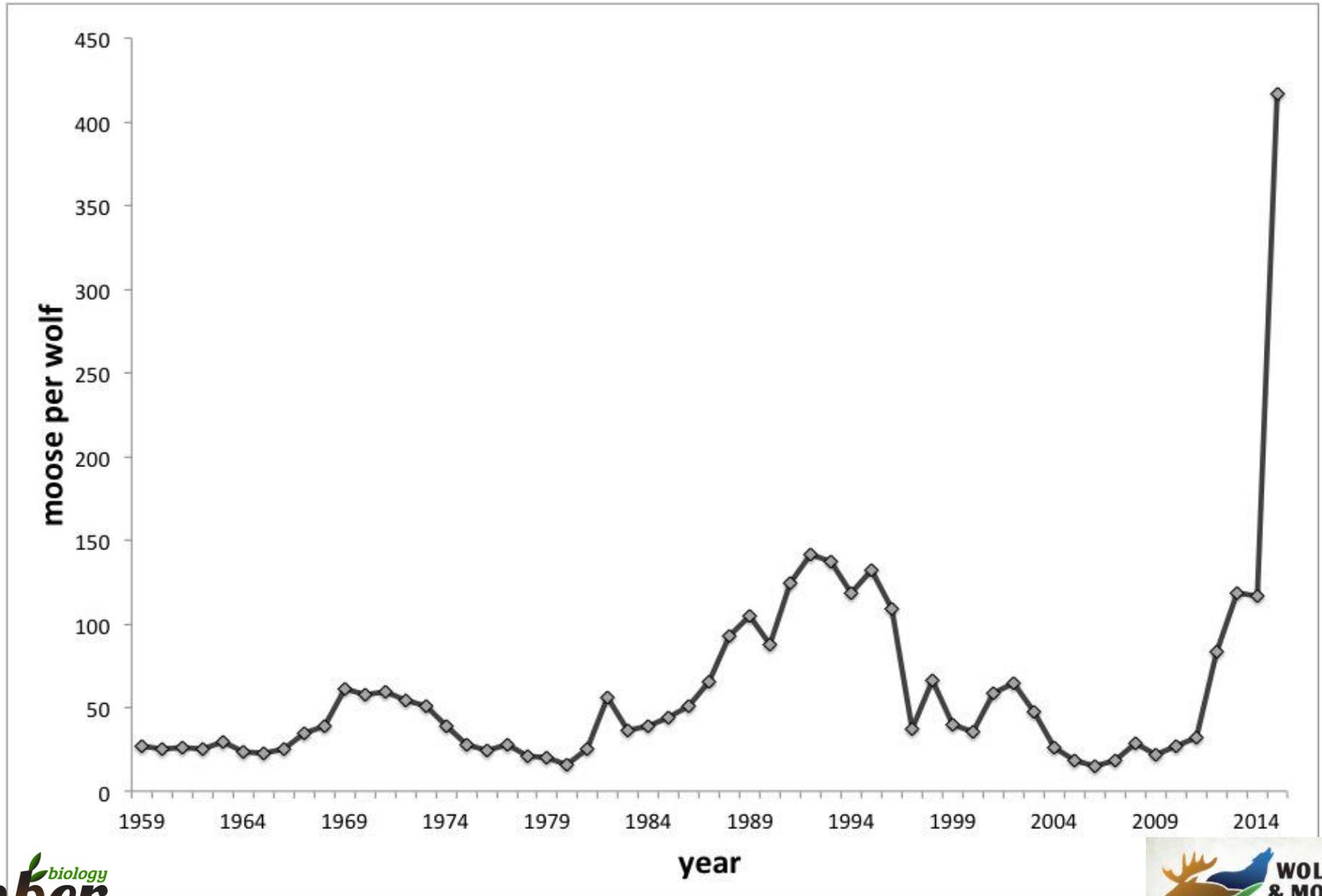


What's up with moose... and wolves... and moose?



5. What are your thoughts about the information on the two graphs? Does anything surprise you?

Number of moose for every one wolf.



6. So... if the decline of the wolf population is not about lack of food, what else might explain it?

We will explore some of these ideas
in later units...



...but for now, it remains a mystery.

Wrapping It Up

- So, we know there are some things we still cannot explain (for example, the very recent decline in the wolves), but are we generally happy with our model?
- Let's review, revise and "summarize"!

What ideas do we now have to make sense of how populations change in size over time?

