

UND Wildlife at Home Education Module – High School

Lesson Title – Impacts of Gas and Oil on Nest Success of Sharp-tailed Grouse in Western North Dakota, and the implications for population trends.

By: Chris Felege, Christine Moe, Travis Desell, and Susan Felege

Pre assessment – How do changes to the physical and biological components of an ecosystem affect populations?

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| Brief Description |  | Core Ideas |
| Primary Standard Addressed | **HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.] | **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. (HS-LS2-1),(HS- LS2-2) |
| Supporting Standard(s) | **Engaging in Argument from Evidence**  Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.  Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)  Evaluate the evidence behind currently accepted explanations to | **Connections to Nature of Science**  **Scientific Knowledge is Open to Revision in Light of New Evidence**  Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS- LS2-2),(HS-LS2-3)  Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6),(HS-LS2-8) |
| Pre-assessment |  | 1. Please see prequiz below. |
| Part 1: Background | Introduce students to background information about Sharp-tailed Grouse and their history on the ND Landscape using the *Background Information* handout below. Look at the three maps showing areas of high gas and oil development (Belden), moderate gas and oil development (Lostwood), and low gas and oil development (Blaisdell). |  |
| Part 2: Brainstorm | Have students construct 3 lists one the first student handout. The first should be a list of what impacts they think gas and oil development will have on Sharp-tailed Grouse in Western North Dakota. The second should be a list of what they think the impacts of gas and oil development will be on the predators of Sharp-tailed Grouse.  The third should be a list of reasons why they think nest success is or is not a good way to predict population growth. |  |
| Goal and Objective #1: Identify study sites as an area of “High” Medium” or “Low” gas and oil development. | Please have students examine the map labeled “oilpads\_nest2(jpg), and determine which study site (Blaidell, Belden, or Lostwood) is an area of High intensity gas and oil development, Medium intensity gas and oil development, or Low intensity gas and oil development. | KEY – Belden is High intensity gas and oil development, Blaisdell is Medium intensity gas and oil development, and Lostwood is low intensity gas and oil development. |
| Goal and Objective #2 | There are 5 different data sets in this educational module. They include Belden 2012 (Bel 2012), Belden 2013 (Bel 2013), Blaisdell 2012 (Bla 2012), Blaisdell 2013 (Bla 2013), and Lostwood 2012 (Lost 2012)   * Students will use collected video data to…  1. Classify nest fate 2. Calculate apparent overall nest success and overall apparent nest failure rates 3. Calculate ratios of different predators depredating videoed nests | Key for nest fate classification by video is shown on Instructor Handout 1, along with nest success and predation classification ratios. |
| Assessment #1 | See Student handout 1 below  Students should watch each short video clip for their study site and record the fate of the nest, or the identity of the predator on Student Handout 1.  After watching all of the videos for their study site (we recommend assigning one study site to each group of students), that group should complete the following calculations: Overall nest success rate and nest failure rate.  Rate of failure due to all predators identified. Answer keys are provided on the Instructor Handout | Compare student classifications and calculations to the answer key on the Instructor Handout. |

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| Goal and Objective #3 | Have students examine the maps showing nest locations and well locations.  Students will then compare their classified and calculated results for different study locations relative to intensity of gas and oil development to determine if…   1. Nest success varies based on differing intensities of gas and oil development 2. If predators vary based on varied intensities of gas and oil development |  |
| Assessment #2 | 1. Does nest success vary based on differing intensities of gas and oil development? 2. Do predators vary based on varied intensities of gas and oil development 3. Extension: evaluate the critical thinking question posed to students about why this might be. | 1. Yes. Charts on the Instructor Key show 23/29 nests hatching in areas with intense gas and oil development (Bel), 18/36 in areas with moderate gas and oil development (Bla), and 8/11 in areas with low gas and oil development (Lost). 2. Yes, Bla (Medium intensity gas and oil development) has the highest number and diversity of predation events. 3. Answers will vary. |
| Pause and debrief | At this point, using JUST the metric of apparent nest success it would appear that intense gas and oil (79.3% nest success) has higher nest success than moderate (50.0% success), or low intensity (72.7% success) gas and oil development. | Is apparent nest success the best, or only, method of evaluating what a population of Sharp-tailed Grouse is doing?  Students should be asked to brainstorm this. Hopefully they will generate ideas that resemble the thought that no, just because an egg hatches does not mean the individual will be recruited into the population. We need to know if the chicks survive to adulthood.  This can be done using “flush counts”, where a biologist tracks a radio collared hen, and “flushes” her, or gets her to run/fly, to see if her brood has survived. |
| Goal and Objective #3 | “Nest success” is one method used by biologists to estimate “recruitment”, or number of individuals who will be born and grow to successfully enter a population of interest. However, just because a single egg hatches from a nest does not mean that this is a good measure of what is happening to the population overall. So, is this a good indicator to determine if a population is growing, shrinking, or staying the same? |  |
| Assessment #3 | Have students examine the summary data tables provided about chick survival, and calculate overall summaries for each study site.   1. Is there a difference in chick survival between High, Medium, and Low gas and oil development intensity? 2. Why might this be? 3. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall in areas like Belden where there is intense gas and oil development? 4. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall areas like Blaisdell or Lostwood where there is moderate gas and oil development that is expected to progressively become more intense? 5. Based on the findings above is nest success the best metric for what is happening to the population of Sharp-tailed Grouse in western North Dakota? | See Instructor Key for answers   1. Yes. The High intensity area (Bel) had 20.7% chick survival, Medium (Bla) had 47.2% chick survival,and Low (Lost) had 45.5% chick survival. 2. Ans will vary. 3. We would expect them to decrease. 4. Increase or stay steady 5. No, we need to account for survival after hatching. |
| Goals and Objectives #4 – examine the long term impacts of what is happening | 1. In North Dakota, Natural Resources are the third largest part of the economy. Hunting, fishing, and other related activities associated with ***renewable*** resources are estimated to account for roughly $70 million dollars each year in the state. Oil and gas are ***nonrenewable*** resources; once they are used up, they will be gone for good. Based on this fact, do you think that laws or regulations should be in place to limit the rate and or intensity of gas and oil development? Explain your answer. 2. Is there a pattern you notice based on number of chicks flushed, in addition to number of hens flushed with chicks, that might shed further insight about production and recruitment of individuals into the population based on sight/intensity of gas and oil development? 3. Propose a method for handling or dealing with this pattern. | 1. Answers will vary but hopefully yes. Balancing human we needs for energy and economic development needs to be handled in a sustainable fashion that preserves the renewable resources we have for future generations. 2. Not only are there are a higher proportion of hens with chicks in medium and low intensity gas and oil areas, but they also tend to have more chicks (higher survival rate). 3. Students can propose a number of solutions to this, but in general, the best and likely most common way would be to average the number of chicks per flush, the number of chicks total. Both will support the observation in #6 above. |

