Hello, I'm (Dr.) Lawrence Uricchio

- Contact: Lawrence.Uricchio@gmail.com
  - Also: lawrence.urricchio@sjsu.edu (I will check this one less frequently so it is not recommended)
  - Note that my last name is not spelled correctly in my sjsu email address!!!
- You can call me: Lawrence or Dr. Uricchio
- My background: Postdoc in biology at Stanford University, PhD in bioinformatics from UCSF
- Research areas: Population genetics & ecology

“Office” hours

- Don’t have an office at SJSU
- Will hang around each day after class to answer questions for up to an hour (we can move outside if there is a large group)
- Also happy to find a time to meet individually by email (so long as demand for this is not too high)
- Will hold extended office hour before exams

So what is a postdoc?

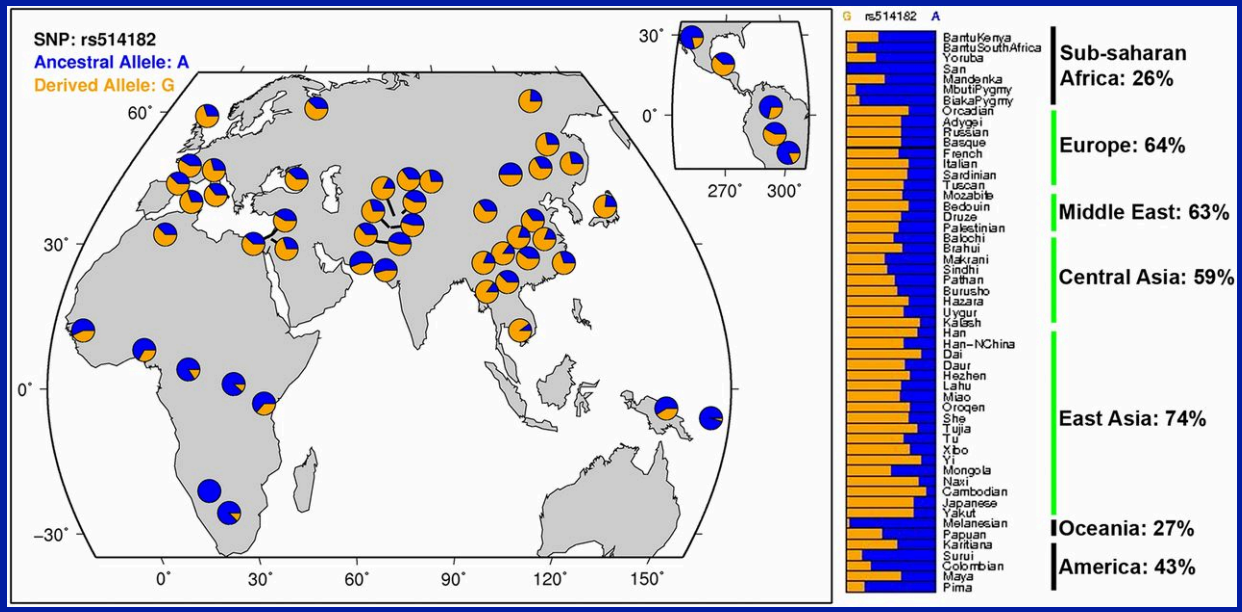
- Academic version of a medical resident
- I’m here as part of my fellowship, which gives me the opportunity to teach at SJSU

My (main) research areas - 1

- Plant community composition: what factors determine the types and number of plants we observe in different environments?
- How do exotic species affect native species?
- How do pathogens affect native and exotic plants?

My (main) research areas - 2

- Human evolutionary biology: how do evolutionary processes contribute to diversity in traits and genes in humans?



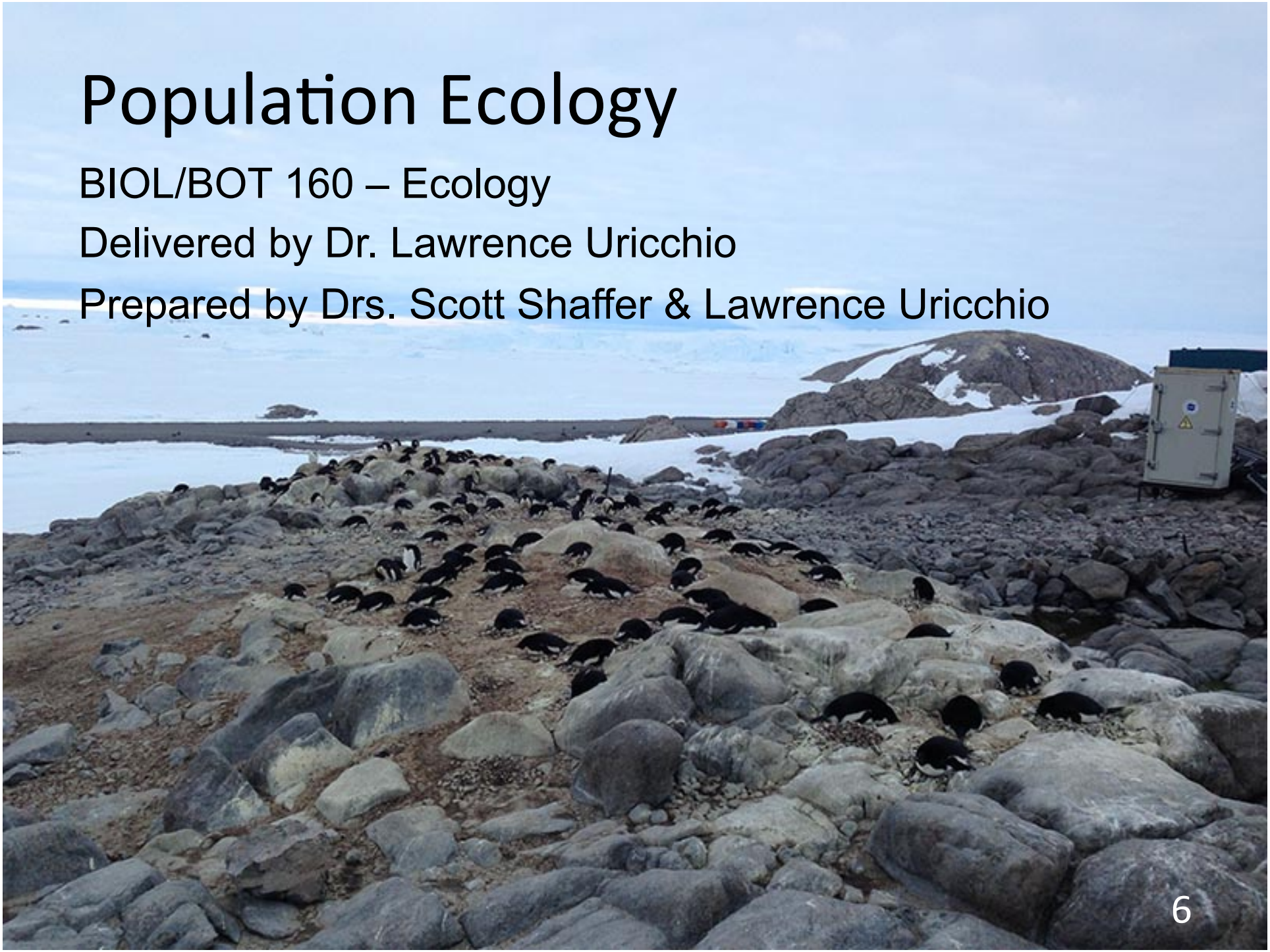
Ko *et al* 2012 (PNAS)

Population Ecology

BIOL/BOT 160 – Ecology

Delivered by Dr. Lawrence Uricchio

Prepared by Drs. Scott Shaffer & Lawrence Uricchio



Learning objectives

- Students should be able to:
  - Define and identify populations and metapopulations
  - Name at least 4 basic characteristics of populations and explain why they are important in assessing population robustness (i.e., population growth or loss)
  - Explain policy implications of population ecology principles under the Endangered Species Act (*you don't need to know the ESA, but you should be able to understand how it relates to population ecology*)
  - Calculate population growth rates from life tables (Next time)

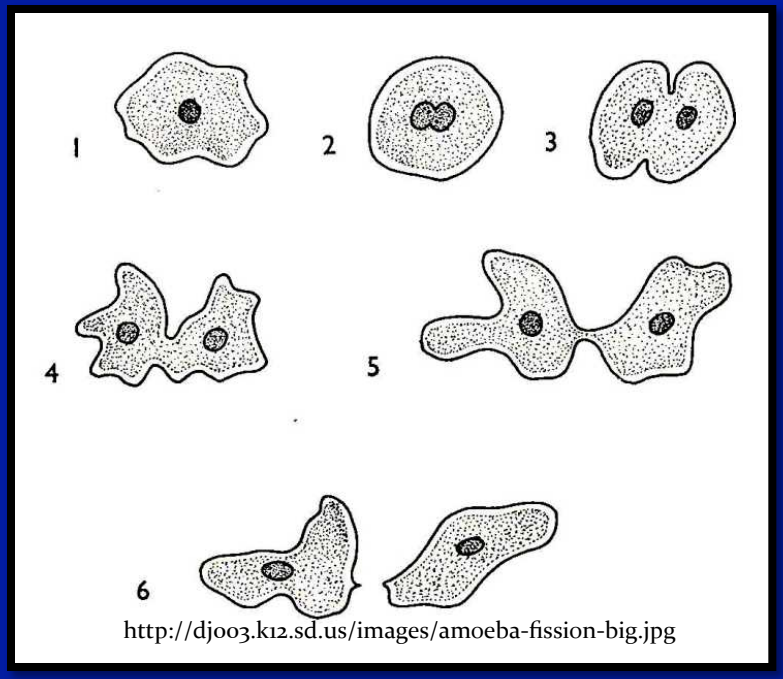
What is a population?