The Phenomenon

Wolf and moose populations on Isle Royale fluctuate in big and small ways.

The Question

How/Why do populations sizes change over time?

What factors might affect the size of certain populations?

The Model:

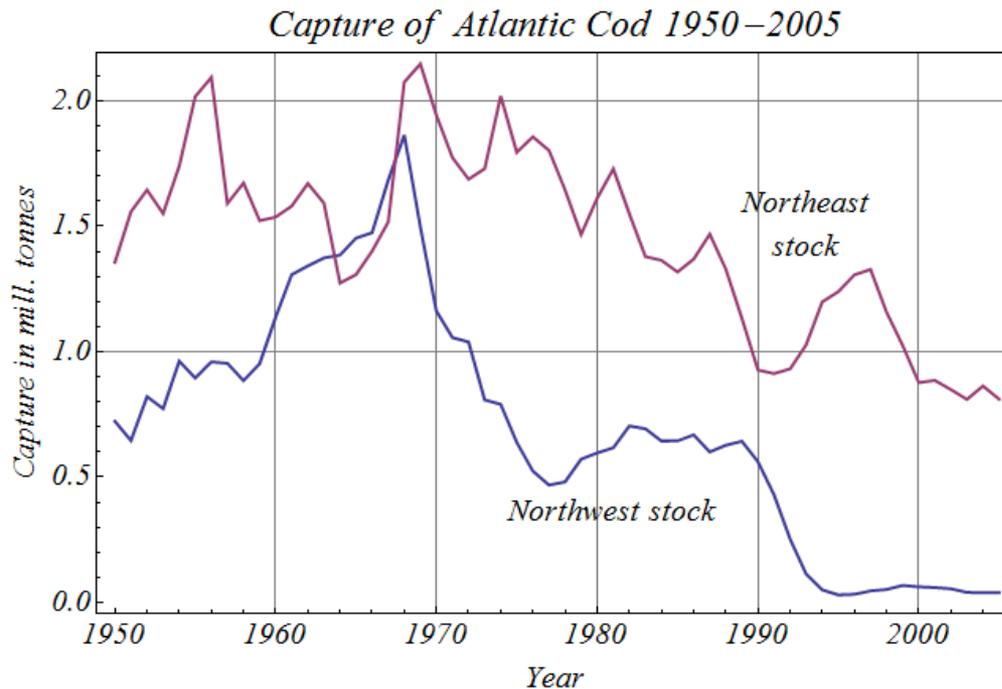
CHANGE IN POPULATION SIZE (Birth vs. Death Rate)

Lets summarize the ideas that represent our best understanding at this time.

Let's revisit extinction...

7. So... what does it mean to go extinct?

Were gray wolves ever in danger of going extinct?
Why or why not?



What does it mean to go extinct?

So, are the wolves of Isle Royale just about extinct?

And gray wolves
in general?



What does it mean to go extinct?

It can be hard to tell when things go extinct...



Lost (c 1850) and... FOUND!!! (2003)

What does it mean to go extinct?

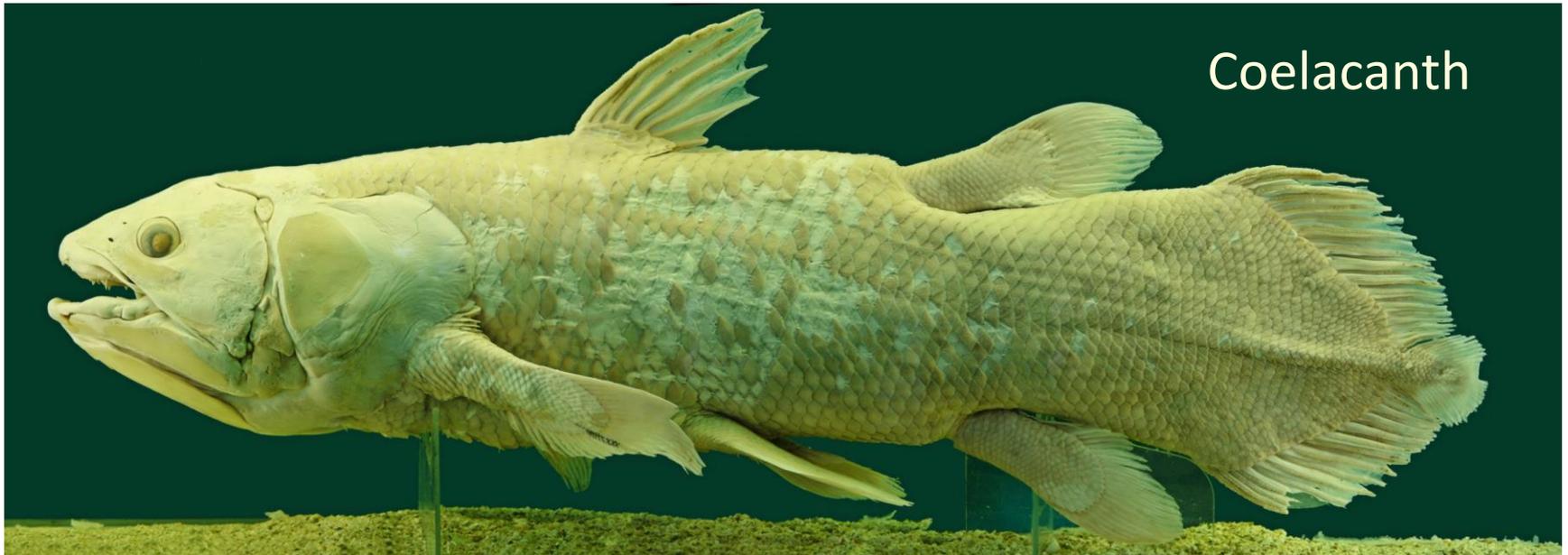
It can be hard to tell when things go extinct...