Prequiz Middle School – HS –LS2-2

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

1. Would increased gas and oil production in western North Dakota increase, decrease, or have no effect on the populations of organisms who live that region?
2. Would monitoring the success or failure rates of nests be the most effective method to make inferences about the populations of a bird species in areas undergoing gas and oil development? Yes No I don’t know
3. If you answered No or I don’t know above, what other methods could be considered?
4. What are some ways we can classify areas undergoing gas and oil development?
5. How can I classify and calculate apparent nest success?
6. What would be the proportion and percent of apparent nest success and failure in a species of bird where 10 nests were monitored, 4 hatched successfully, and 6 were depredated?
7. Does an increase in number or types of predators always mean that a prey species will decrease in number? Yes No I don’t know
8. Just because a chick hatches from an egg, does this mean it will survive to join the population as a breeding member the next season? Yes No I don’t know.
9. Would higher nest success (proportions of nests that have at least one chick hatch) always have better population growth overall than areas with lower nest success? Yes No I don’t know
10. Should there be a balance between human use and consumption of renewable and nonrenewable resources? Explain your answer please.

Student Handout – Wildlife at Home Middle school education module

We will seek to answer the following questions using real-world, real-life data from a collaborative project between the University of North Dakota and North Dakota Game and Fish.

Part 1 - Brainstorm some predictions in the space below to the following questions.

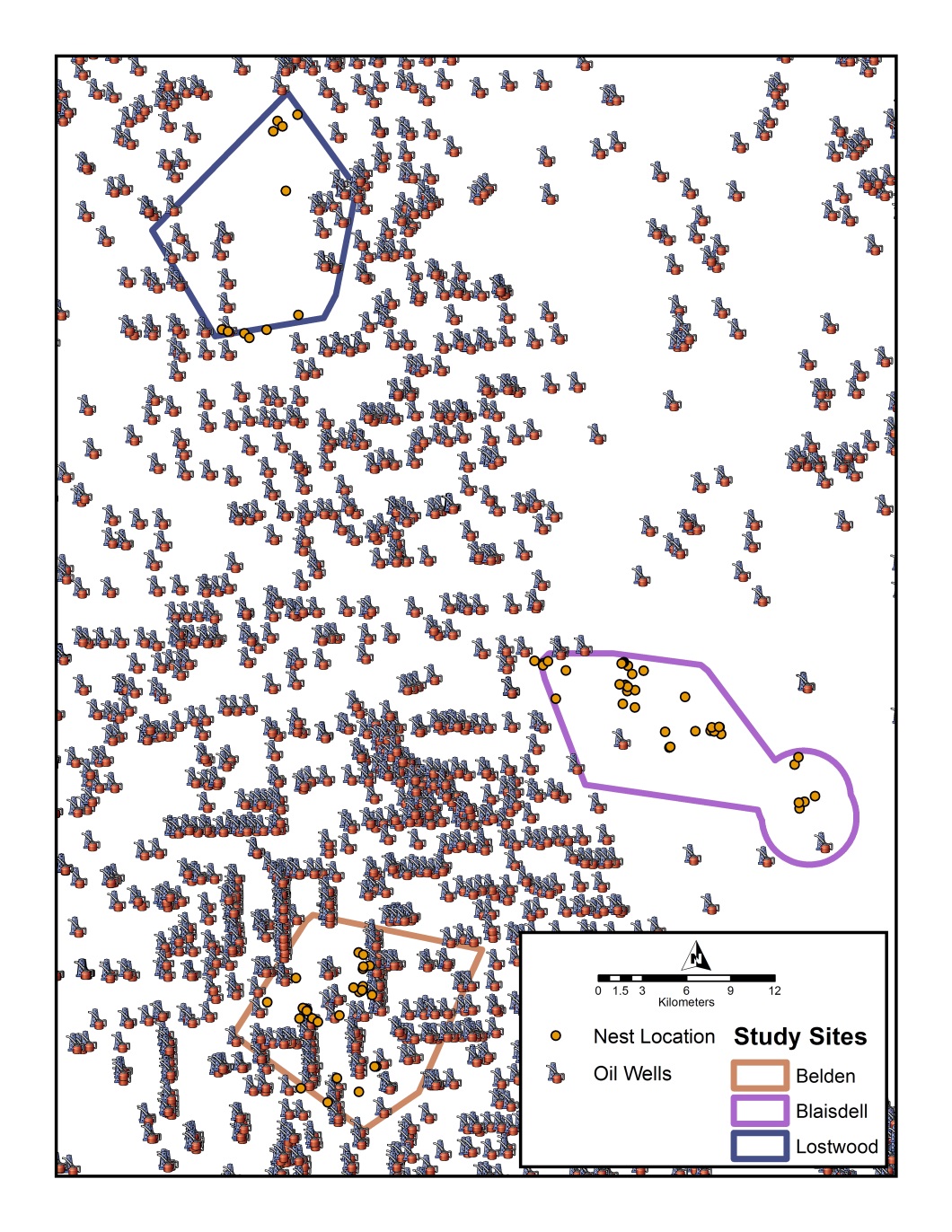
#1. What impact(s) do you think gas and oil development will have on Sharp-tailed Grouse in Western North Dakota?

