Main Points

1) Why is genetic diversity important?

-- mutations, inbreeding, genetic drift, and gene flow

-- example: isolation management as a conservation strategy to combat hybridization (Novinger and Rahel reading)

2) Species as "units" of conservation

-- why species?

-- example: the unfortunate plight of a low-profile, uncharismatic vertebrate (Drietz reading)

3) Overview of biological sampling

4) Sources of population variability

-- review of population growth

-- demographic stochasticity

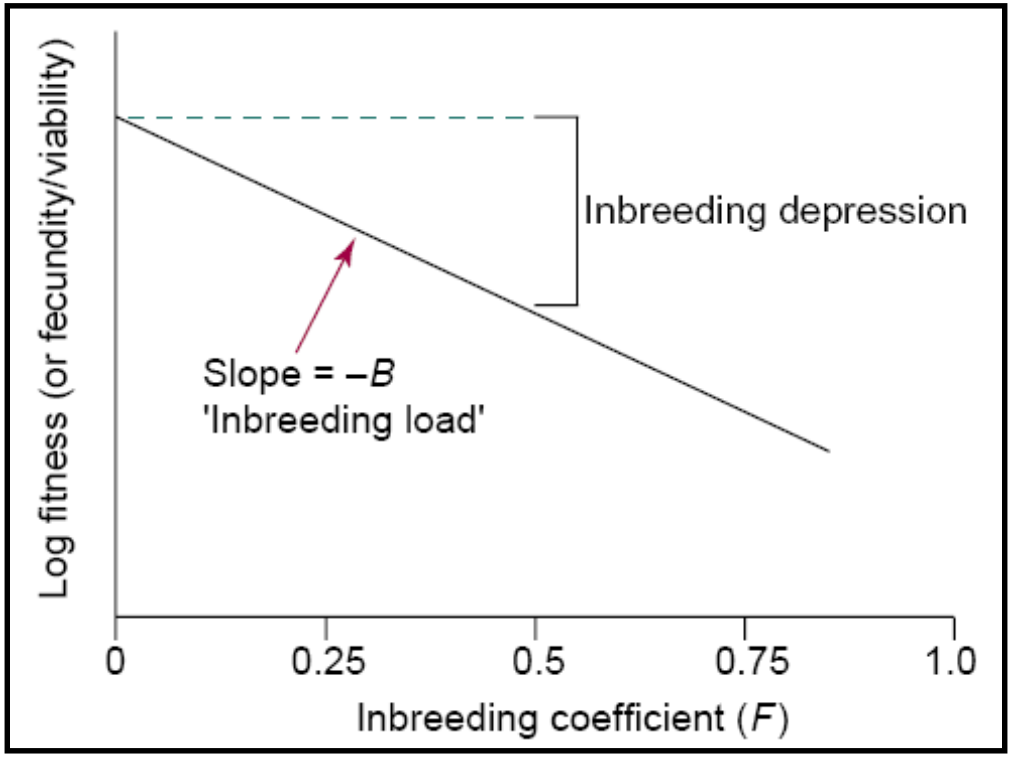
-- geometric population growth

Pre-reading: Thursday 2 February: Ripple et al, Ford et al, Ripple et al #2
Tuesday: NA

Terms: inbreeding depression, genetic drift, gene flow, outbreeding depression, keystone species, foundation species, flagship species, umbrella species, sample, statistical population, precision, bias, variance, confidence interval

Why Is Genetic Diversity Important (Or Is It)?