- Biological Population
  - Classic Definition:
    - Interbreeding individuals of the same species living in the same place at the same time.

http://www.stillwatersci.com/resources/ripp1_main.jpg

What is a population?

- Biological Population
  - Alternative Definition:
    - ***Intrabreeding*** individuals of the same species living in the same place at the same time.

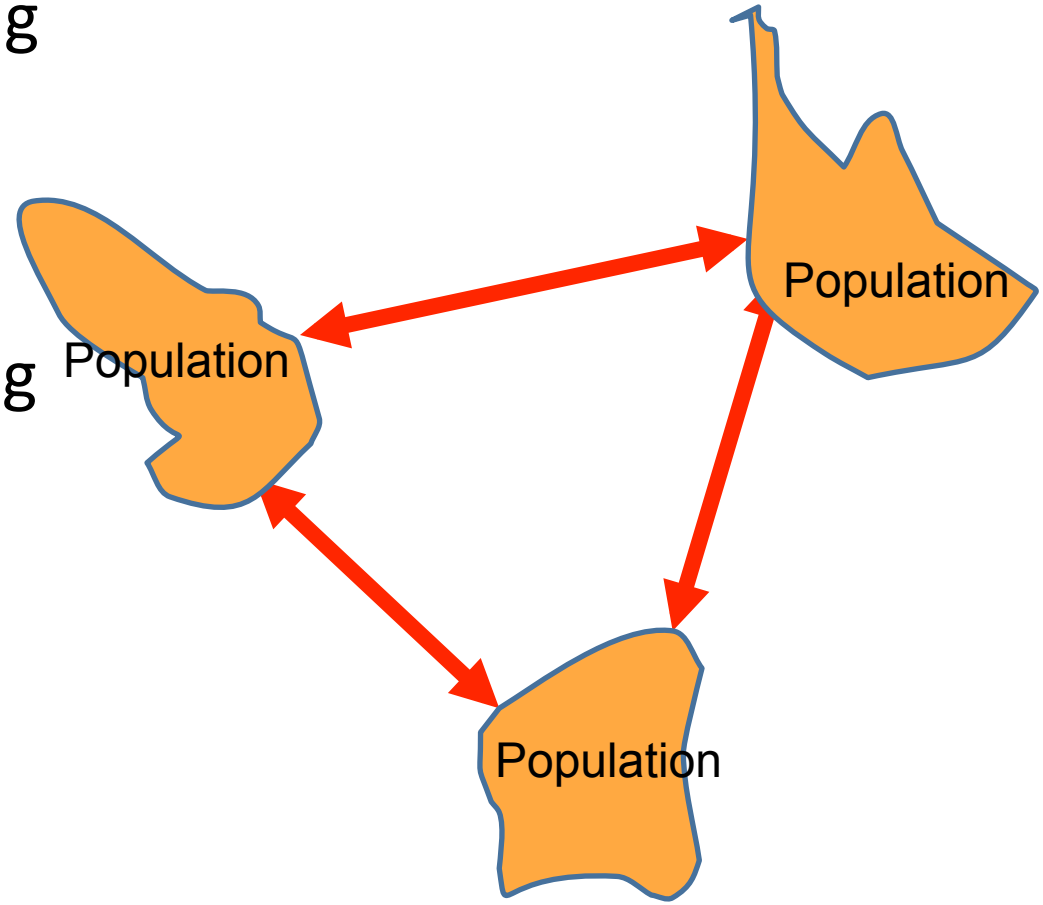


http://dj003.k12.sd.us/images/amoeba-fission-big.jpg

Includes ASEXUAL Reproduction

What is a metapopulation?

- Metapopulation
  - Groups of interacting populations
  - Implies that genetic information is mixing



Are the following populations, metapopulations, or neither?

1.Tigers captive breeding program with tigers (potentially of different species) collected from around the world,

2. Grizzly bears and polar bears that produce offspring

An analogy

- A doctor observes a baby's weight over time
- Diagnoses baby (*e.g.*, baby isn't eating enough)
- Prescribes treatment (*e.g.*, supplement with formula)

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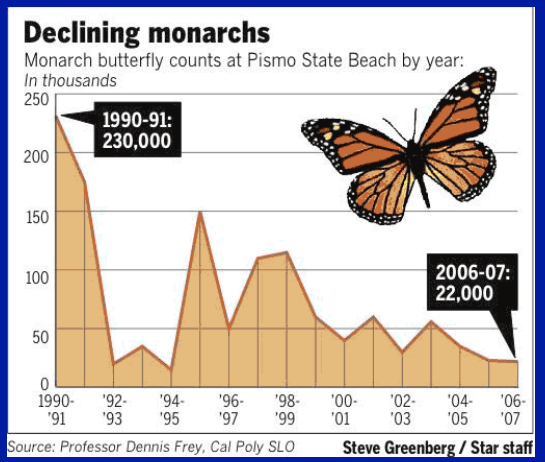
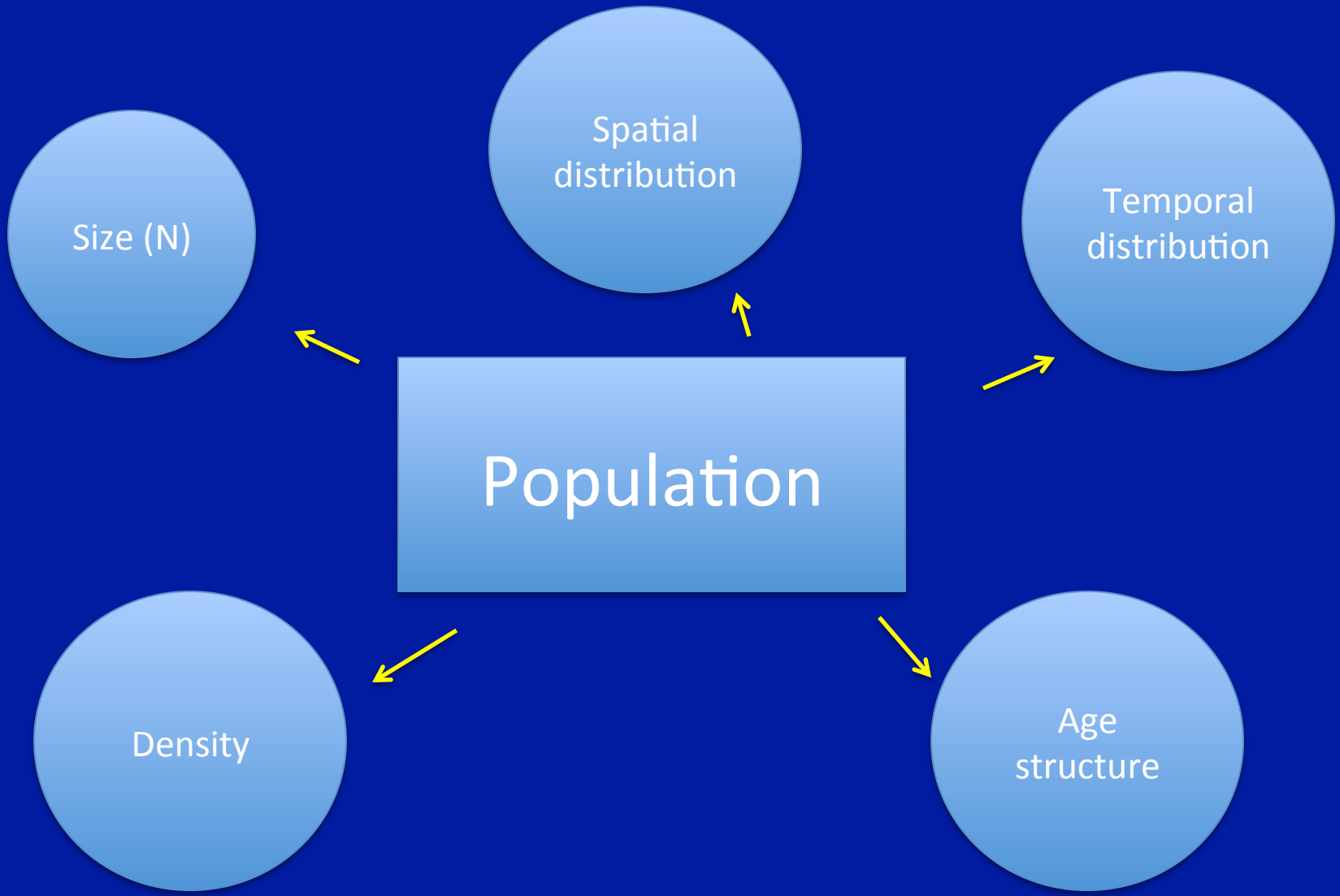
- Population ecologist observes population size over time
- Assesses cause of population decline (*e.g.*, habitat loss)
- Possibly recommends remediation