#2. What do you think the impact of gas and oil development will be on the population of predators who prey on Sharp-tailed Grouse in Western North Dakota?

#3. Some scientists believe that monitoring nesting birds to see what percentage of nests have at least a single egg hatch is an effective way to determine what the population is doing (growing, shrinking, or staying stable). This is called “apparent nest success”. Other scientists believe that more data is needed because apparent nest success only tells you how many nests had at least a single egg hatch. These scientists argue that to determine what a population is doing, you need to know how well the chicks survive after they hatch. Do you think that apparent nest success is an effective method of monitoring a population like Sharp-tailed grouse?

Part 2 – Goal and Objective #1

Next, look at the map below, and classify the three study sites as either High intensity, Medium Intensity, or Low intensity gas and oil development.



|  |  |
| --- | --- |
| Study Site | Classification |
| Belden |  |
| Blaisdell |  |
| Lostwood |  |

Goal and Objective #2A - Next, please select (or have your teacher assign) one of the 5 data sets, including Belden 2012 (Bel 2012), Belden 2013 (Bel 2013), Blaisdell 2012 (Bla 2012), Blaisdell 2013 (Bla 2013), and Lostwood 2012 (Lost 2012). You will then watch a series of videos collected from nesting Sharp-tailed grouse, and attempt to classify the fate of each nest by identifying if it was successful (had at least one chick hatch), or if it was depredated (eaten by a predator). If the nest was depredated, please identify the predator that ate the eggs. Fill in the table below using the videos you watch from each study site. Once done, exchange data with other groups for the other 4 study sites so that everyone has all data from all 5 sites. This will be used in the 2B to calculate apparent next success, and n 2C to calculate ratios of different predators by site.

|  |  |  |
| --- | --- | --- |
| Folder | File | Description |
| Bel 2012 |  |  |
|  | 148.954\_48.11126\_102.440147.wmv |  |
|  | 149.085\_48.06332\_102.44829.wmv |  |
|  | 149.495\_48.05411\_102.4242.wmv |  |
|  | 149.723\_48.12235\_102.38943.wmv |  |
|  | 149.733\_48.06872\_102.41512.wmv |  |
|  | 149.772\_48.11158\_102.44098.wmv |  |
|  | 149.783\_48.12148\_102.39020.wmv |  |
|  | 149.801\_48.07501\_102.3787.wmv |  |
|  | 149.823\_48.0599\_102.39538.wmv |  |
|  | 149.892\_48.12108\_102.39192.wmv |  |
|  | 150.462\_48.10577\_102.43574.wmv |  |
|  |  |  |
| Bel 2013 |  |  |
|  | 148.203\_48.13689\_102.38178.wmv |  |
|  | 148.222\_48.11228\_102.44405.wmv |  |
|  | 149.052\_48.13511\_102.38803.wmv |  |
|  | 149.554\_48.11663\_102.47623.wmv |  |
|  | 149.573\_48.1223\_102.3886.wmv |  |
|  | 149.573\_48.12436\_102.38857.wmv |  |
|  | 149.744\_48.145075\_102.39126.wmv |  |
|  | 149.783\_48.12209\_102.38947.wmv |  |
|  | 149.793\_48.14372\_102.38706.wmv |  |
|  | 149.801\_48.075062\_102.380261.wmv |  |
|  | 149.823\_48.13639\_102.3874.wmv |  |
|  | 150.242\_48.11884\_102.38034.wmv |  |
|  | 150.261\_48.11042\_102.44061.wmv |  |
|  | 150.342\_48.10705\_102.41093.wmv |  |
|  | 150.432\_48.10356\_102.430624.wmv |  |
|  | 151.564\_48.1238\_102.39722.wmv |  |
|  | 151.644\_48.13074\_102.44943.wmv |  |
|  | 151.675\_48.10591\_102.44745.wmv |  |
|  |  |  |
| Bla 2012 |  |  |
|  | 148.574\_48.27494\_102.05381.wmv |  |
|  | 149.514\_48.27065\_102.05257.wmv |  |
|  | 149.523\_48.30938\_102.13190.wmv |  |
|  | 149.704\_48.31793\_102.21283.wmv |  |
|  | 149.744\_48.31460\_102.13560.wmv |  |
|  | 149.851\_48.27302\_102.07603.wmv |  |
|  | 150.011\_48.26365\_102.10049.wmv |  |
|  | 150.022\_48.30297\_102.13860.wmv |  |
|  | 150.101\_48.29605\_102.20289.wmv |  |
|  | 150.121\_48.31679\_102.21333.wmv |  |
|  | 150.183\_48.31303\_102.19262.wmv |  |
|  | 150.202\_48.29144\_102.14163.wmv |  |
|  | 150.232\_48.29914\_102.13702.wmv |  |
|  | 150.261\_48.28890\_102.13067.wmv |  |
|  | 150.441\_48.29417\_102.08427.wmv |  |
|  | 150.592\_48.31908\_102.20883.wmv |  |
|  | 150.742\_48.29950\_102.12988.wmv |  |
|  | 150.761\_48.27290\_102.06213.wmv |  |
|  | 150.781\_48.30264\_102.13810.wmv |  |
|  | 151.564\_48.27240\_102.05879.wmv |  |
|  | 151.664\_48.27504\_102.06100.wmv |  |
|  |  |  |
| Bla 2013 |  |  |
|  | 148.083\_48.316793\_102.139091.wmv |  |
|  | 148.144\_48.223319\_102.983576.wmv |  |
|  | 148.183\_48.227321\_101.978768.wmv |  |
|  | 148.333\_48.250338\_101.986414.wmv |  |
|  | 148.603\_48.275052\_102.054266.wmv |  |
|  | 149.103\_48.301747\_102.136489.wmv |  |
|  | 149.433\_48.230512\_101.968899.wmv |  |
|  | 149.483\_48.303390\_102.143740.wmv |  |
|  | 149.535\_48.264052\_102.099581.wmv |  |
|  | 149.584\_48.273320\_102.103740.wmv |  |
|  | 149.863\_48.311217\_102.121439.wmv |  |
|  | 149.973\_48.316282\_102.140299.wmv |  |
|  | 150.292\_48.254638\_101.982571.wmv |  |
|  | 150.452\_48.226955\_101.983856.wmv |  |
|  | 151.632\_48.316050\_102.141333.wmv |  |
|  | 151.654\_48.319730\_102.221072.wmv |  |
|  |  |  |
| Lost 2012 |  |  |
|  | 148.043\_48.52878\_102.49752.wmv |  |
|  | 148.473\_48.65523\_102.43999.wmv |  |
|  | 149.503\_48.65188\_102.43567.wmv |  |
|  | 149.554\_48.52755\_102.49201.wmv |  |
|  | 149.564\_48.61229\_102.43444.wmv |  |
|  | 149.654\_48.64902\_102.44421.wmv |  |
|  | 150.512\_48.53613\_102.42688.wmv |  |
|  | 150.622\_48.52777\_102.45663.wmv |  |
|  | 150.832\_48.52606\_102.47702.wmv |  |
|  | 151.632\_48.65865\_102.42151.wmv |  |
|  | 151.683\_48.52316\_102.47265.wmv |  |