- **genetic variation reduces probability of <u>inbreeding depression</u>.**



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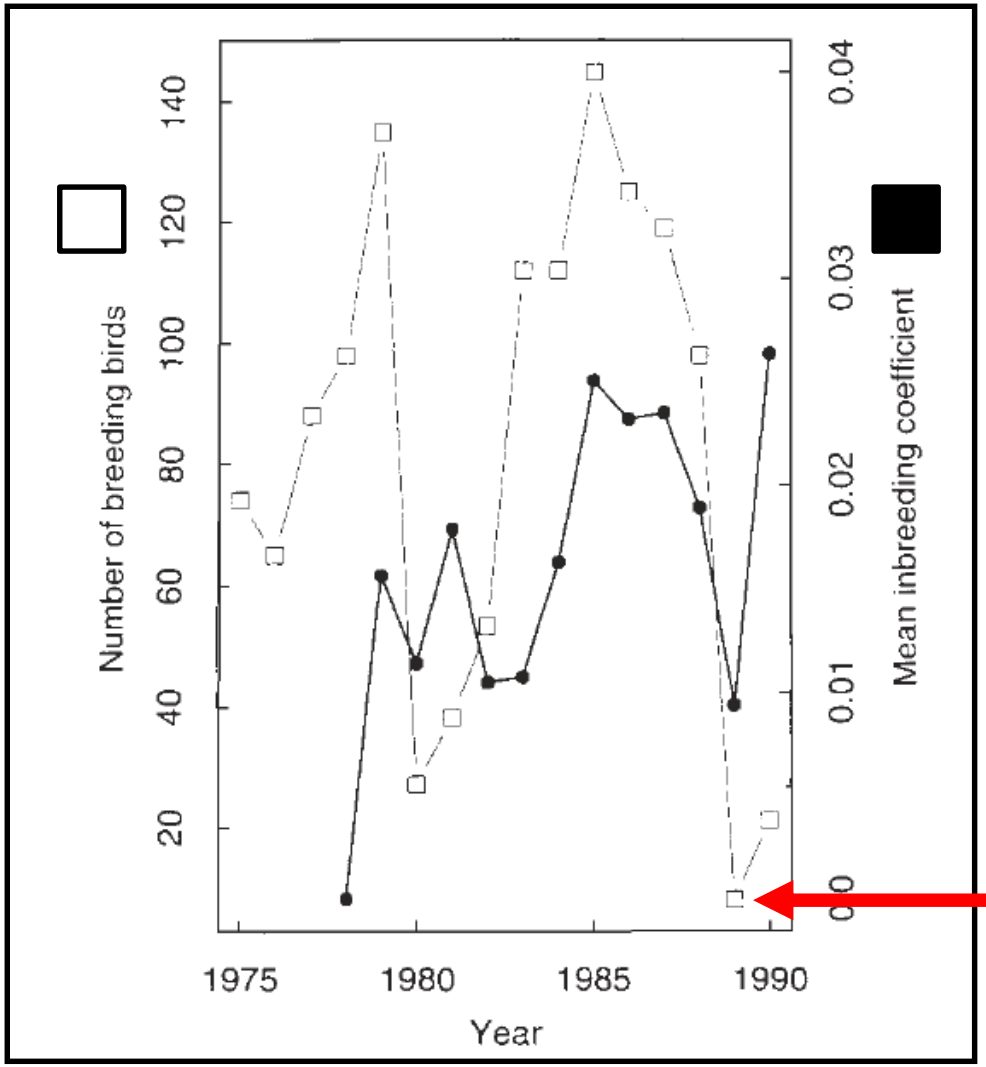

unusually severe winter

Keller et al. 1994. Nature.

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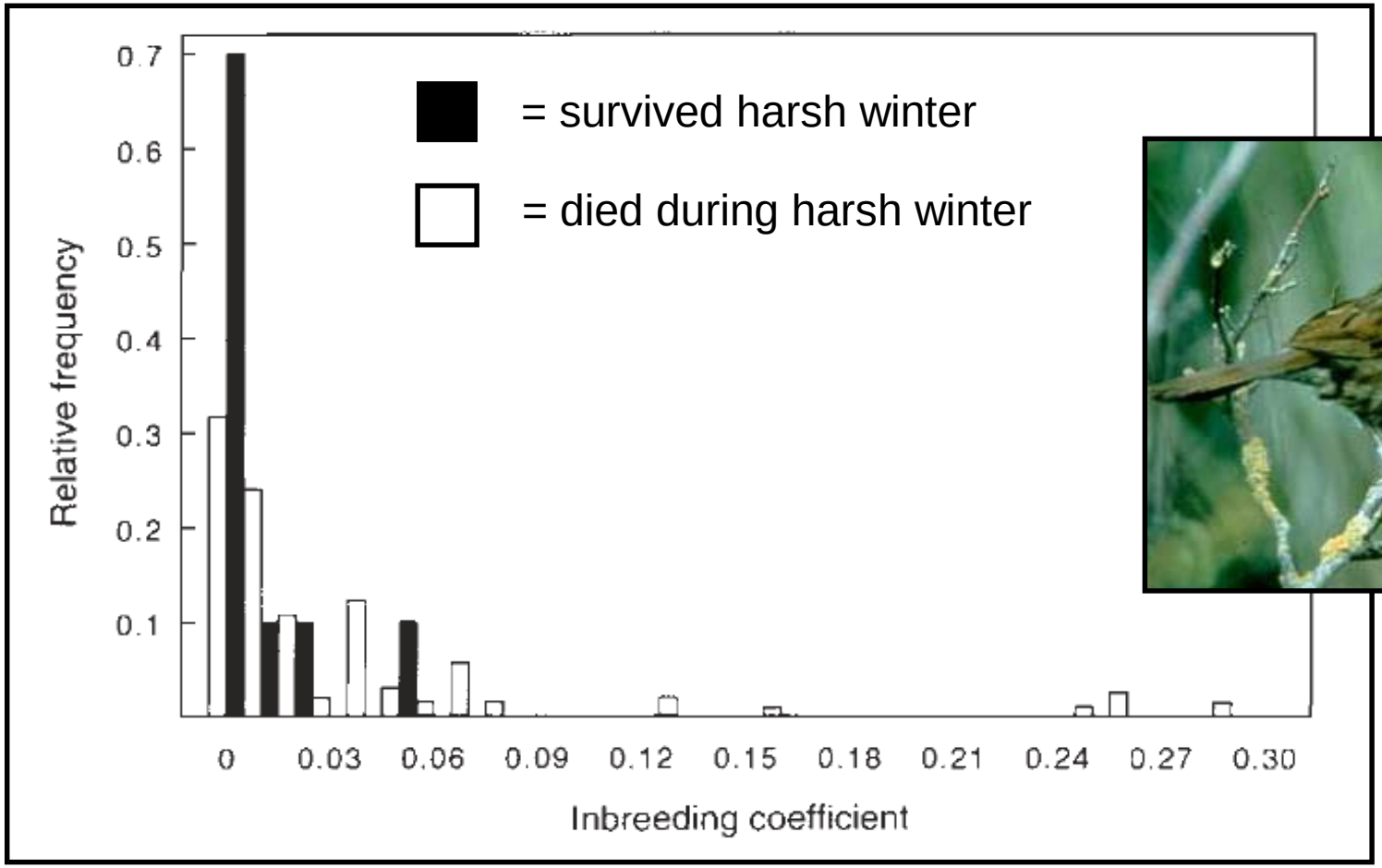