Population characteristics



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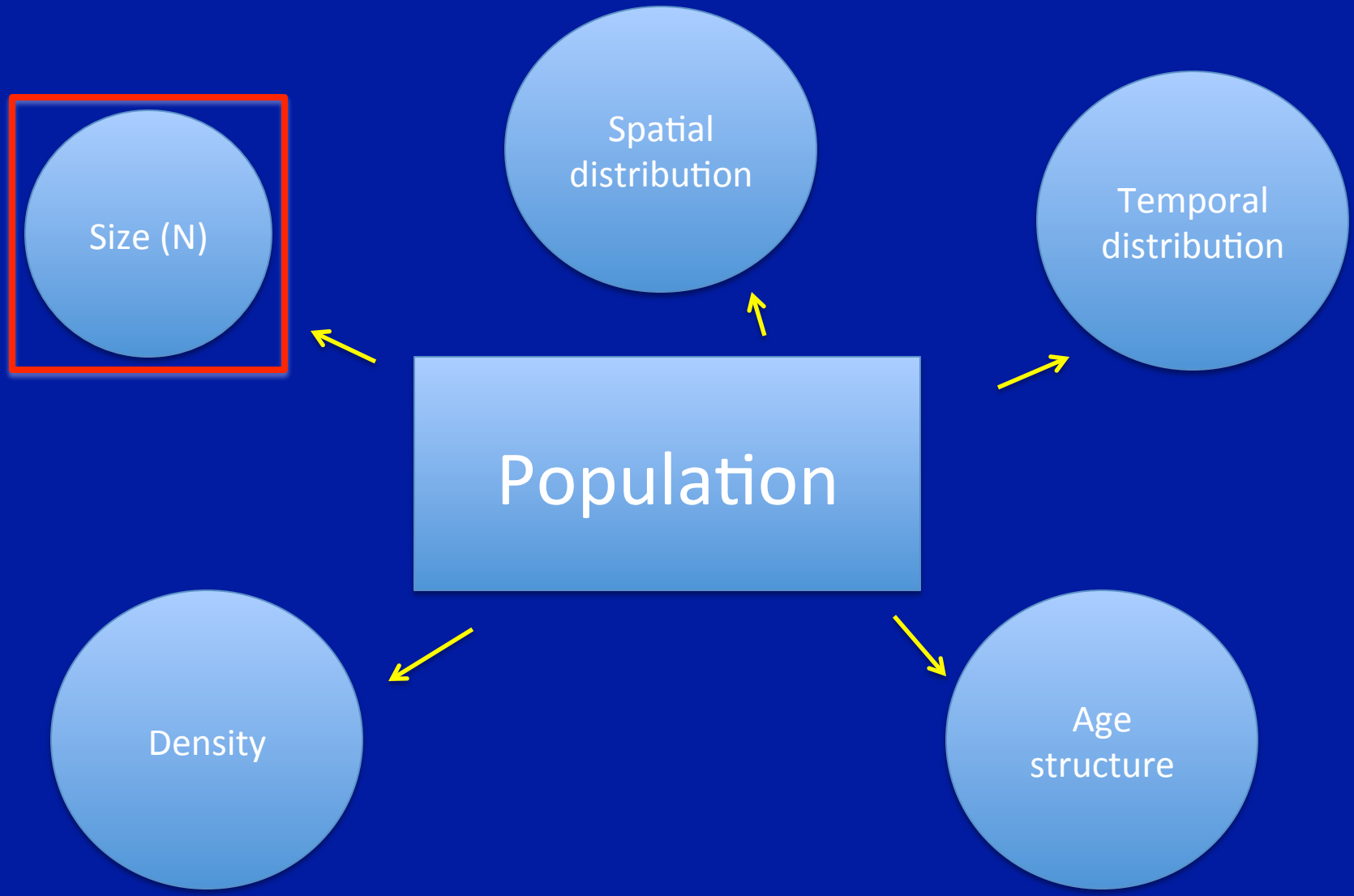
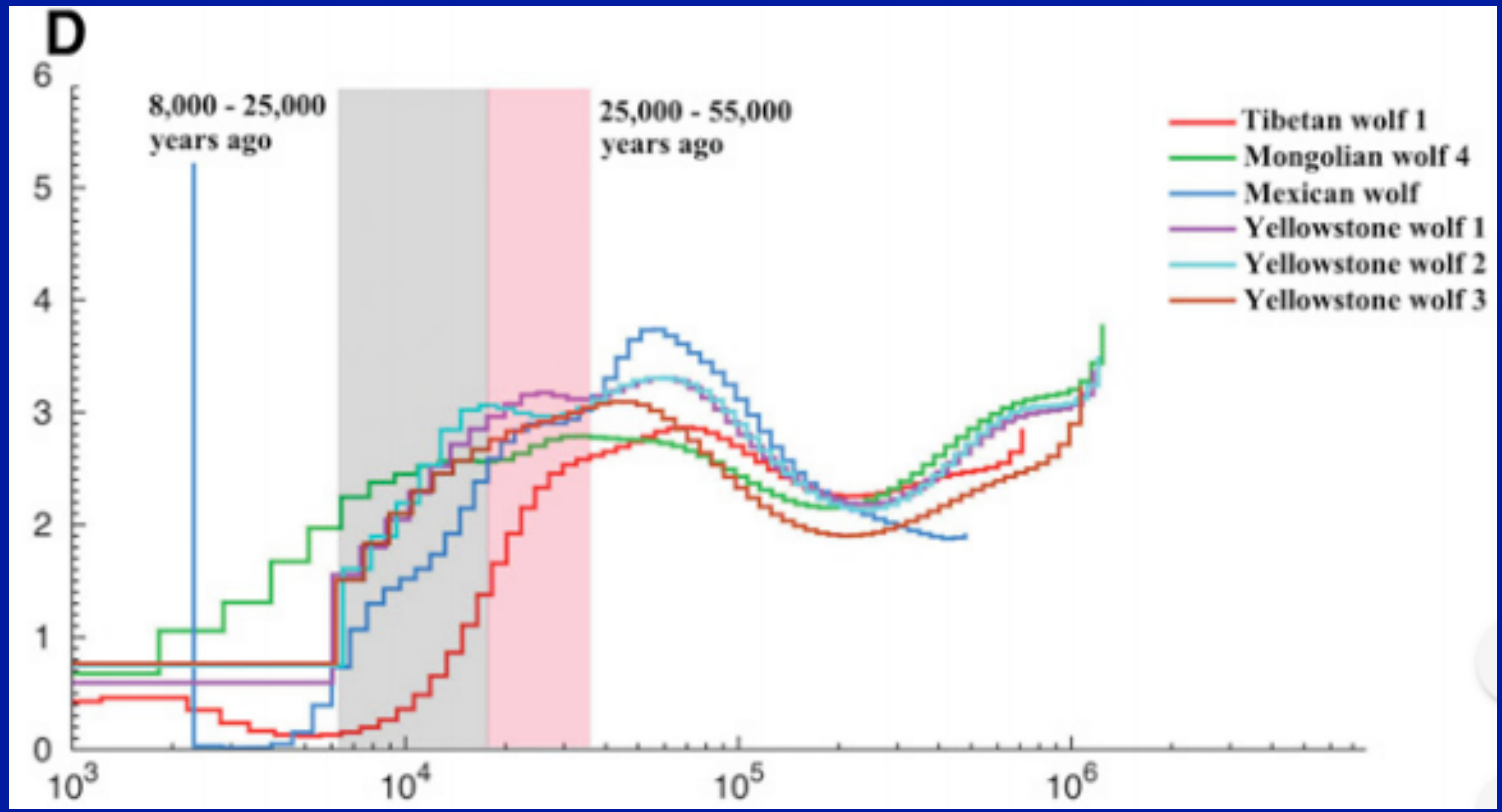


Why do we care?