Goal and Objective 2B – Using the data above, calculate apparent overall nest success for each site, and overall apparent nest failure rates for each site for each year. Fill this out in the space below. Calculations for each site can be done by doing the following:

1. Count the total number of nests by site that were monitored.
2. Count the number of nests that were successful.
3. Count the number of nests that were depredated.
4. Divide #2 / #1 to get apparent nest success rates.
5. Divide #3 by #1 to get apparent nest failure rates.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bel 2012 |  | proportion | percent |  | Bel 2013 |  | proportion | percent |
| Success |  |  |  |  | Success |  |  |  |
| Depredated |  |  |  |  | Depredated |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Bla 2012 |  | proportion | percent |  | Bla 2013 |  | proportion | percent |
| Success |  |  |  |  | Success |  |  |  |
| Depredated |  |  |  |  | Depredated |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Lost 2012 |  | proportion | percent |  |  |  |  |  |
| Success |  |  |  |  |  |  |  |  |
| Depredated |  |  |  |  |  |  |  |  |

Next, combine the data for both years for Belden (Bel 2012 and 2013), and use this to fill in the first table, Bel Total. Do the same for Blaisdell, and fill in the second table (Bla Total). You can copy the data from Lostwood because severe snowfall and lack of resources combined to prevent any data from being collected in 2013 at that study site.

|  |  |  |  |
| --- | --- | --- | --- |
| Bel Total |  | proportion | percent |
| Success |  |  |  |
| Depredated |  |  |  |
|  |  |  |  |
| Bla Total |  | proportion | percent |
| Success |  |  |  |
| Depredated |  |  |  |
|  |  |  |  |
| Lost Total |  | proportion | percent |
| Success |  |  |  |
| Depredated |  |  |  |

Based on the above, do differences in the intensity of gas and oil development seem to have an impact on the nest success of Sharp-tailed Grouse?

How does this align with your prediction in the Part 1 Brainstorm above?

Goals and Objectives 2C – Calculate the ratios of different predators depredating nests. Go back to your data where you attempted to identify the predators that were depredating nests. Use this information to fill out the summary tables in the space below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel 2012 |  |  |  | Bel 2013 |  |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching |  |  |  | Chicks Hatching |  |  |
| Badger |  |  |  | Badger |  |  |
| Skunk |  |  |  | Skunk |  |  |
| Hawk |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Bla 2012 |  |  |  | Bla 2013 |  |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching |  |  |  | Chicks Hatching |  |  |
| Hawk |  |  |  | Skunk |  |  |
| Skunk |  |  |  | coyote |  |  |
| Coyote? |  |  |  | badger |  |  |
| Fox |  |  |  | Raccoon |  |  |
| Badger |  |  |  |  |  |  |
| Raccoon |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Lost 2012 |  |  |  |  |  |  |
| Fates: | Proportion | Percent |  |  |  |  |
| Chicks hatching |  |  |  |  |  |  |
| Raccoon |  |  |  |  |  |  |
| Badger |  |  |  |  |  |  |
| Unknown |  |  |  |  |  |  |