Lost (c 1971) and... FOUND!!! (2005)

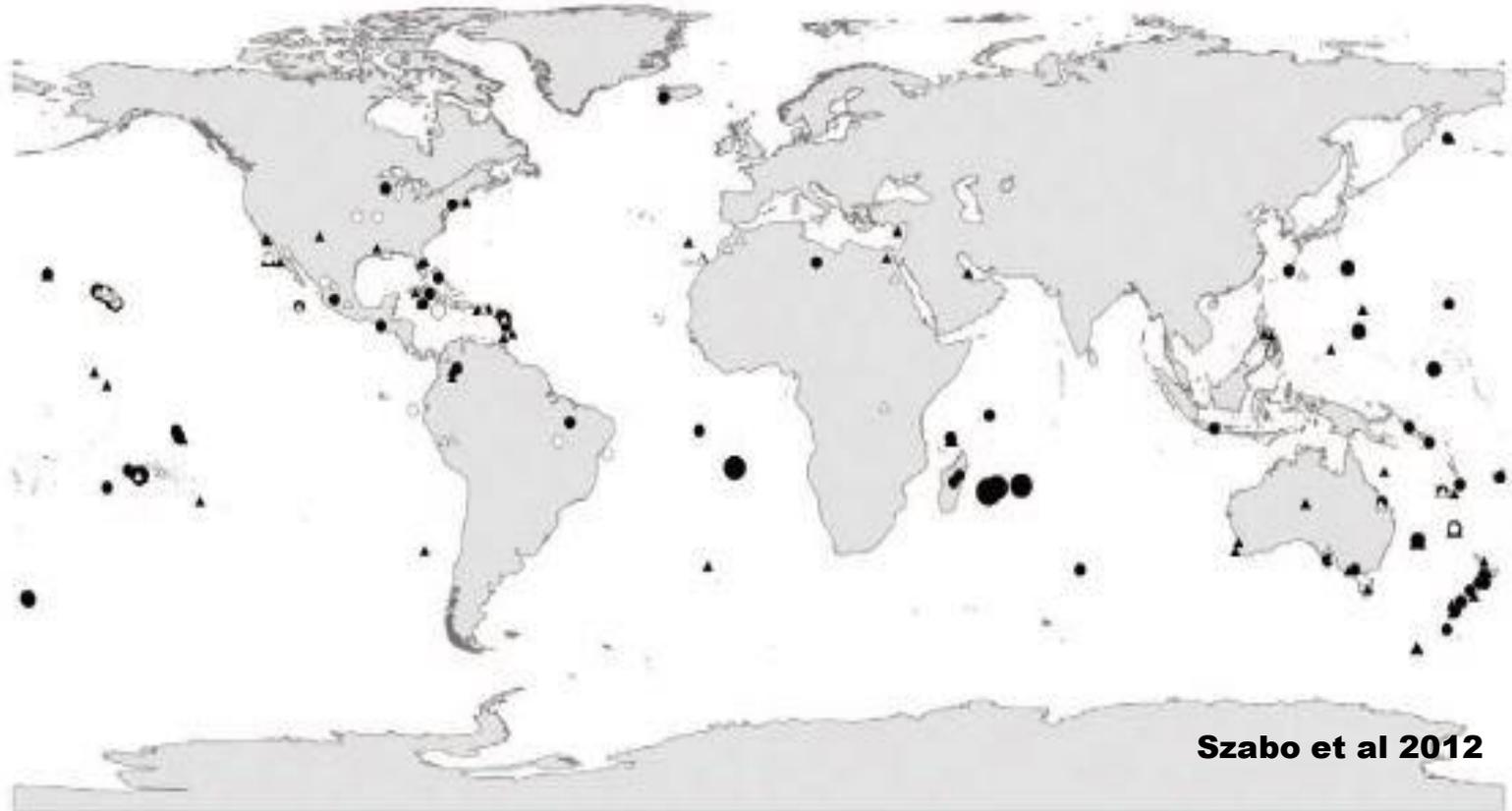
What does it mean to go extinct?