- A central goal of ecology: explain *why* we observe changes in populations over time
- First, we must describe the *patterns* we observe and define relevant population *characteristics*
- Assessing population growth can have policy implications (*e.g.*, Endangered Species Act (ESA))

Example: gray wolf population size decreases over time



Fan et al 2016 Genome Research

By 1973, only a few hundred wolves in the 48 lower states

Note that time runs backwards on the x-axis!

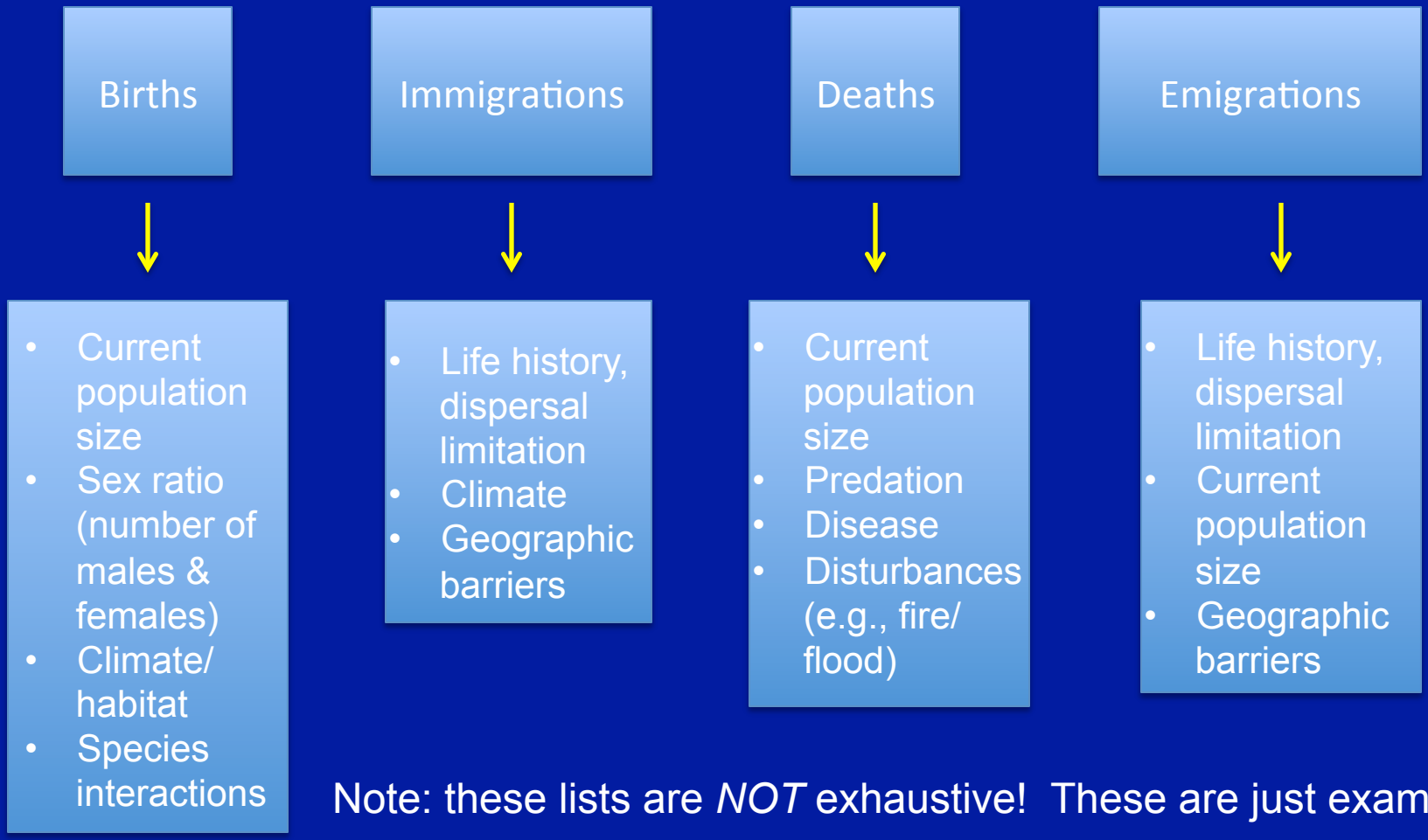
Think-pair-share:
Factors that impact wolf populations

Processes that alter population size

- Population size increases with [B]irths and [I]migrations
- Population size decreases with [D]eaths and [E]migrations
- So change in population size (dP) is given by