Now use the above data to create summarized data tables in the space below like you did above for the Success and Depredated Totals.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel Total |  |  |  | Bla Total | |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching |  |  |  | Chicks hatching |  |  |
| Badger |  |  |  | Hawk |  |  |
| Skunk |  |  |  | Skunk |  |  |
| Hawk |  |  |  | Coyote? |  |  |
|  |  |  |  | Fox |  |  |
| Lost Total |  |  |  | Badger |  |  |
| Fates: | Proportion | Percent |  | Raccoon |  |  |
| Chicks hatching |  |  |  |  |  |  |
| Raccoon |  |  |  |  |  |  |
| Badger |  |  |  |  |  |  |
| Unknown |  |  |  |  |  |  |

Use the above to answer the following questions:

1. Which site had the most diversity in the number and/or type of predators?
2. Look back the map (oilpads\_nests(2).jpg). One of the biologists involved in this project hypothesized that the reason Blaisdell has the highest number and diversity of predators was because the predators were essentially being pushed out of areas that had intense gas and oil development, and into surrounding, less pressured areas. Do you agree, why or why not?
3. What data or evidence would you like to test the above hypothesis?

Pause and Debrief

Goals and Objectives #3 - At this point, using JUST the metric of apparent nest success it would appear that intense gas and oil (79.3% nest success) has higher nest success than moderate (50.0% success), or low intensity (72.7% success) gas and oil development. Is apparent nest success the best, or only, method of evaluating what a population of Sharp-tailed Grouse is doing?

Brainstorm an answer in the space below.

In order to try and address the question of chick survival, biologists conducted what are called “flush counts”, where a biologist tracks a radio collared hen, and “flushes” her, or got her to run/fly, to see if her brood of chicks has survived. Data for this is summarized in the tables below. The last date where information was available for each hen was used to construct the following tables. Use this information to calculate summary data at the end of this section.

|  |  |  |
| --- | --- | --- |
| Bel 2012 | Date | Notes |
| 148.954\_48.11126\_102.440147.wmv | 27-Sep | \*\*1 chick |
| 149.085\_48.06332\_102.44829.wmv | 23-Aug | no chicks |
| 149.495\_48.05411\_102.4242.wmv | 14-Aug | \*\*1 chick |
| 149.723\_48.12235\_102.38943.wmv | 6-Jul | Nest Dep |
| 149.733\_48.06872\_102.41512.wmv | 26-Jul | Mortality |
| 149.772\_48.11158\_102.44098.wmv | 1-Sep | \*\*9 chicks |
| 149.783\_48.12148\_102.39020.wmv | 20-Jul | \*\*1 chick |
| 149.801\_48.07501\_102.3787.wmv | 27-Sep | no chicks |
| 149.823\_48.0599\_102.39538.wmv | 23-Aug | No chicks |
| 149.892\_48.12108\_102.39192.wmv | 26-Jul | No chicks |
| 150.462\_48.10577\_102.43574.wmv | 1-Sep | no chicks |

|  |  |  |
| --- | --- | --- |
| Bel 2013 | Date | Notes |
| 148.203\_48.13689\_102.38178.wmv | 26-Oct | no chicks |
| 148.222\_48.11228\_102.44405.wmv | 24-Jul | no chicks |
| 149.052\_48.13511\_102.38803.wmv | 5-Aug | \*\*4 chicks |
| 149.554\_48.11663\_102.47623.wmv | 26-Jul | no chicks |
| 149.573\_48.1223\_102.3886.wmv | 5-Jul | No chicks |
| 149.573\_48.12436\_102.38857.wmv | 5-Jul | No chicks |
| 149.744\_48.145075\_102.39126.wmv | 31-Jul | \*\*4 chicks |
| 149.783\_48.12209\_102.38947.wmv | 13-Jun | no chicks |
| 149.793\_48.14372\_102.38706.wmv | 31-Jul | no chicks |
| 149.801\_48.075062\_102.380261.wmv |  | No data |
| 149.823\_48.13639\_102.3874.wmv | 5-Aug | no chicks |
| 150.242\_48.11884\_102.38034.wmv | 31-Jul | no chicks |
| 150.261\_48.11042\_102.44061.wmv | 1-Jul | no chicks |
| 150.342\_48.10705\_102.41093.wmv | 17-Jul | no chicks |
| 150.432\_48.10356\_102.430624.wmv |  | No data |
| 151.564\_48.1238\_102.39722.wmv | 5-Aug | no chicks |
| 151.644\_48.13074\_102.44943.wmv | 25-Oct | no chicks |
| 151.675\_48.10591\_102.44745.wmv | 5-Aug | no chicks |

|  |  |  |
| --- | --- | --- |
| Bla 2012 | Date | Notes |
| 148.574\_48.27494\_102.05381.wmv | 13-Jun | \*\*10 Chicks |
| 149.514\_48.27065\_102.05257.wmv | 14-Sep | Mortality |
| 149.523\_48.30938\_102.13190.wmv | 10-Oct | \*\*8 chicks |
| 149.704\_48.31793\_102.21283.wmv | 27-Jul | \*\*1 Chick |
| 149.744\_48.31460\_102.13560.wmv | 2-Aug | no chicks |
| 149.851\_48.27302\_102.07603.wmv | 24-Jul | \*\*Chicks, #unkn |
| 150.011\_48.26365\_102.10049.wmv | 2-Aug | no chicks |
| 150.022\_48.30297\_102.13860.wmv | 9-Jul | \*\*5 chicks |
| 150.101\_48.29605\_102.20289.wmv | 2-Aug | no chicks |
| 150.121\_48.31679\_102.21333.wmv | 6-Jul | \*\* 11 chicks |
| 150.183\_48.31303\_102.19262.wmv | 24-Jul | \*\*Chicks, #unkn |
| 150.202\_48.29144\_102.14163.wmv | 28-Jun | \*\*1 Chick |
| 150.232\_48.29914\_102.13702.wmv | 13-Sep | \*\*flushed w 5 chicks |
| 150.261\_48.28890\_102.13067.wmv | 20-Aug | \*\*Chicks, #unkn |
| 150.441\_48.29417\_102.08427.wmv | 9-Jul | \*\*8 chicks |
| 150.592\_48.31908\_102.20883.wmv | 27-Aug | no chicks |
| 150.742\_48.29950\_102.12988.wmv | 25-Aug | no chicks |
| 150.761\_48.27290\_102.06213.wmv | 14-Sep | no chicks |
| 150.781\_48.30264\_102.13810.wmv |  | No Data |
| 151.564\_48.27240\_102.05879.wmv | 27-Aug | No chicks |
| 151.664\_48.27504\_102.06100.wmv | 23-Aug | No chicks |