Keller et al. 1994. Nature.

Genetic Drift and Gene Flow

- **genetic variation reduces probability of <u>genetic drift</u> (and usually is maintained by <u>gene flow</u>).**

Outbreeding Depression and Hybridization

- **artificially high levels of connectivity may result in <u>outbreeding depression</u>.**

- **genetic swamping of adaptive alleles may occur following the removal of dispersal barriers.**

- **in severe cases, may lead to hybridization in which two species interbreed.**

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<u>HUH?</u>

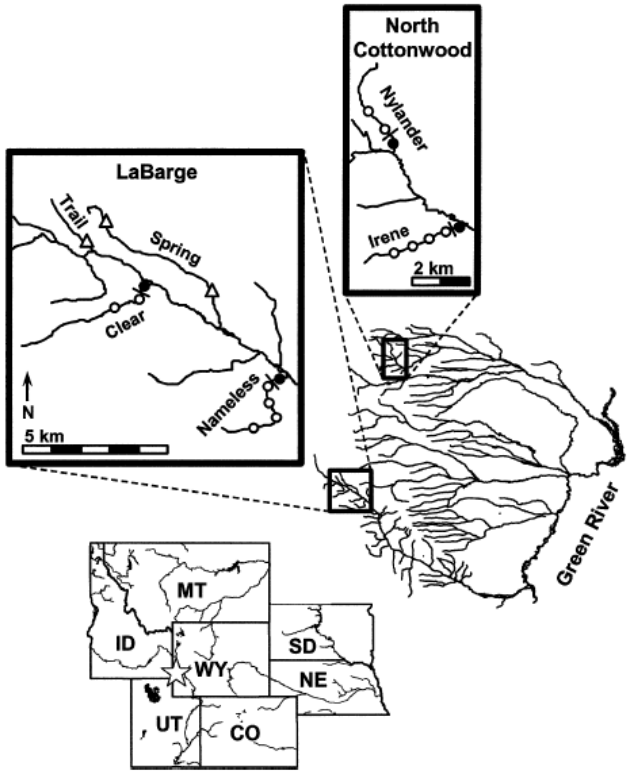
Isolation Management as a Conservation Strategy

- **cutthroat trout, hybridization, and alien species -- many subspecies (now threatened or endangered) in the isolated streams of the Intermountain West.**

Discussion Q: Novinger and Rahel 2003 reported on a series of management interventions conducted in attempt to protect Colorado River cutthroat trout.

What were these interventions? Did they work?

Why or why not? What potentially negative, unintended consequences did the authors mention might arise from their interventions?



Novinger and Rahel. 2003. Cons Biol.

Why Species?