$$dP = [B + I] - [D + E]$$

Processes that alter population size

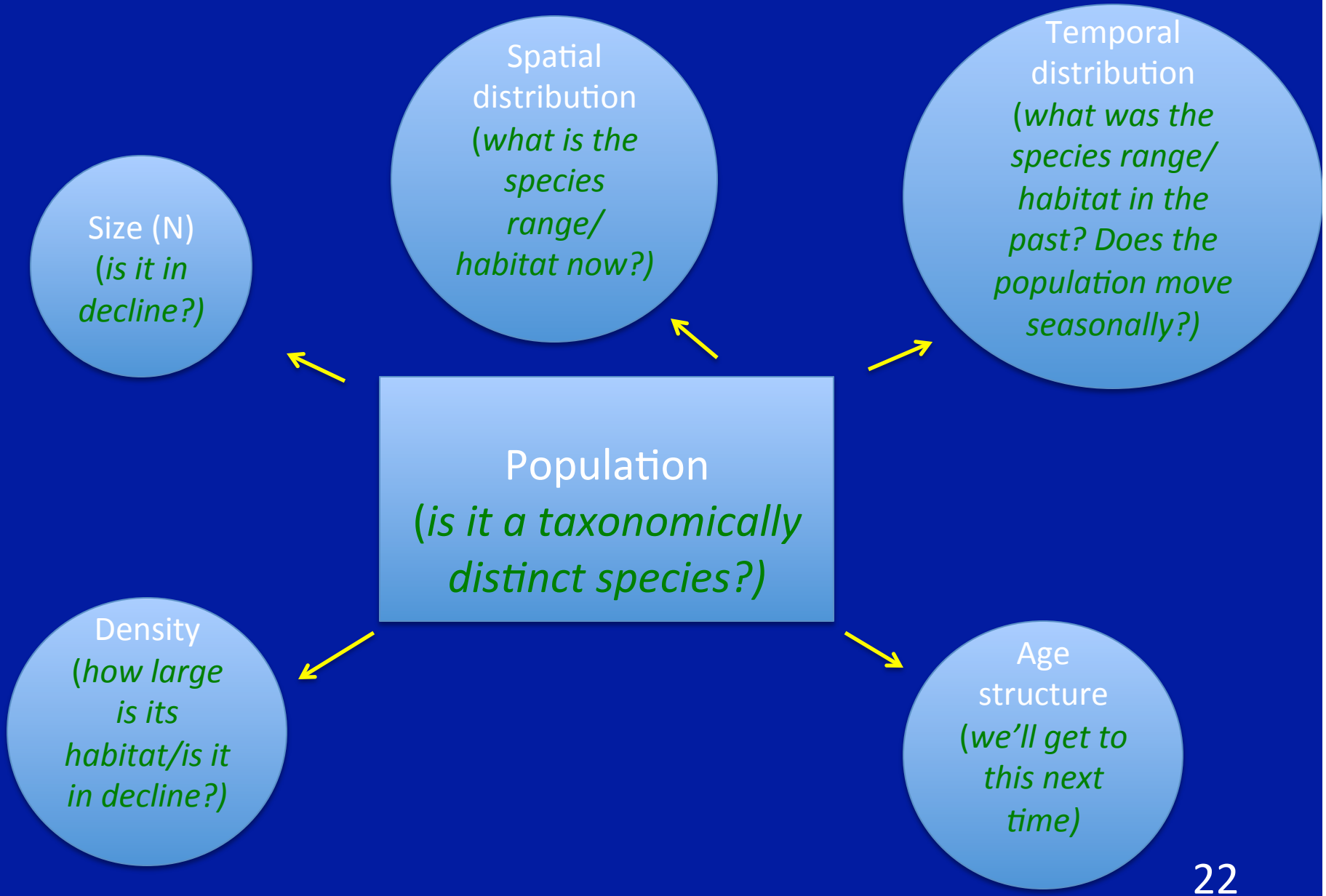


Note: these lists are *NOT* exhaustive! These are just examples

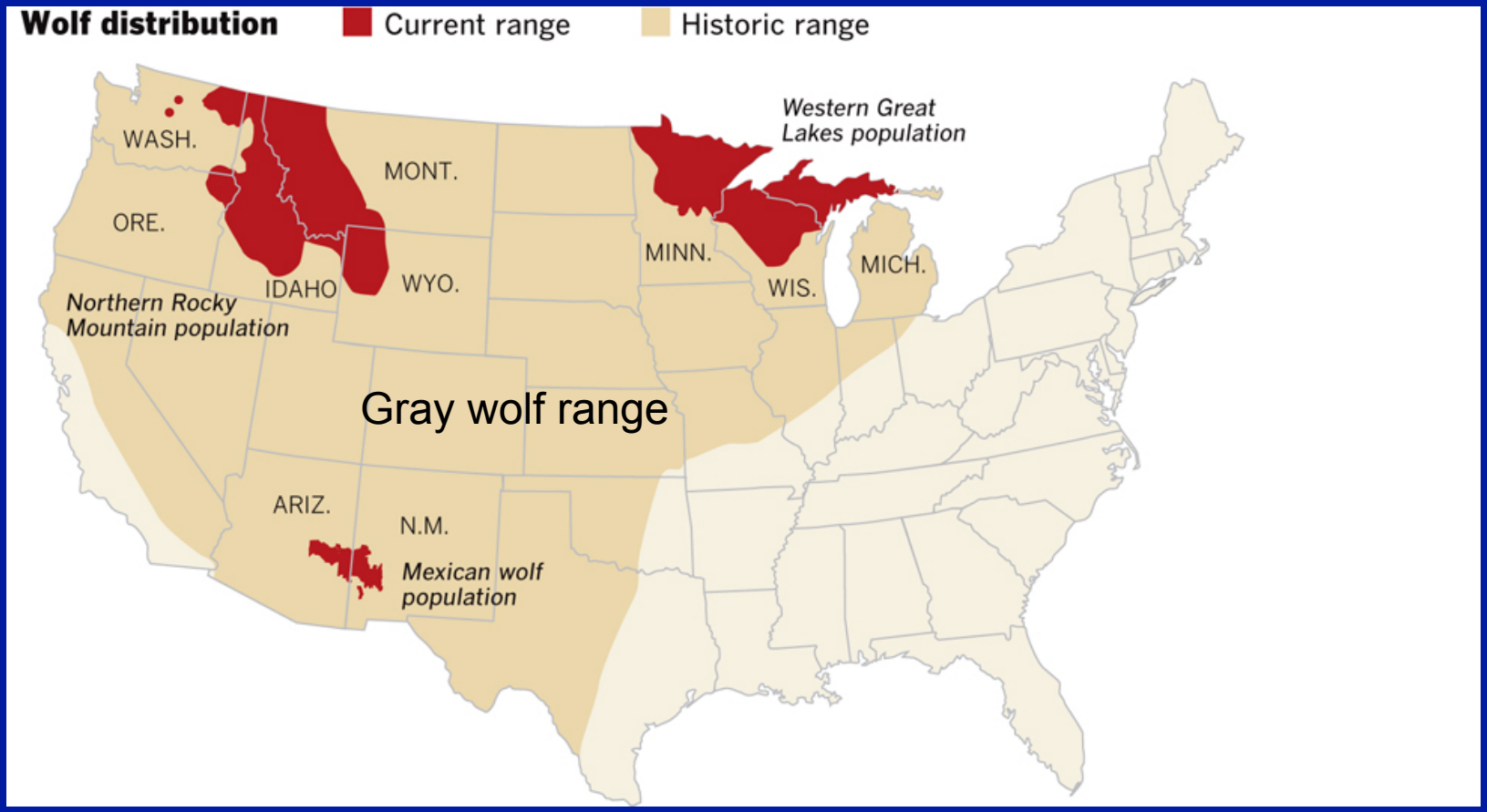
How do species gain protected status under the Endangered Species Act (ESA)?

- Is the species taxonomically distinct?
- Is the range reduced by habitat loss?
- Is the species in decline because of consumption, predation, or disease, or some human-mediated factor?

Population characteristics in relation to the ESA



A case study: which wolves should be protected?



http://graphics.latimes.com/towergraphic-la-me-wolves/

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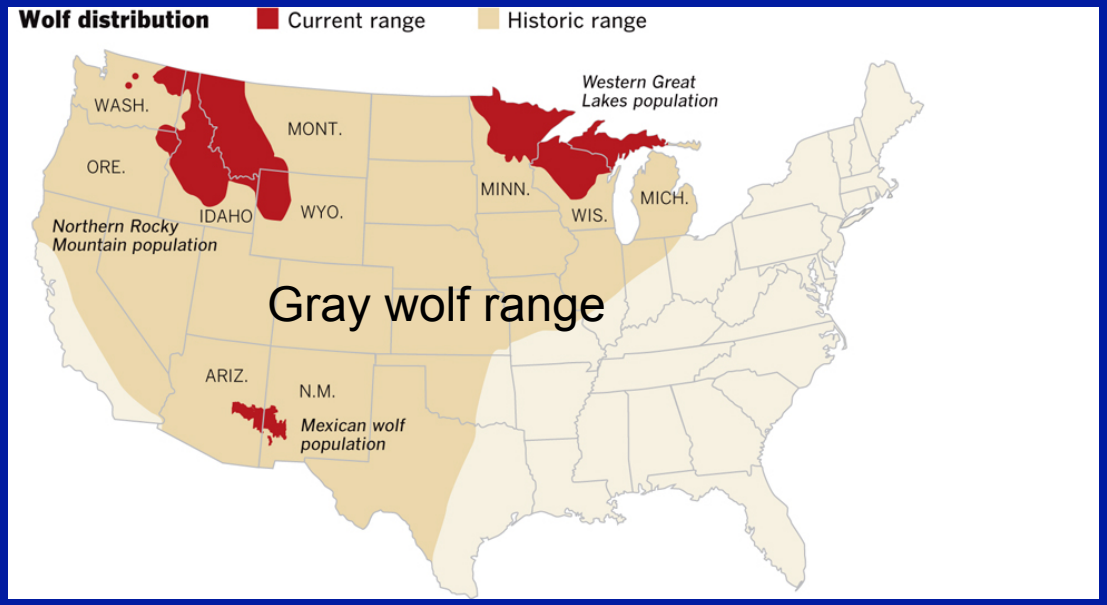

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Should the gray wolf be protected?

1. Is it a distinct species? ✓
2. Is its range shrinking?
3. Is the species in decline?

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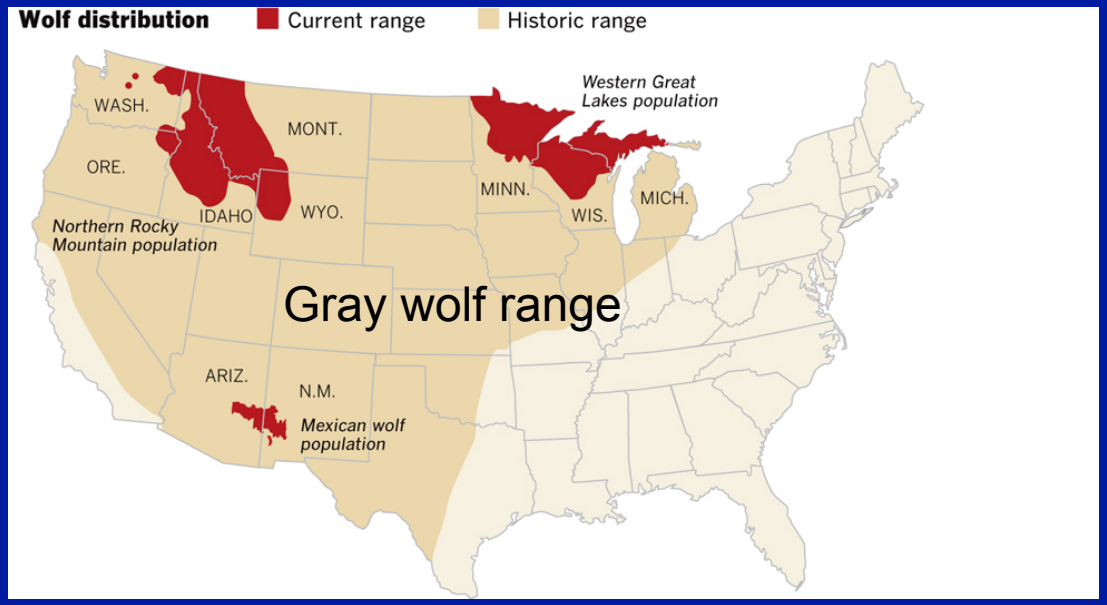

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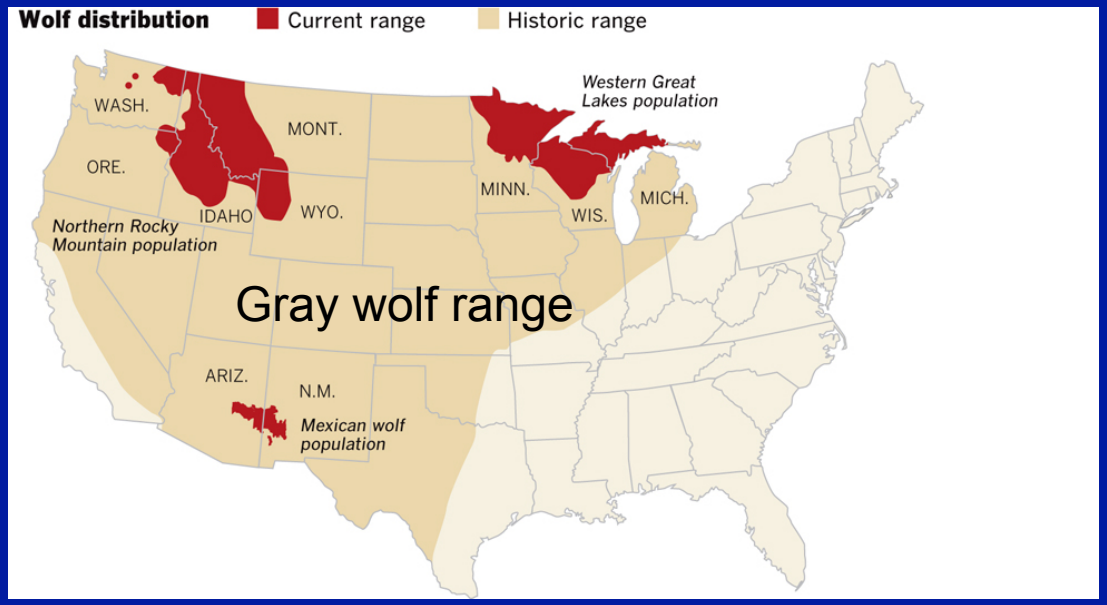

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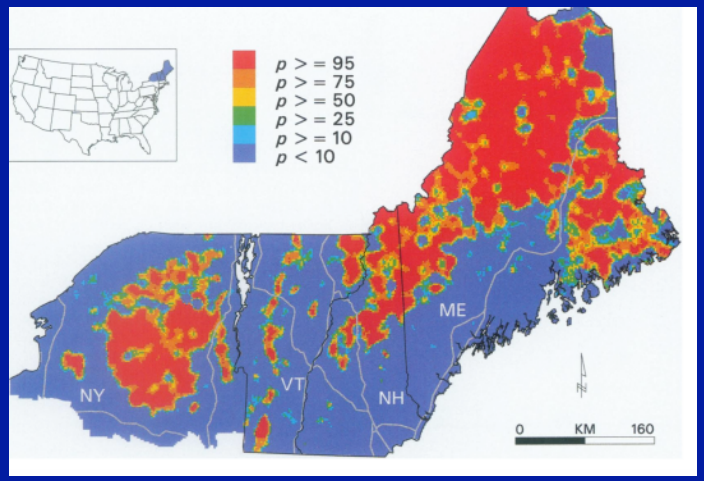
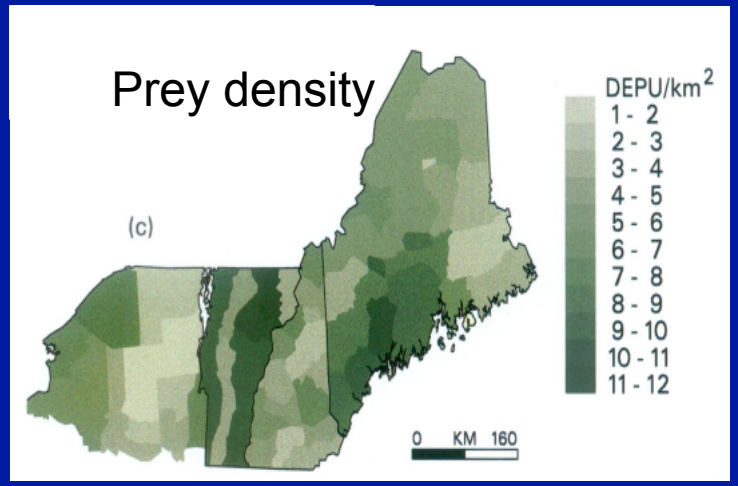
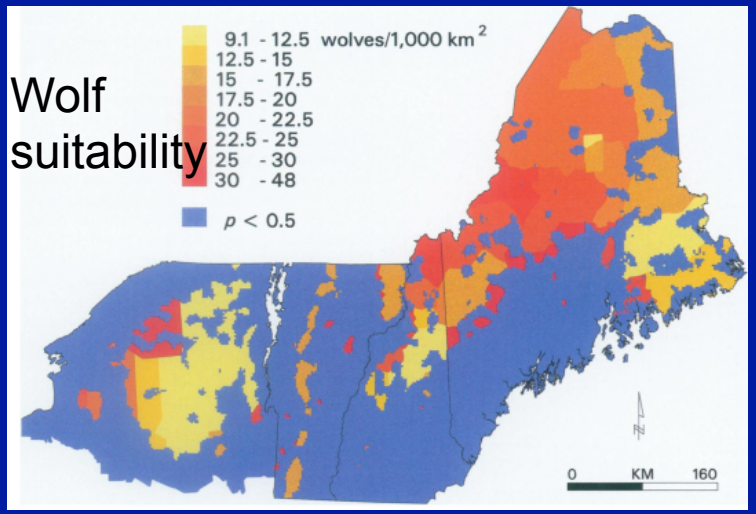
Limiting factors for species ranges

Habitat suitability





- Wolves like mixed conifer/ deciduous forests
- Wolves like to eat (obviously)



Mladenoff & Sickley 1998

Limiting factors for species ranges

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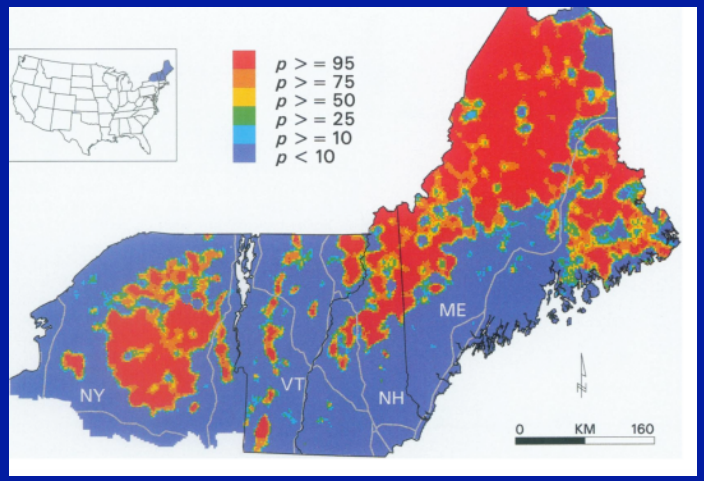
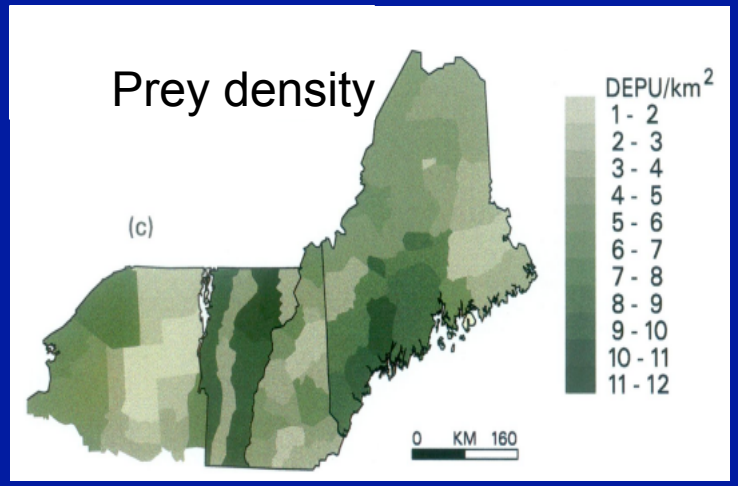
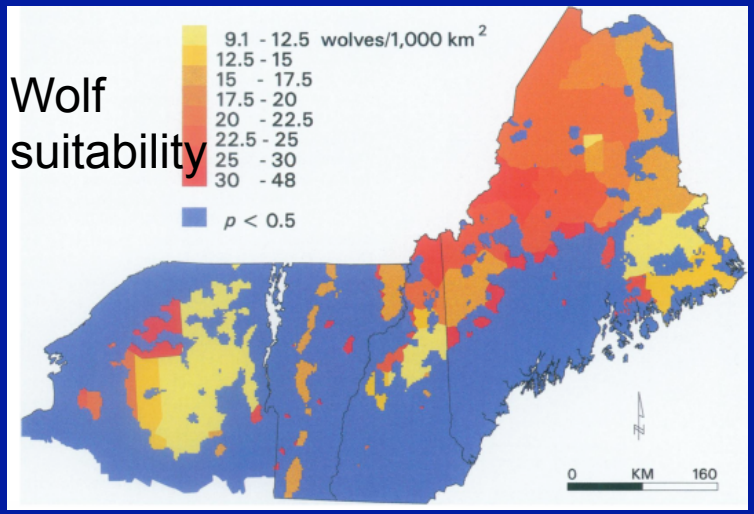


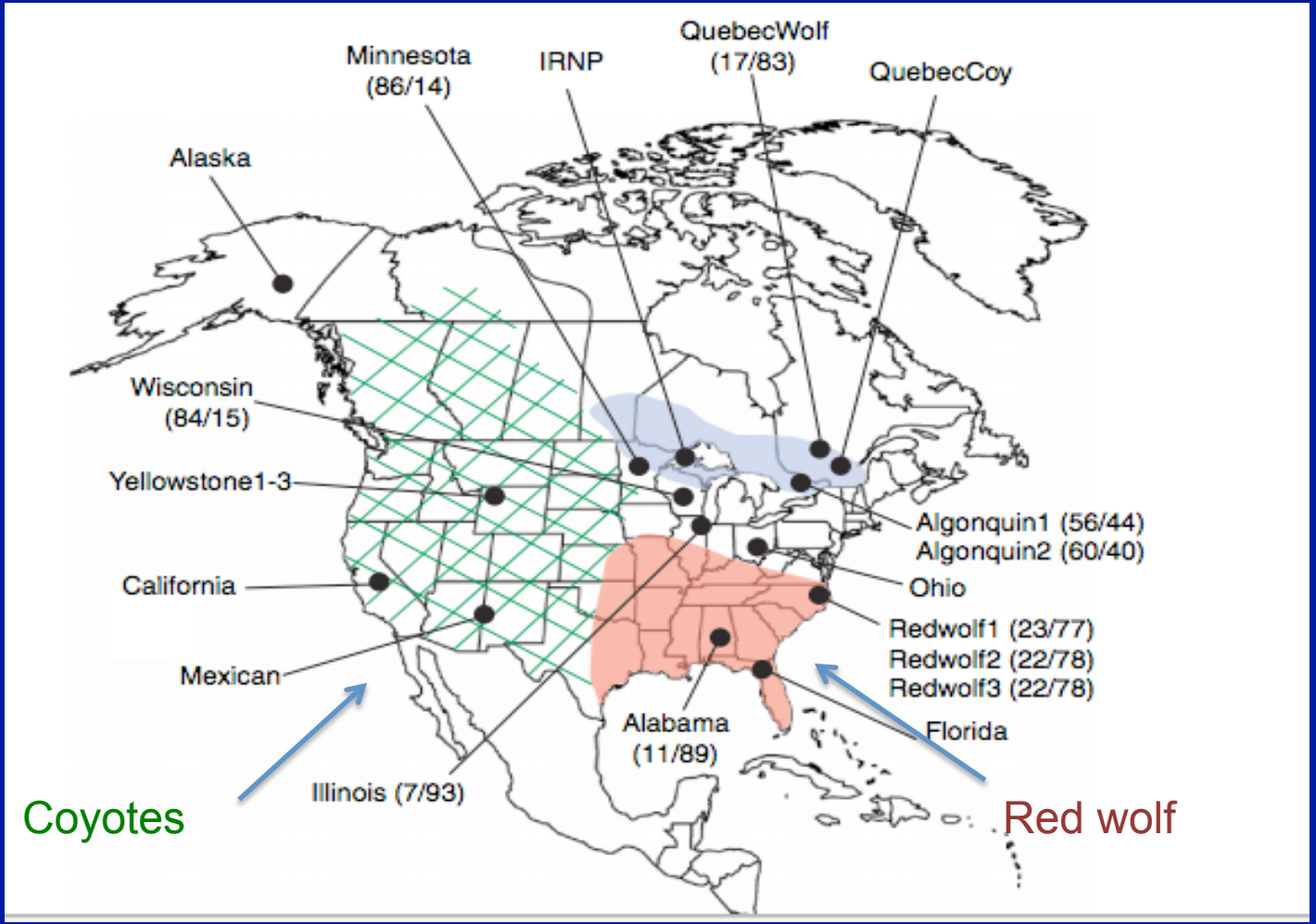


Population density may vary in space (and also in time) →



Mladenoff & Sickley1998

What about the red wolf?



vonHoldt et al 2016

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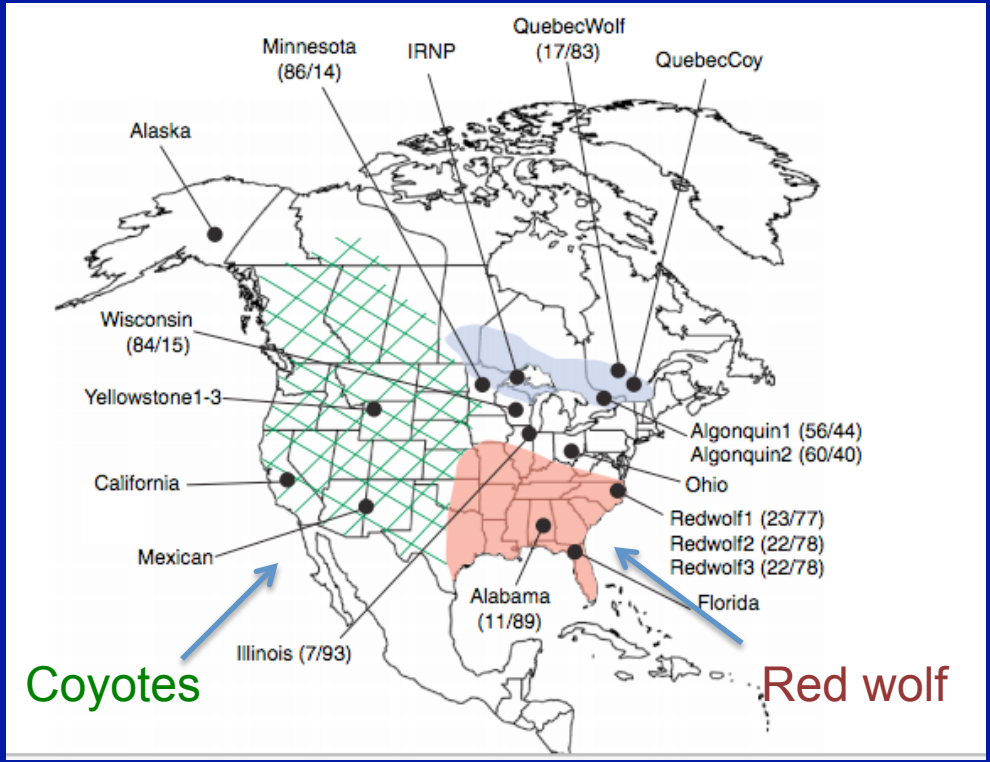

Should the red wolf be protected?