|  |  |  |
| --- | --- | --- |
| Bla 2013 | Date | Notes |
| 148.083\_48.316793\_102.139091.wmv | 1-Aug | no chicks |
| 148.144\_48.223319\_102.983576.wmv | 26-Aug | \*\*4 chicks |
| 148.183\_48.227321\_101.978768.wmv | 25-Aug | \*\*4 chicks |
| 148.333\_48.250338\_101.986414.wmv | 5-Jul | no chicks |
| 148.603\_48.275052\_102.054266.wmv | 18-Aug | \*\*Chicks, #unkn |
| 149.433\_48.230512\_101.968899.wmv | 25-Aug | no chicks |
| 149.483\_48.303390\_102.143740.wmv | 5-Jul;25-Jul | no chicks |
| 149.535\_48.264052\_102.099581.wmv | 24-Aug | no chicks |
| 149.584\_48.273320\_102.103740.wmv | 24-Aug | no chicks |
| 149.863\_48.311217\_102.121439.wmv | 7-Aug | No chicks |
| 149.973\_48.316282\_102.140299.wmv | 24-Aug | \*\*2 chicks |
| 150.292\_48.254638\_101.982571.wmv | 12-Jul | \*\*9 chicks |
| 150.452\_48.226955\_101.983856.wmv | 5-Aug | \*\*3 chicks |
| 151.632\_48.316050\_102.141333.wmv | 15-Jul | no chicks |
| 151.654\_48.319730\_102.221072.wmv | 17-Jul | Mortality |

|  |  |  |
| --- | --- | --- |
| Lost 2012 | Date | Notes |
| 148.043\_48.52878\_102.49752.wmv | 19-Jun | Mortality |
| 148.473\_48.65523\_102.43999.wmv |  | No data |
| 149.503\_48.65188\_102.43567.wmv |  | No data |
| 149.554\_48.52755\_102.49201.wmv | 6-Aug | \*\*Chicks, #unkn |
| 149.564\_48.61229\_102.43444.wmv | 2-Jul | \*\*flushed with 1 |
| 149.654\_48.64902\_102.44421.wmv | 23-Aug | No chicks |
| 150.512\_48.53613\_102.42688.wmv | 25-Jul | \*\*flush brood |
| 150.622\_48.52777\_102.45663.wmv | 30-Jul | No chicks |
| 150.832\_48.52606\_102.47702.wmv | 17-Jul | \*\*flushed with 2 chicks |
| 151.632\_48.65865\_102.42151.wmv | 13-Aug | \*\*flushed with 1 chick |
| 151.683\_48.52316\_102.47265.wmv | 19-Jul; 16-Aug | No chicks |

One problem with data like this is that it can be very hard to get an accurate count of the number of chicks with a hen in tall grass or other vegetation. As a result, Biologists usually just ask if at least a single chick survives from the clutch. Using this idea, please calculate the proportion and percent of clutch survival, clutch failure, and unknowns in the tables below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel Total | Proportion | Percent |  | BlaTotal | Proportion | Percent |
| Clutch Survival |  |  |  | Clutch Survival |  |  |
| Clutch Failure |  |  |  | Clutch Failure |  |  |
| unknown |  |  |  | unknown |  |  |
|  |  |  |  |  |  |  |
| Lost Total | Proportion | Percent |  |  |  |  |
| Clutch Survival |  |  |  |  |  |  |
| Clutch Failure |  |  |  |  |  |  |
| unknown |  |  |  |  |  |  |

1. Is there a difference in chick survival between High, Medium, and Low gas and oil development intensity?

2. Why might this be?

3. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall in areas like Belden where there is intense gas and oil development?

4. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall areas like Blaisdell or Lostwood where there is moderate gas and oil development that is expected to progressively become more intense?

5. Based on the findings above is nest success the best metric for what is happening to the population of Sharp-tailed Grouse in western North Dakota? Explain your answer.

6. Is there a pattern you notice based on number of chicks flushed, in addition to number of hens flushed with chicks, that might shed further insight about production and recruitment of individuals into the population based on sight/intensity of gas and oil development?