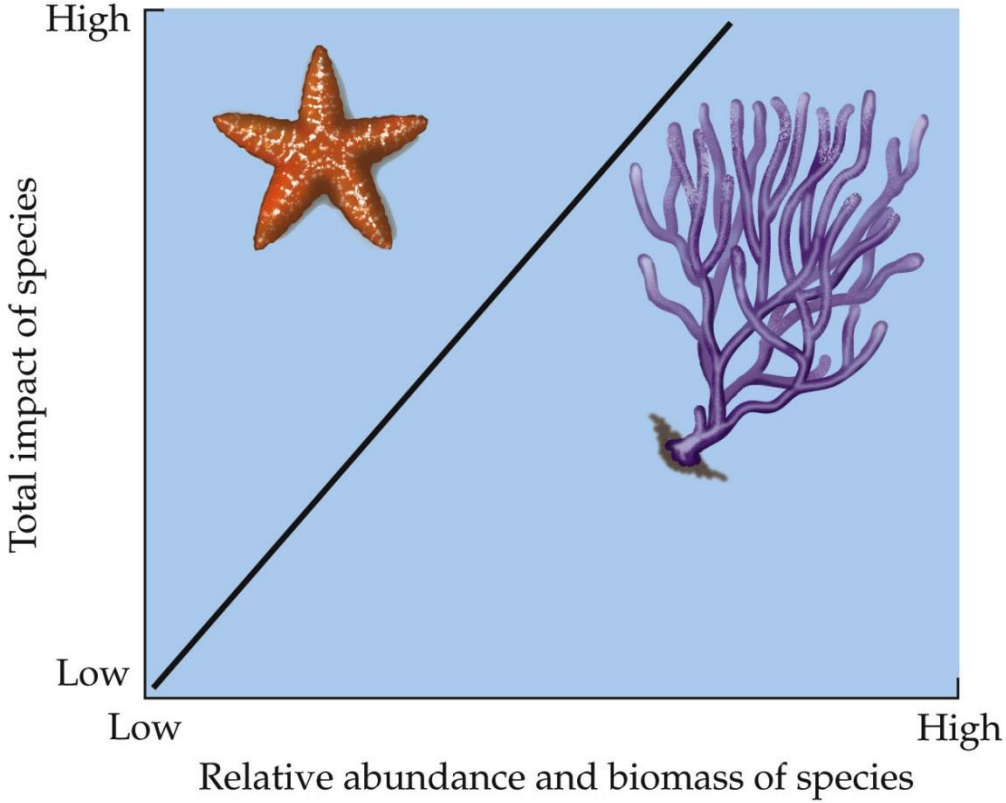
- species are logical “endpoints” for evolution (at least over ecological time scales).

- conservation legislation and classifications (e.g., US Endangered Species Act, IUCN Red List, CITES) focus on species.

Why Species?

- <u>keystone species</u> = those with a large effect on other species because of the "role" they play in communities. Often (but not always) are predators and ecosystem engineers. (Contrast with <u>foundation species</u>).

Trouble with Foundation and Keystone Species Concepts?

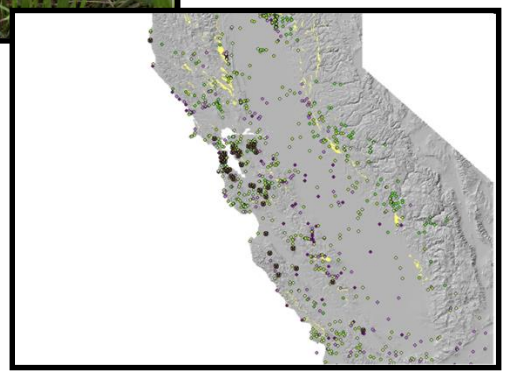


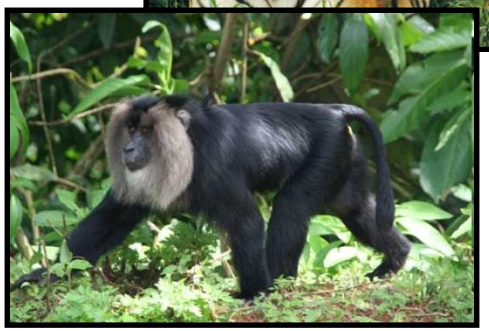
ECOLOGY, Figure 15.17

Why Species?

- **by targeting wide-ranging species for conservation efforts, we may be able to protect other species.**

- **<u>umbrella species</u> = one whose minimum area requirements are at least as large as others in the community, ecosystem, or habitat for which protection is sought.**





Why Species?

- **public can relate to (at least some!) species.**

- **<u>flagship species</u> = iconic animals that provide focus to generate conservation efforts for a broader cause.**

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The Unfortunate Plight of Low-profile, Uncharismatic Microfauna

- **geographic range restricted to 2 square miles around Mortenson Lake NWR in Albany County**

- **low genetic diversity, chytrid fungus, pesticides, and predation by exotic fishes have been implicated in its extinction**

- **reliant upon population augmentation from captive populations**

The Unfortunate Plight of Low-profile, Uncharismatic Microfauna

"We are in the process of reverting the management of the refuge back to what it once was. The lack of grazing appears to have had a negative affect (Withers, 1992) on the toads' ability to breed and bask," said Michelle Geraud, Wyoming Toad Recovery Coordinator with the U.S. Fish and Wildlife Service.

Discussion Q: Dreitz 2006 argued that conservation efforts for the Wyoming toad were failing (or had failed).

What reasons did she give for why recovery was failing?

More broadly, would you as a conservation biologist allocate limited effort, money, and time to this species? Why or why not?

The Unfortunate Plight of Low-profile, Uncharismatic Microfauna

"…inferences from this kind of count-based survey are biased because detection rate varies among counts…there is no estimate of detection probability."

"It is inappropriate to base management actions for a critically endangered species on unpublished and non-peer reviewed reports."

"It is impossible…to infer the status of the population, project the population's long-term viability, or evaluate the Wyoming toad recovery effort."

Statistics Review

- <u>Sample</u> = collection of data through which we calculate statistics

- <u>Statistic</u> = quantitative descriptor of sample, through which inferences to population are made

Statistics Review

- <u>Population (Statistical)</u> = larger group about which inferences are made

- <u>Parameter</u> = quantitative descriptor of population, for which the true value typically is not known

sample of western chorus frogs

sample of eastern WY amphibians

stat. population of western chorus frogs

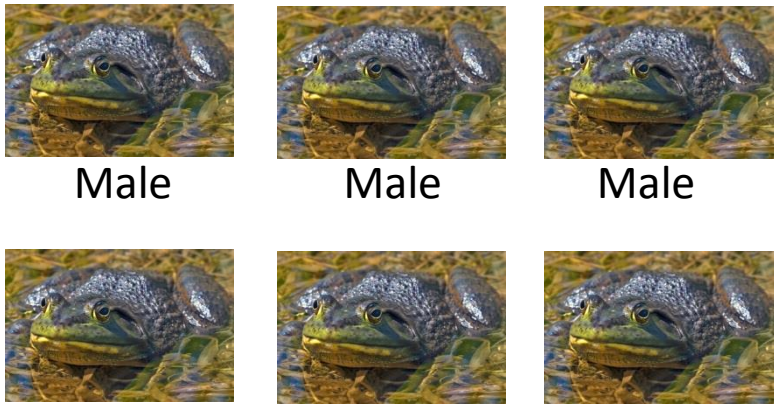
stat. population of eastern WY amphibians

Statistics Review

- **<u>Bias</u> = systematic over- or underrepresentation of individuals in a sample**

<u>biased sample</u>

Sample 1 of bullfrogs

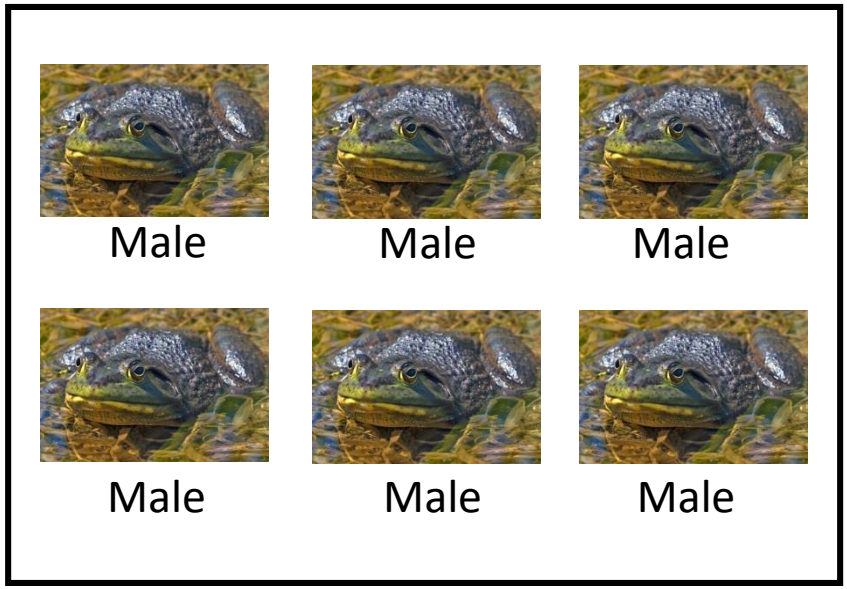


Statistics Review

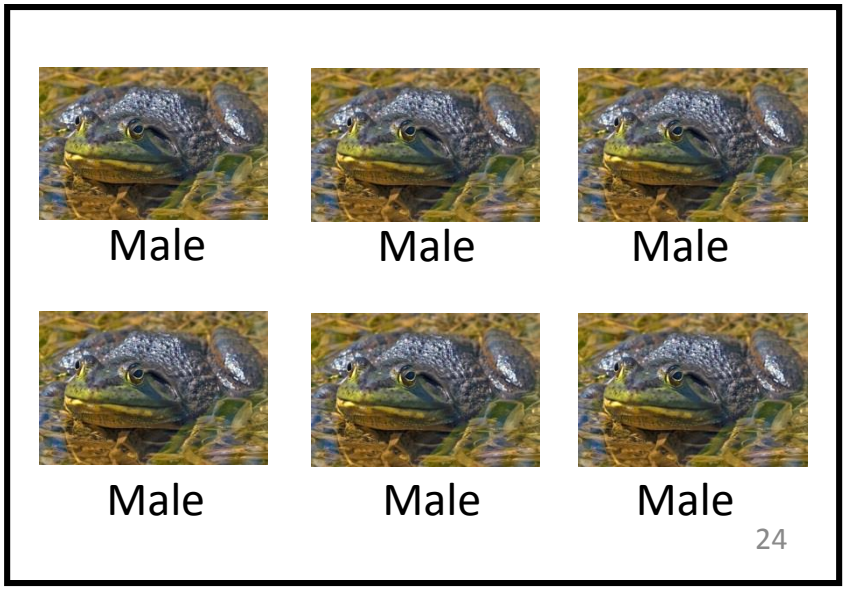
- **<u>Precision</u> = degree of repeatability or conformity**

<u>precise samples</u>

Sample 1 of bullfrogs



Sample 2 of bullfrogs



Statistics Review

- **<u>Precision</u> = degree of repeatability or conformity**

<u>imprecise samples</u>

Sample 1 of bullfrogs


Male


Male


Male


Male


Male


Male

Sample 2 of bullfrogs


Female

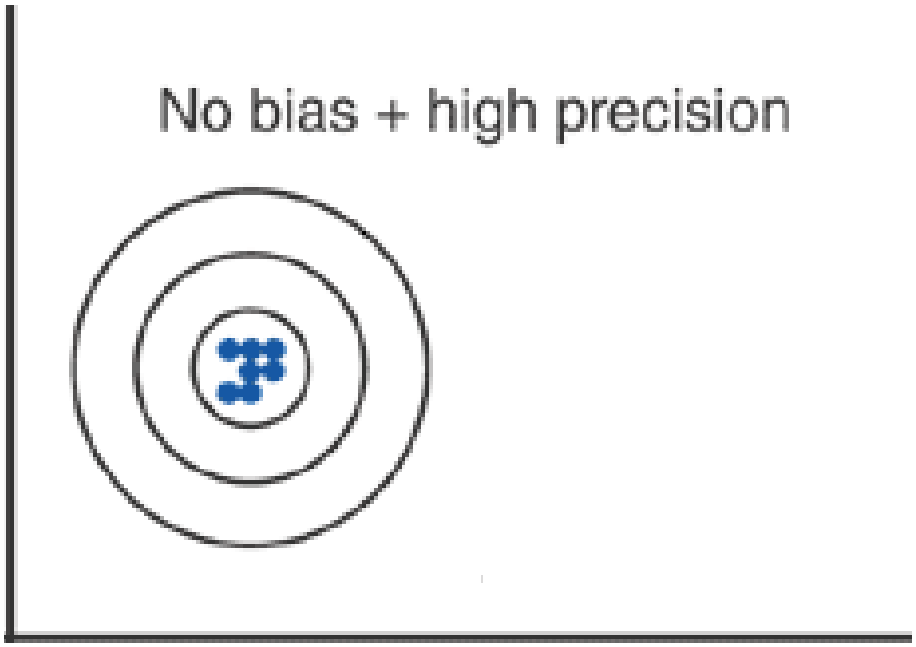

Female

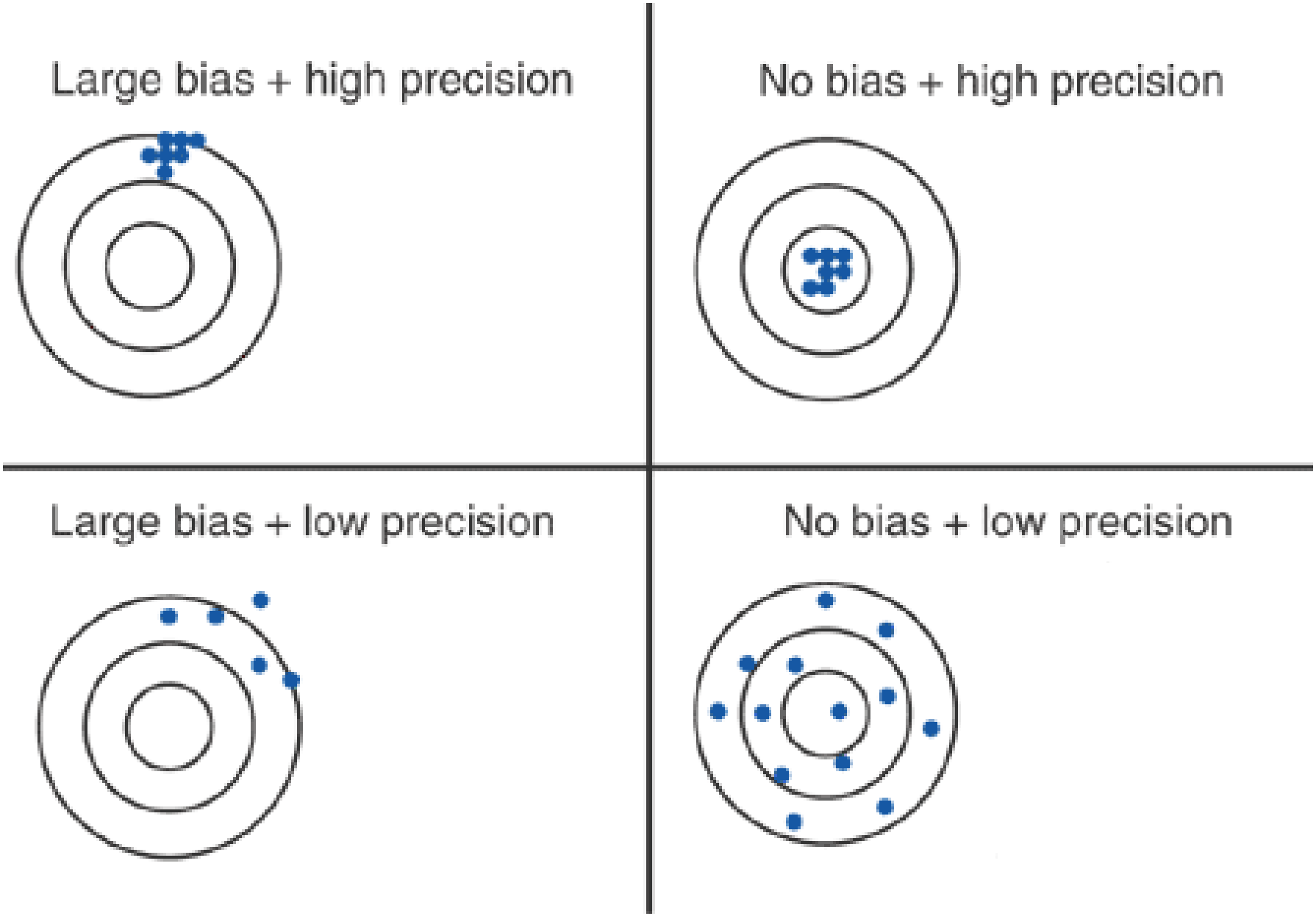

Female

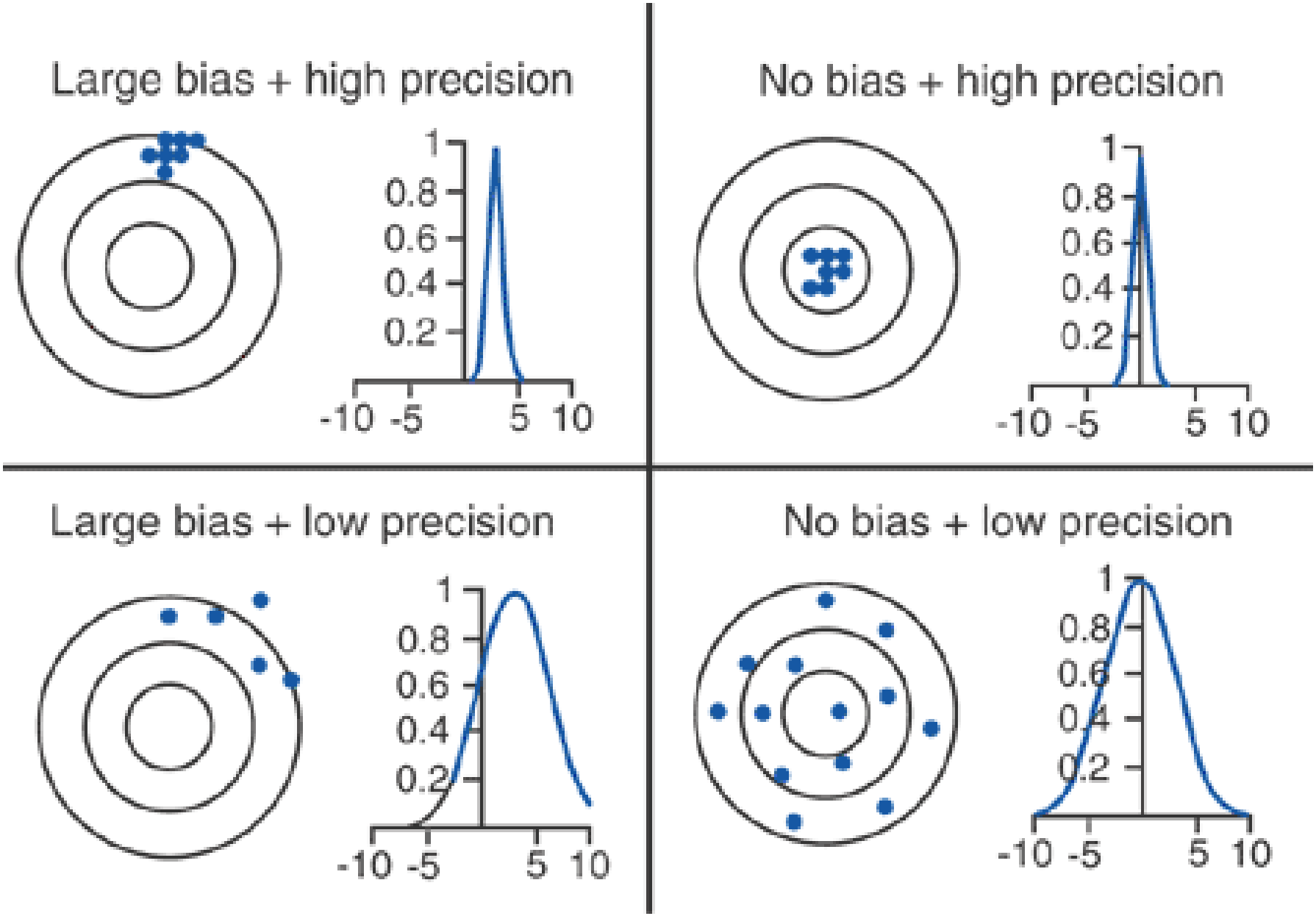

Female


Female


Female


No bias + high precision


Large bias + high precision
No bias + high precision
Large bias + low precision
No bias + low precision


Large bias + high precision
No bias + high precision
Large bias + low precision
No bias + low precision
1
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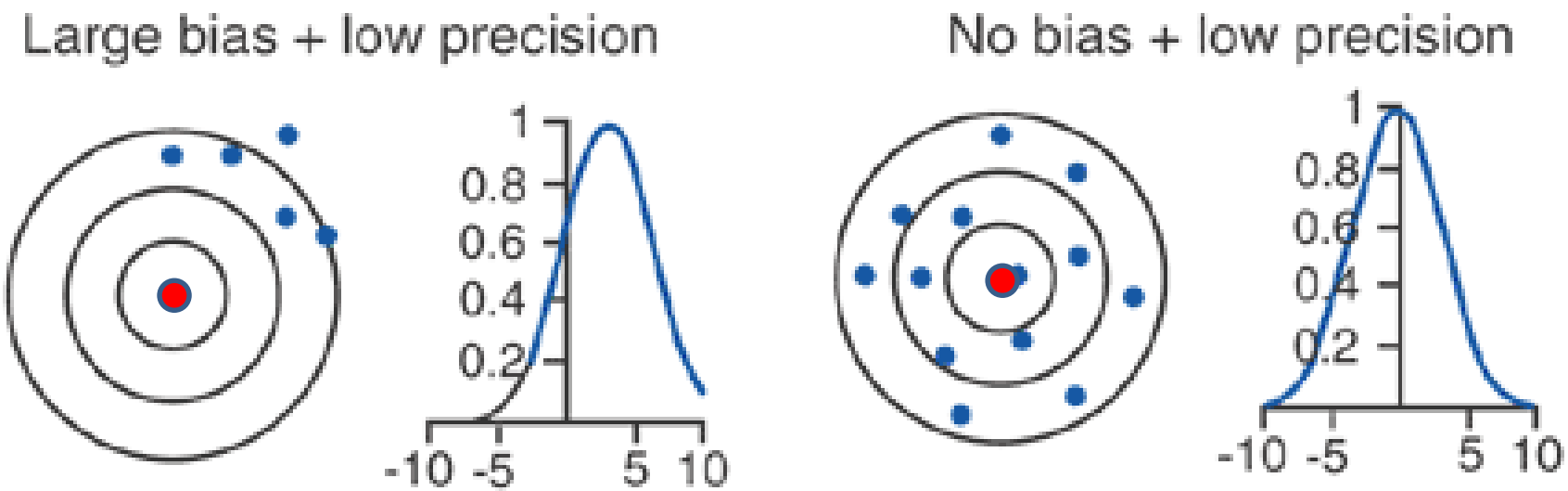
Seize the Second Moment

- <u>Variance (σ^2)</u> $= (1/n-1) \sum_{i=1}^{n} (x_i - \bar{x})^2$



Seize the Second Moment

- <u>Variance (σ^2)</u> $= (1/n-1) \sum_{i=1}^{n} (x_i - \bar{x})^2$

- <u>Confidence interval</u> $= \bar{x} \pm 1.96(\sigma/\sqrt{n})$