1. Is it a distinct species? ??
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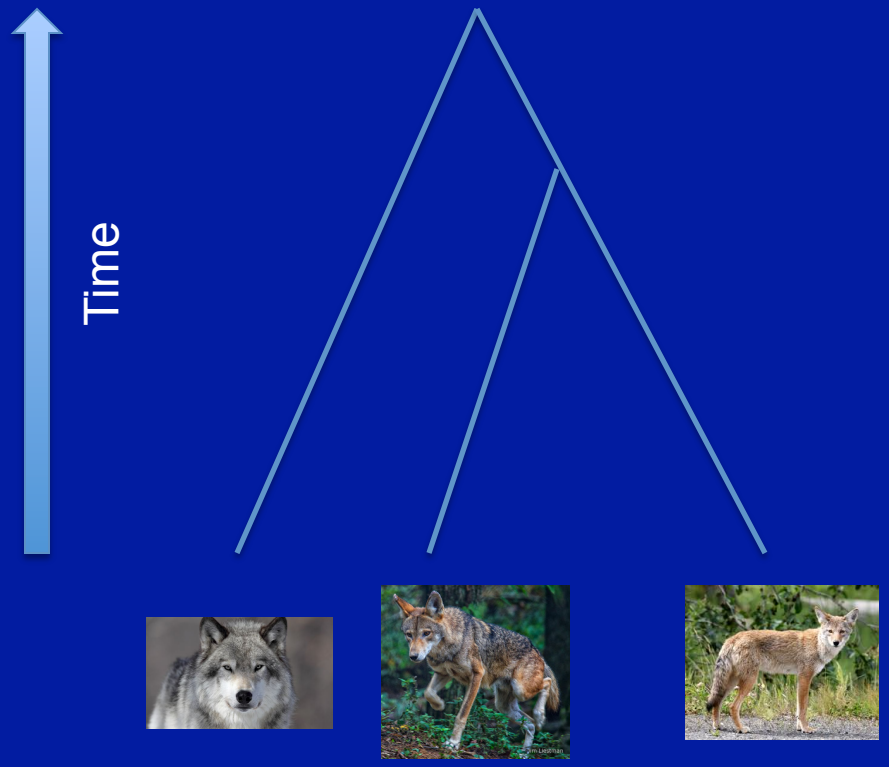
3. Is the species in decline? ✓

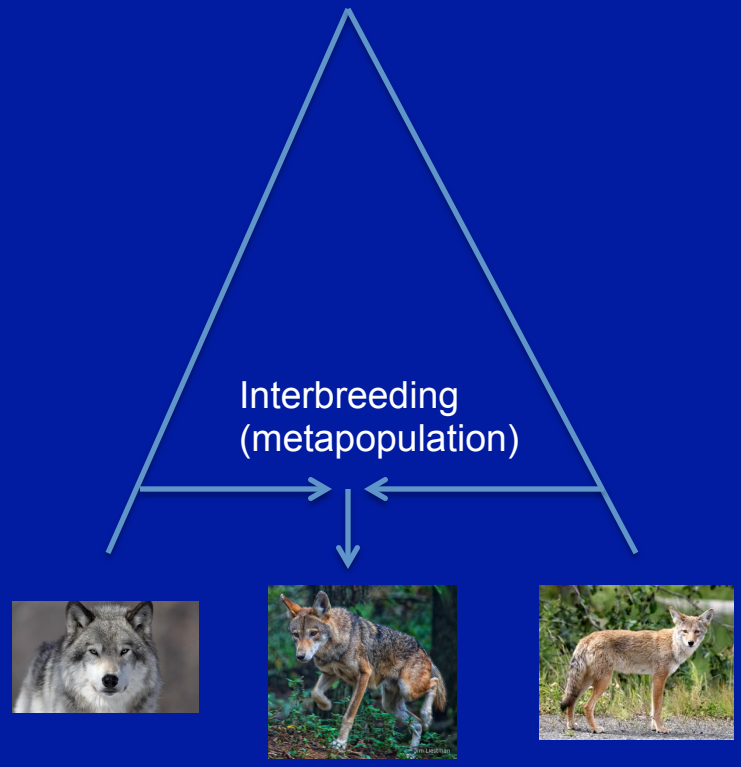
vonHoldt et al 2016

Is the red wolf a distinct species?

Hypothesis 1: red wolf
is an ancient/distinct lineage



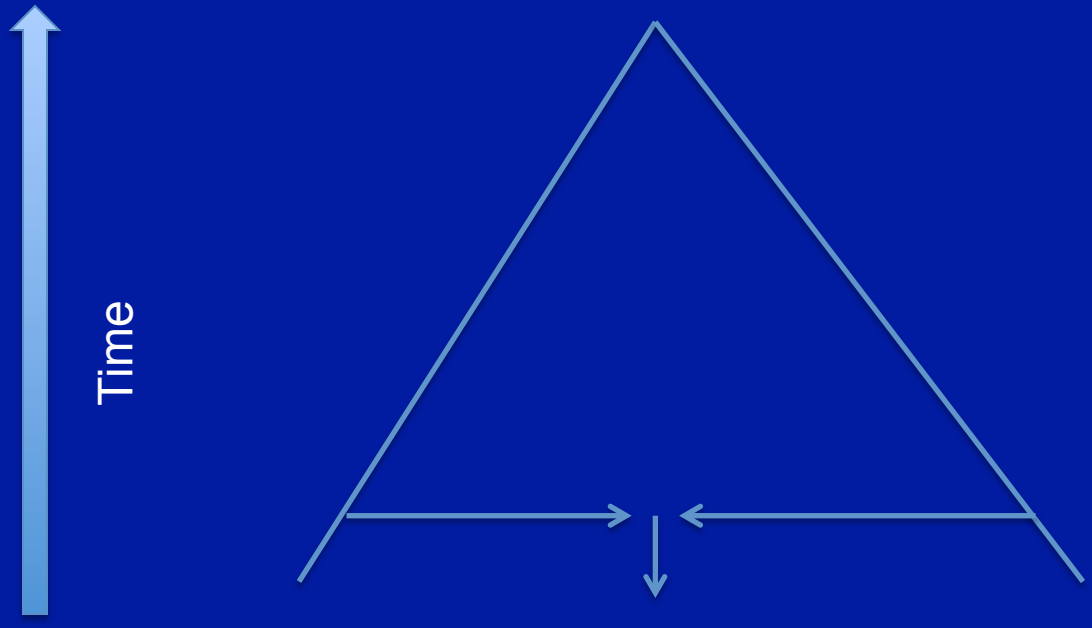
Hypothesis 2: red wolf is a recent
mixture of coyote and gray wolf



Predictions of hypothesis 1 (red wolves are a distinct species)

Red wolf will have its own distinct DNA sequences not found in gray wolf or coyote

Predictions of hypothesis 2 (coyotes and gray wolves formed a metapopulation -- recent hybrids resulted in red wolves)



Red wolf will not have its own unique DNA, it will be a mix of gray wolf and coyote

Gray

ATGCGAC

Red

ATGTATAC

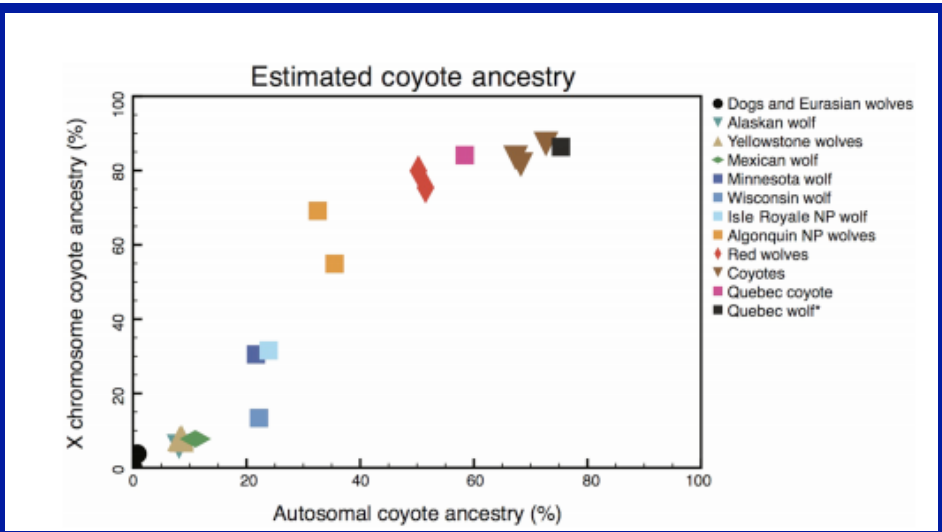
Coyote

GCTATCG

Red wolf and eastern wolf are not distinct species

EVOLUTIONARY GENETICS

Whole-genome sequence analysis shows that two endemic species of North American wolf are admixtures of the coyote and gray wolf



Hypothesis 2 is supported by DNA sequence data

vonHoldt *et al* 2016 Nature Communications

Conservation implications

- US Fish & Wildlife Services had argued for de-listing the gray wolf as endangered because its range overlapped with the eastern wolf/red wolf, while these wolves were protected
- But DNA analysis shows these are very similar to coyotes!!
- Authors argue for a less rigid species definition for the ESA

Learning objectives recap

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