7. Propose a method for handling or dealing with this pattern.

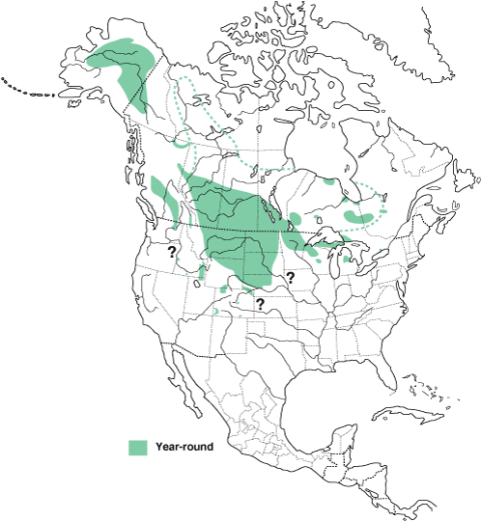
In North Dakota, Natural Resources are the third largest part of the economy. Hunting, fishing, and other related activities associated with ***renewable*** resources are estimated to account for roughly $70 million dollars each year in the state. Oil and gas are ***nonrenewable*** resources; once they are used up, they will be gone for good. Based on this fact, do you think that laws or regulations should be in place to limit the rate and or intensity of gas and oil development? Explain your answer.

Background

Sharp-Tailed Grouse Ecology and Information

Sharp-tailed Grouse (*Tympanuchus phasianellus*) are medium sized, ground-nesting birds who usually weigh an average 880 g (Sibley 2000). This makes them about half the size of a chicken. The coloration is a drab gray-brown mottled with white. Both sexes have horizontal or v-shaped markings on the breast, a slight crest on the head, white spots on the wings, light colored flanks and belly, and feathered legs (Johnson and Knue 1989). Males have purple air sacs on the side of the neck and a yellow comb above the eyes, both of which are only visible during mating season. Wings are short and rounded, used for short bursts of flight followed by gliding. The tail is pale and pointed.

Distribution



Sharp-tailed Grouse can be found from Alaska, east to East Central Canada, south through Michigan, Minnesota and Wisconsin, and west to Southern Colorado and Utah. Sharp-tailed Grouse prefer open, fairly treeless areas that contain a mix of dense grasses, forbs, and shrubs. Habitat is chosen based on openness and plant density (Marks 2007).

Nesting habitat of grouse depends on what is available to them. Some studies have suggested that grouse prefer to nest near areas with taller, denser shrubs. This is not a necessity for a successful nest, as many females will select areas with lower shrub cover but a higher level of forbs (Goddard et al. 2009). The extra cover provided by the shrubs or dense forbs is most important during the first 14 days after chicks hatch, which is when offspring survival rates are the lowest due to predation and adverse weather (Goddard and Dawson 2009).

Ecology

### Diet

The diet of adult grouse is comprised mainly of plant material, including buds, flowers, and seeds. A small portion of the adult diet consists of insects, including ants, beetles, grasshoppers and crickets (Marks 2007). Chicks however are thought to feed heavily on insects because this helps promote feather development. The only months when grouse do not consistently feed on the ground are the winter months when snow covers these food sources. During these months, grouse will often forage in shrubs and trees.

### Reproduction

Sharp-tailed Grouse are among four species of North American grouse that congregate in specific areas, known as leks, to engage in elaborate mating rituals known as 'dancing' (Videos are available at this link https://www.youtube.com/watch?v=vCEQgpzNPBY). Mating is based on selection of suitable males, who take part in the displays, by females, who do not display but rather observe male displays and choose a mate. The size of a lek is relatively small, ranging from as small as a small house or as large as a baseball diamond. Leks are traditionally used for multiple years, although if the habitat is no longer suitable a new lek may be formed elsewhere. A lek is usually found within 1-2 kilometers of denser grass cover, which is necessary for nesting materials and cover (Prose 1987). Leks often have low, sparse vegetation, allowing for clear vision in all directions and adequate space to engage in dancing, as well as vision to help escape and minimize predation. Areas that are often used for leks include rangeland, harvested or low cropland, low ridges and knolls, recent burns, and even abandoned runways (Prose 1987).

Beginning in March he males gather on the lek in the morning beginning at roughly 30 minutes before sunrise and begin to “dance”, displaying to try and attract a female. The dancing ritual by the males is highly elaborate, and students are encouraged to use internet resources such as Youtube, to view some of the spectacular footage available (one link is provided above, but there are many available).

Once a mate is attracted, the hen will usually her first fertilized egg within 1-3 days with an additional egg being laid every 1-2 days. Clutch sizes average 11-12 eggs. Once laying is complete the hen will incubate the eggs for 21-25 days. Despite being laid days apart, the eggs all hatch at roughly the same time due to incubation starting only after the last egg has been laid. The precocial young (born well developed with feathers, eyes open, and ready to leave the nest shortly after hatch) will leave the nest within 24 hours of hatching (Roersma 2001).

### Predation

Common nest predators include coyote (*Canis latrans*), striped skunk (*Memphitis memphitis*), a variety of ground squirrels, and common ravens (*Corvus corax*). A variety of hawks, and owls are also thought to prey upon sharp-tailed grouse. Current research at The University of North Dakota is attempting to shed more light on interactions between these predators and sharp-tailed grouse. Information is available at the Wildlife@Home website.

## Conservation

Sharp-tailed grouse populations are in decline in many areas, but this decline is not considered to be a major concern yet. Many states and provinces that have Sharp-tailed Grouse populations have a hunting season on the bird because the population is currently thought to be sustainable.

One major factor contributing to the declines noted is habitat loss. Two different factors play into this. First, many acres of grassland are being converted for agriculture. Second, grouse will move away from an area if too much woody vegetation is present. This is especially evident in areas with leks, where males will abandon a lek where even small increases of woody vegetation have occurred (Hanowski et. al. 2000). Furthermore, recent expansion of gas and oil development in western North Dakota may result in fragmentation of the vast grasslands favored by sharp-tailed grouse, as well as frequent disturbances such as noise, additional lighting, and dust.

For more information on these animals and the habitat they live in, you can also view the training videos for identifying sharp-tailed grouse, their nests, and their predators by visiting the Wildlife@Home webpage hosted by UND at http://volunteer.cs.und.edu/csg/wildlife/.

INSTRUCTOR KEY – Wildlife at Home Middle school education module

We will seek to answer the following questions using real-world, real-life data from a collaborative project between the University of North Dakota and North Dakota Game and Fish.

Part 1 - Brainstorm some predictions in the space below to the following questions.

#1. What impact(s) do you think gas and oil development will have on Sharp-tailed Grouse in Western North Dakota?

Answers will vary

#2. What do you think the impact of gas and oil development will be on the population of predators who prey on Sharp-tailed Grouse in Western North Dakota?

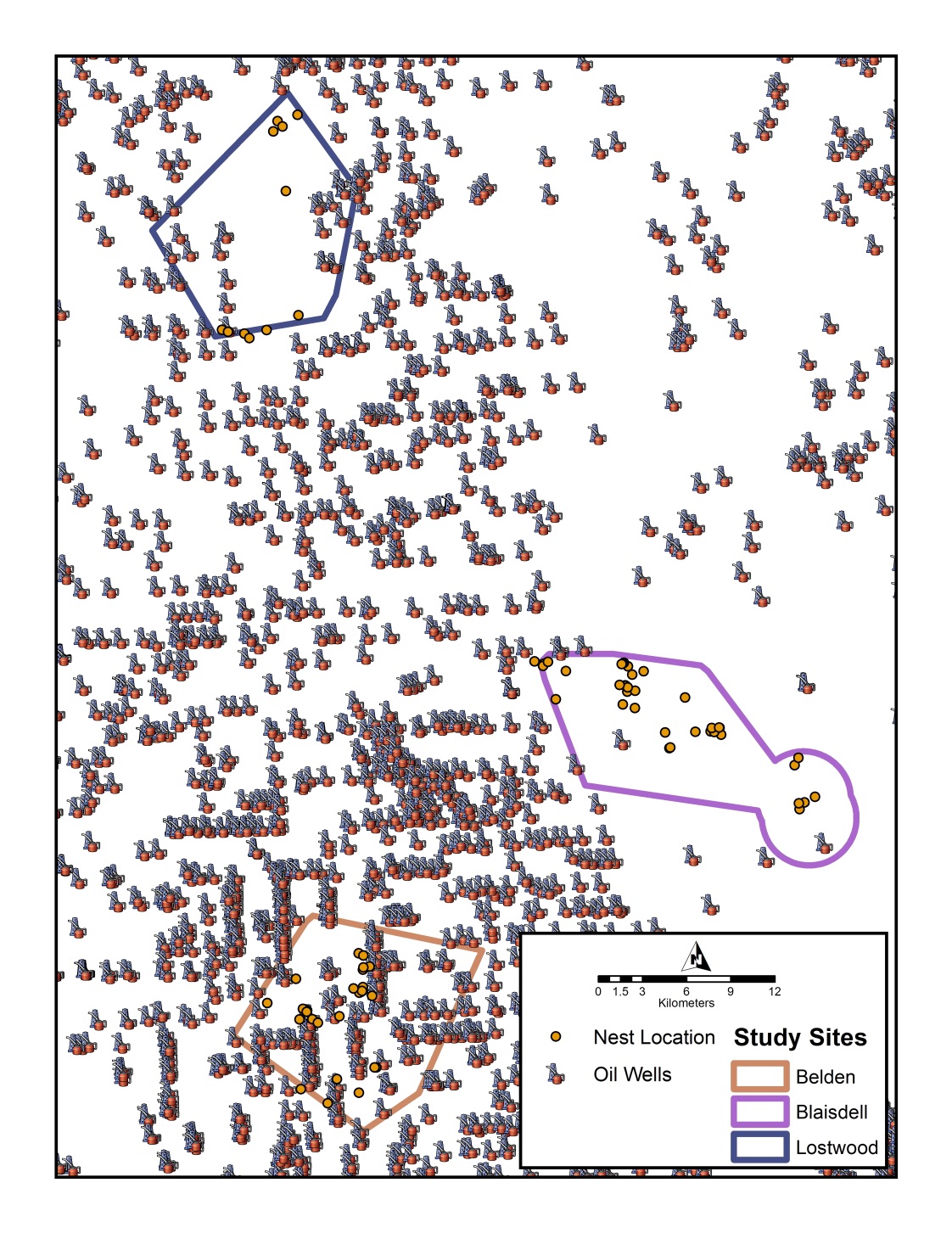
Answers will vary

#3. Some scientists believe that monitoring nesting birds to see what percentage of nests have at least a single egg hatch is an effective way to determine what the population is doing (growing, shrinking, or staying stable). This is called “apparent nest success”. Other scientists believe that more data is needed because apparent nest success only tells you how many nests had at least a single egg hatch. These scientists argue that to determine what a population is doing, you need to know how well the chicks survive after they hatch. Do you think that apparent nest success is an effective method of monitoring a population like Sharp-tailed grouse?

Answers will vary but students should be encouraged to come to a conclusion that more data, or more information, is always better, so anything that presents the opportunity for this should be considered positive. This will be illustrated below when students find that chick production actually looks higher in high intensity gas and oil, but their survival is MUCH lower once they hatch, which will be illustrated in the stop after that.

Part 2 – Goal and Objective #1

Next, look at the map below, and classify the three study sites as either High intensity, Medium Intensity, or Low intensity gas and oil development.



|  |  |
| --- | --- |
| Study Site | Classification |
| Belden | High Intensity |
| