Short Performance Assessment: **HS-LS2-1**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**Black-Footed Ferrets**		
Designed by Modified by	NextGen Storylines Glen Cochrane, Kevin Talento, and Maria Zambuto	Course(s)	**High School Life Science**

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Performance Expectation	**HS-LS2-1**: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. **Clarification Statement**: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets. **Assessment Boundary**: Assessment does not include deriving mathematical equations to make comparisons.

Science and Engineering Practice	**Using Mathematics and Computational Thinking** • Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
Disciplinary Core Ideas	**LS2.A: Interdependent Relationships in Ecosystems** • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
Crosscutting Concept	**Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Student Performance	1. Representations 2. Mathematical and/or computational modeling 3. Analysis

[1] The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project http://snapgse.stanford.edu/

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Name_____

Black-Footed Ferret/ el Hurón de Patas Negras

Targeted PE: HS-LS2-1

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]

Phenomenon Description:

The Black-Footed Ferret (see figure 1) is an endangered species. Scientists call it “America’s cutest assassin” because they have large teeth and are very effective in killing prairie dogs. A lot of people consider prairie dogs (see figure 2) and their burrows problematic, therefore, protecting ferrets is important in environments where there is a large population of prairie dogs.



Figure 1. Black Footed Ferrets



Figure 2. Prairie Dogs next to a burrow.

Scientists are trying to increase the number of Black-Footed Ferrets living in the wild at select sites in the Great Plains shown on the map below (see figure 3). Black Footed Ferrets have been reintroduced at more than 11 sites in North America. The scientists chose these areas because they have large populations of prairie dogs. The prairie dogs mainly eat grasses and short shrubs that are common in the Great Plains.

Image on right is Figure 1 from Jachowski et al (2011)

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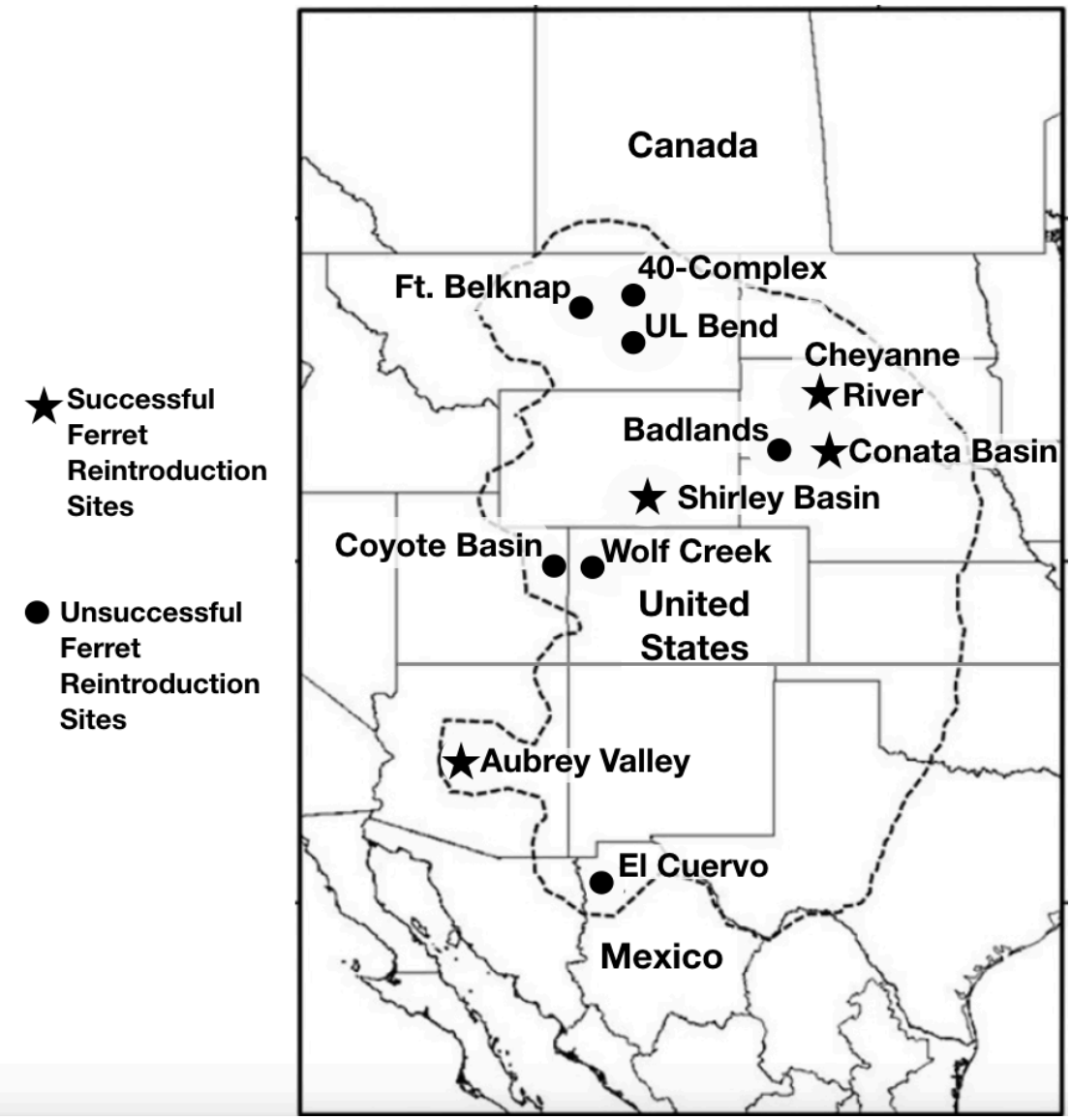


Figure 3. Map of Black Footed Ferret Reintroduction Sites

Scientists have been collecting data for several years on the number of prairie dogs and ferrets in these areas, the amount of precipitation these areas receive, and the number of plague events.

On the following page, Table 1 shows data for each of the 11 sites the scientists studied.

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Table 1. Ferret Reintroduction Site Data

Site Data			Prairie Dog Data			Ferret data	
FACTORS							
Ferret Reintroduction Site Name	**Mean Yearly Rainfall (in)**	**Site Area (ha)**	**No. of Prairie Dog Colonies per Site**	**Mean Prairie Dog Colony Size**	**Avg. Relative Prairie Dog Biomass per Site**	**No of Ferrets 2 Yrs. Post Re-introduction**	**Successful Site**
40-complex	14.75	1382.09	7	69.39	0.0098	0	No
Aubrey Valley	21.86	10985.14	32	251.59	0.4618	66	Yes
Shirley Basin	18.53	7739.61	98	312.17	1	239	Yes
Badlands	13.78	2414.05	45	955.22	0.1407	22	No
Cheyanne River	21.72	15868.47	33	1792.67	0.6895	75	Yes
Conata Basin	16.29	3033.17	56	121.15	0.2216	239	Yes
Coyote Basin	9.76	6163.66	13	67.21	0.1030	11	No
El Cuervo (MX)	9.71	6721.83	65	100	0.0574	17	No
Ft. Belknap	14.75	100.43	22	227.18	0	0	No
Wolf Creek	14.3	559.87	7	6876.62	0.0022	13	No
UL Bend	11.66	9815.24	4	1724.16	0.0489	10	No

Source: Jachowski, D. S., Gitzen, R. A., Grenier, M. B., Holmes, B., & Millspaugh, J. J. (2011)

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Prompt 1:
1. The scientists collected the data in order to determine what factors are most important in explaining why some ferret reintroduction sites were more successful than others. What should they conclude from the data?

- Be sure to name factors that were **and** were not important, and
- Justify your answer in terms of the data presented in **Table 1**

Unimportant Factors	Important Factors
Factor: Justification:	Factor: Justification:
Factor: Justification:	Factor: Justification:

Prompt 2:
2. In the table above, what data are necessary to determine the carrying capacity of ferrets in an area of a given size?

a. Prairie dog biomass, number of prairie dog colonies, and site area
b. Prairie dog biomass, number of prairie dog colonies, and average colony size
c. Number of prairie dog colonies
d. Site area

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Prompt 3:

3a. Using the data found in table 1, calculate the **total quantity of prairie dogs** in the following two site areas:

Coyote Basin:

Shirley Basin:

3b. Determine the **proportion of prairie dogs to ferrets** in the following two site areas:

Coyote Basin:

Shirley Basin:

Prompt 4

4. On the basis of the data in the chart, what do you predict would be the effect of a change in rainfall in Coyote Basin? Justify your answer.

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Prompt 5:
The scientists have continued to study a new area in Montana near the current Montana site, and they want to predict how many ferrets could occupy this area. Here are some facts about the new area.

- Annual Rainfall - 17.59 inches
- Area - 4600 hectares
- Number of prairie dog colonies on site - 48
- Prairie dog colony size on site - 473.24
- Relative Prairie Dog Biomass - 0.3221

5. Using the data you already have, make a prediction about whether this is likely to be a successful reintroduction site. Explain your reasoning.

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Source of Phenomenon Evidence Used:

Jachowski, D. S., Gitzen, R. A., Grenier, M. B., Holmes, B., & Millspaugh, J. J. (2011). The importance of thinking big: large-scale prey conservation drives black-footed ferret reintroduction success. *Biological Conservation*, *144*(5), 1560-1566. Linked Below:
https://ac.els-cdn.com/S0006320711000474/1-s2.0-S0006320711000474-main.pdf?_tid=8764ee3b-887b-4f05-b7ce-678f9a6fe382&acdnat=1539966175_4674fbe0ce7b05a84b0f2f7ddf6690a8

Jachowski, D. S., & Lockhart, J. M. (2009). Reintroducing the black-footed ferret Mustela nigripes to the Great Plains of North America. *Small Carnivore Conservation*, *41*(15), 58-64.
https://www.researchgate.net/profile/David_Jachowski/publication/228484317_Reintroducing_the_black-footed_ferret_Mustela_nigripes_to_the_Great_Plains_of_North_America/links/53fb2e640cf2e3cbf5660971.pdf

Jachowski, D. (2014). *Wild Again: The Struggle to Save the Black-footed Ferret*. Univ of California Press.
https://www.amazon.com/Wild-Again-Struggle-Black-Footed-Ferret/dp/0520281659

New York Times Article - *In Kansas, a Line Is Drawn Around a Prairie Dog Town. (2011). Felicity Barringer*
https://www.nytimes.com/2006/12/11/us/11prairiedogs.html

In case we need to create our own data, there is a simple R program for us to use

Jachowski, D. S., Rota, C. T., Dobony, C. A., Ford, W. M., & Edwards, J. W. (2016). Seeing the forest through the trees: considering roost-site selection at multiple spatial scales. *PloS one*, *11*(3), e0150011.
https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0150011&type=printable

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