4DEEr: Incorporating 4DEE into a deer-based figure set

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Learning Objective

Overall: Students will use data visualizations to determine the ecological and human dimensions of white-tailed deer management.

- ❖ Set 1: Impact of high deer densities on the ecosystem
- ❖ Set 2: Outcome of deer management
- ❖ Set 3: Management choices

Figure Set	Student-active Approach	Cognitive Skill
1. Ecological effects of high deer density on biotic and abiotic forest factors. (Rooney et al. 2000; McShea and Rappole 2000; Woods et al. 2019)	Turn-to-your-neighbor	Comprehension, interpretation, application, analysis
2. Outcomes of deer management	Visual analysis, informal group work, making predictions	Comprehension, interpretation, analysis, synthesis
3. Management choices (Chase et al. 2002; Merrill et al. 2006; Peters et al. 2020)	Citizen's argument	Comprehension, interpretation, application, analysis

Augmented 4DEE Dimensions

Core Ecological Concepts:
- ➢ Organisms
  - ❖ Abiotic and biotic features of the environment
- ➢ Population dispersion
  - ❖ Exponential and logistic growth – cycles
- ➢ Community
  - ❖ Species diversity
  - ❖ Competition
  - ❖ Succession
  - ❖ Disturbance
- ➢ Ecosystems
  - ❖ Predation
  - ❖ Regulators
- ➢ Biosphere

Ecology Practices:
- ➢ Natural history
  - ❖ Making observations and connections
- ➢ Fieldwork
  - ❖ Habitat assessment
- ➢ Quantitative reasoning and computational thinking
  - ❖ Data skills –data visualization
  - ❖ Modeling and simulation
- ➢ Working collaboratively
- ➢ Communicating and applying ecology
- ➢ Designing and critiquing investigations
  - ❖ Argument from evidence

Human-Environment Interactions:
- ➢ Human accelerated environmental change – there is no pristine ecosystem nor total equilibrium
  - ❖ Anthropogenic impacts
- ➢ How humans shape and manage the environment
  - ❖ Urban ecosystems, urban ecology, urban-rural gradient
  - ❖ Ecological stewardship
  - ❖ Natural resource management
  - ❖ Conservation biology
- ➢ Ethics
  - ❖ Environmental ethics

Cross-cutting Themes:
- ➢ Systems
- ➢ Spatial & Temporal
  - ❖ Scales

Set 1: Establishing effects on biotic and abiotic forest factors.
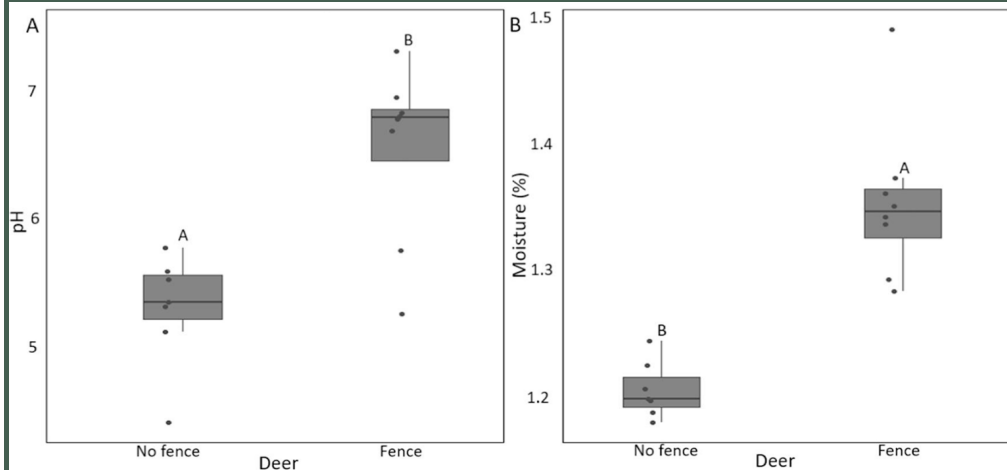

Figure 1c. Box and whisker plot of soil pH (A) and percent soil moisture (B) with bars representing a 95% confidence interval where deer are present (No fence) or absent (Fence) superimposed on the raw data values. Letters indicate the difference between averages in treatments based on Tukey's post hoc comparison (P < 0.05). (Figure modified from: Woods et. al, 2019)

1. Why do you think the researchers chose to display this data with a box and whisker plot? Could they have used any other data visualizations?
2. What conclusion can you draw regarding the effect of deer on soil physicochemical properties?
3. What consequences might this have for forests with high deer densities?
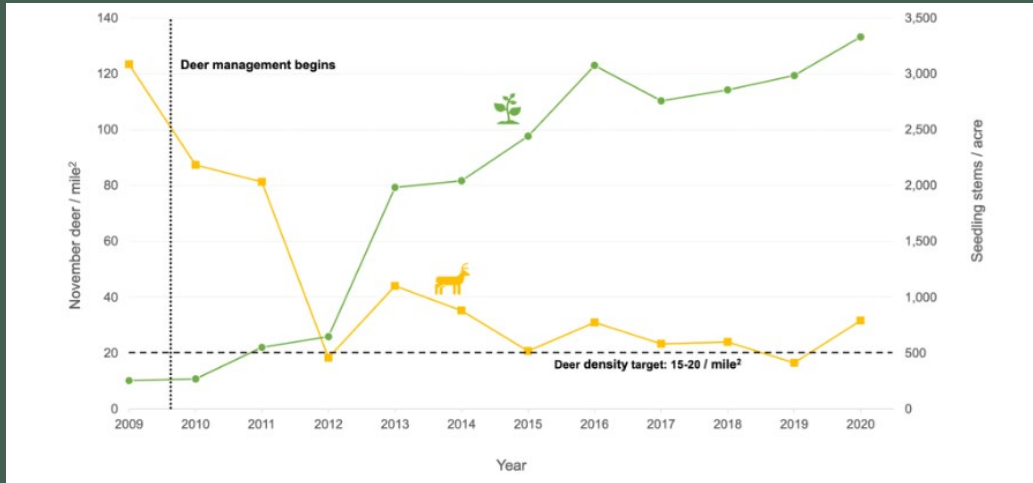
Set 2: Outcomes of deer management

Figure 2b: The relationship between seedling numbers and deer population density in Catoctin Mountain Park. (Graph from Weinberg McClosky, Jessica. Case Studies in Deer Management: What's worked to support forest regeneration in eastern national parks, what hasn't, and what's next? National Park Inventory & Monitoring ND. Retrieved July 16, 2023). https://storymaps.arcgis.com/stories/5b5fe3b82f664093ad435040724706ef

1. **Describe** the two graphs. How are they similar? How are they different?
2. What **conclusion** can you draw regarding the effect of deer management on seedling number?
3. What **predictions** would you make about sustainable forest regeneration in the future in these two forests? Brainstorm **challenges** that could potentially impact forest regeneration. What information would you need to make a more informed conclusion?
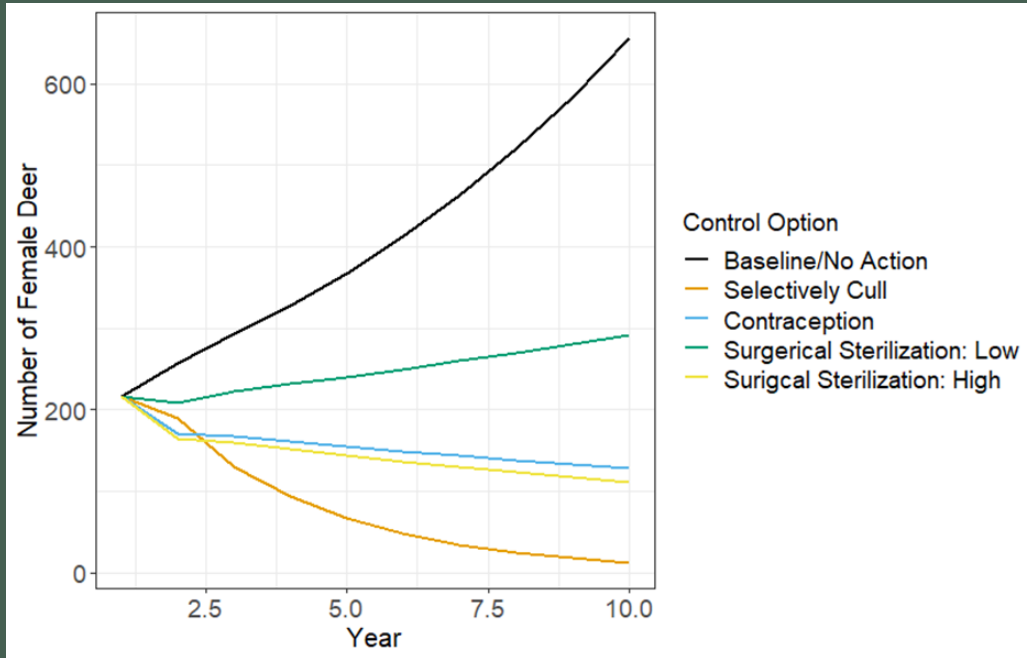
Set 3: Management Choices

Figure 3: Ten years of simulated white-tailed deer (*Odocoileus virginianus*) populations in Cayuga Heights, New York, with and without population control methods. Control methods include selective culling, contraception, and surgical sterilization at low (45%) and high (85%) capture successes. The relative impact of no direct population control methods is indicated by "Baseline/No Action."

3. Which control method had the largest relative impact on deer population size in the simulations?

4. Do you think that future deer populations will match the numbers in this figure? Why or why not?

Add citizen survey data …

After 10 minutes, each Deer Committee should select a delegate to orally present the group's reasoning behind selecting a management option. After each group has presented, we will then attempt to come to a consensus as a class. If a consensus cannot be reached, the class will vote on a control option.

Thoughts on the process

- Valuable to have collaborators
- Helpful to ID existing dimensions which allows you to fill in areas where lacking
- Viewing the set as a "story" helped us focus and align our 3 parts

Challenges:
- Difficult to construct a product that meets the needs of majors and non-majors
    - Ultimately focused on majors but non-majors could still take a piece

Questions?

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