It can be hard to tell when things go extinct...



Lost (66 million years ago) and... FOUND!!! (1938)

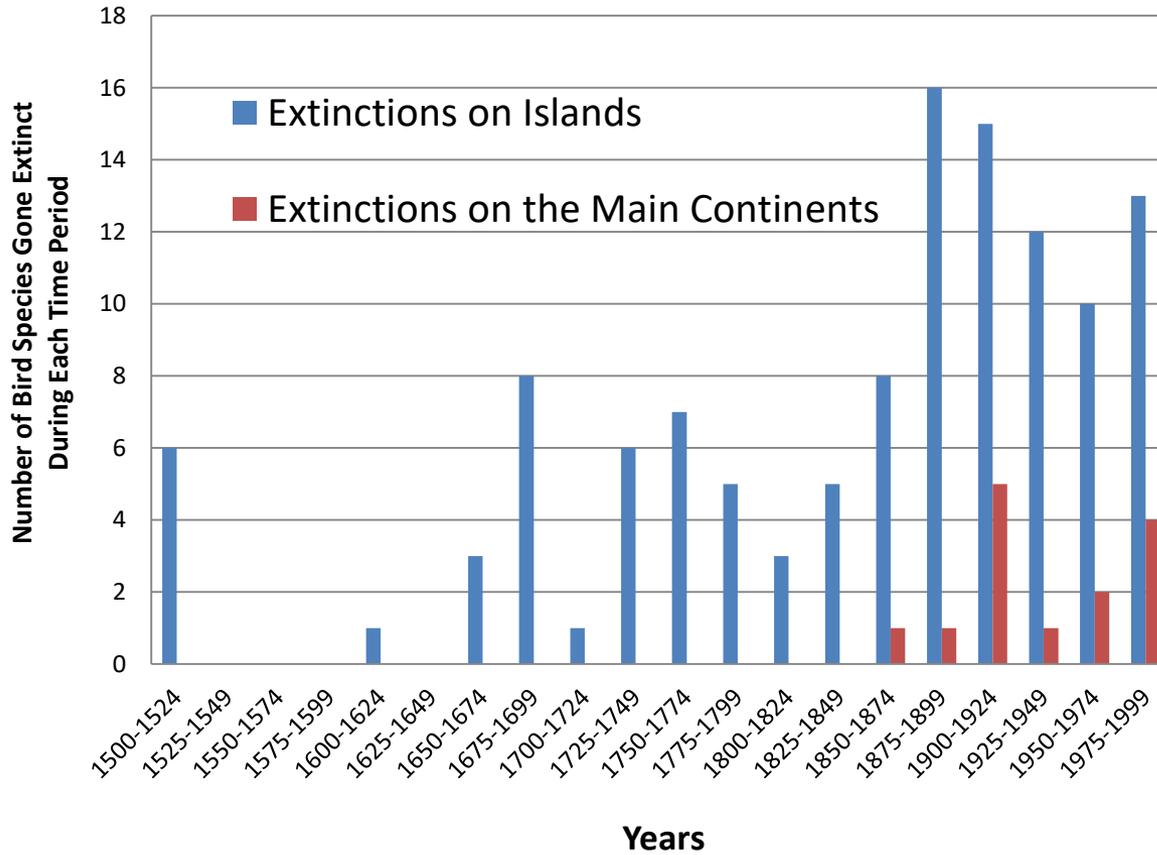
8. Where do extinctions occur?



Locations of bird species extinctions since 1500.
Bigger circles show the areas where more bird species have gone extinct.
Is there a pattern?

8. Where do extinctions occur?

Bird Extinctions Around the World



Reproduced from Szabo et al 2012

A good example of a bad thing.



Brown tree snakes were introduced to Guam accidentally from the Admiral Islands immediately following World War II.

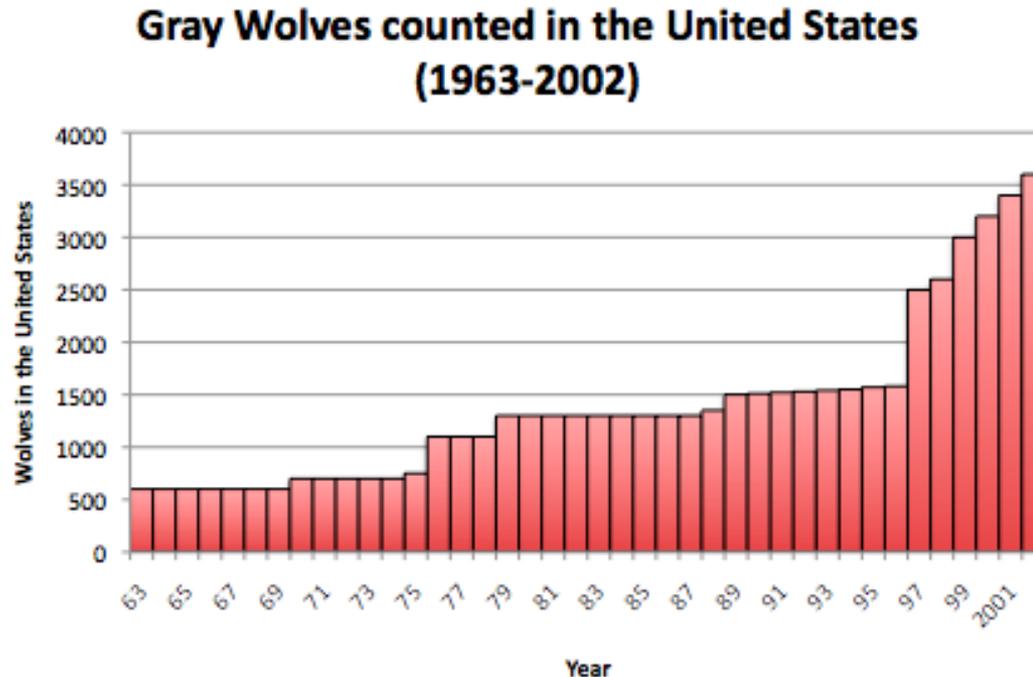
Over the next 30 years, 10 of the 12 native bird species went extinct.

The remaining two species have fewer than 200 individuals remaining on the island.

9. So...why are extinctions more common on islands?

A last word about wolves...

What has happened to gray wolves in the U.S.?



Graph courtesy of



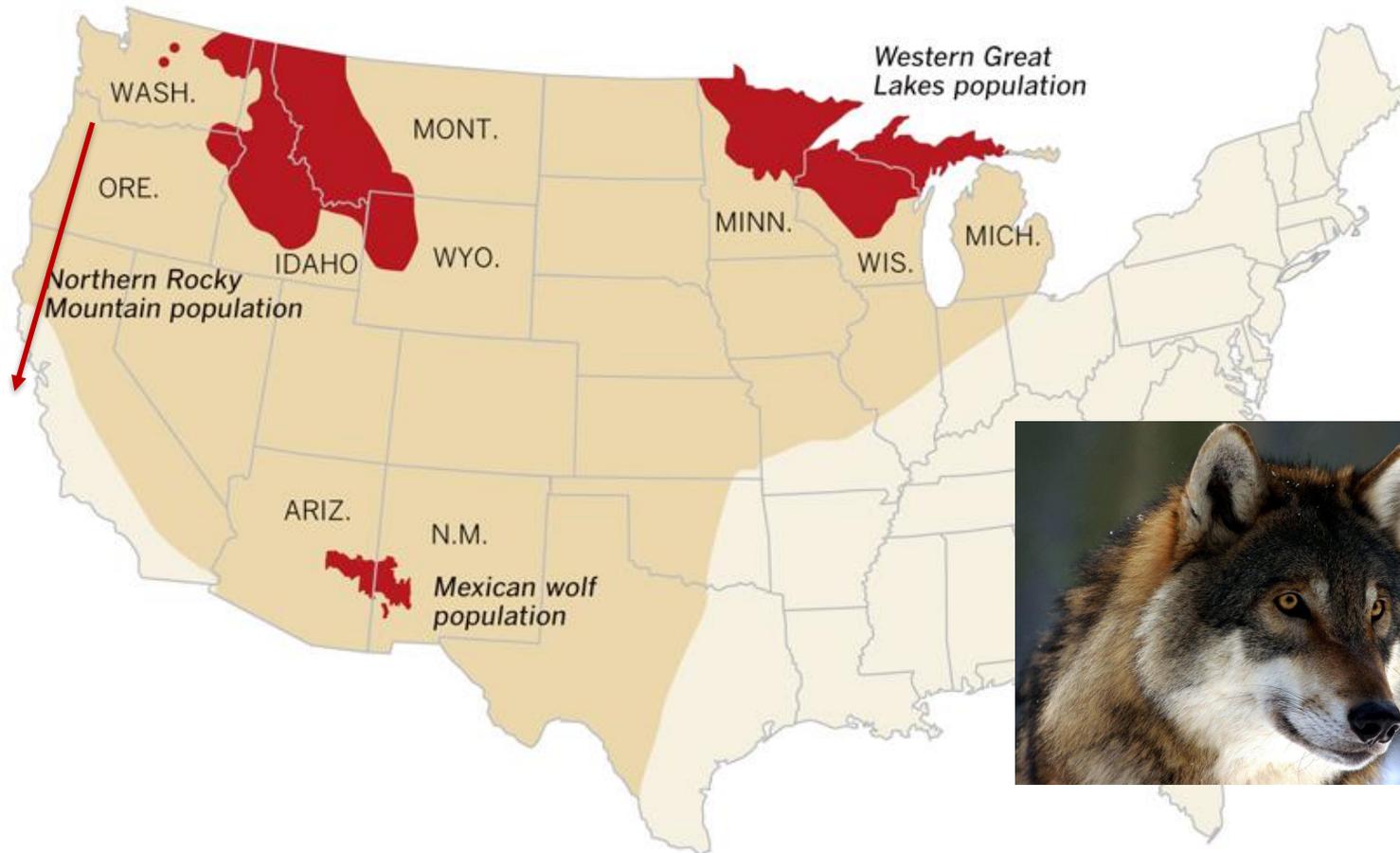
- Some protection starting in 1960's. Listed as "Endangered" in the 1970's.
- Recovery was slow until the 1990's when some wolves were imported from Canada to help repopulate.

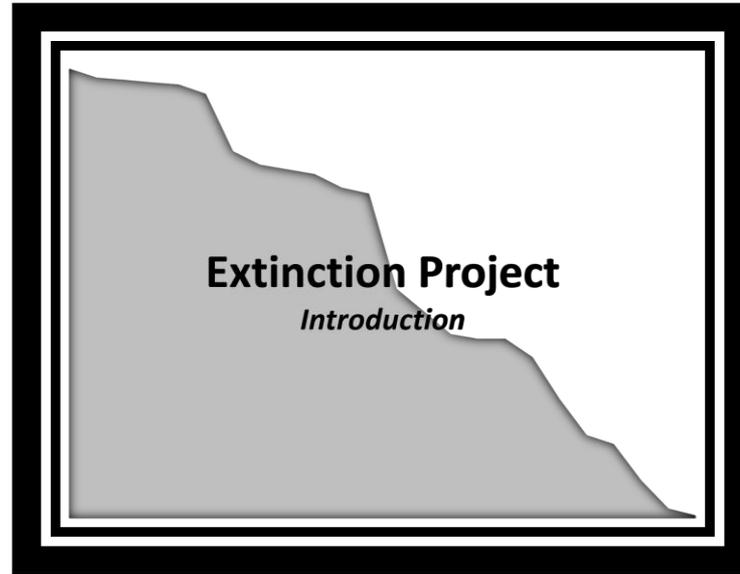
Canis lupus, the gray wolf – a story of recovery?

Wolf distribution

■ Current range

■ Historic range





Introduction to the Extinction Project

End the lesson sequence with an introduction to the Extinction Project if you plan to do the (optional) year-long version. If you are choosing to run the project only as a year-end culmination project, delay introducing it until the appropriate time.

See the website for details on both versions of the Extinction Project.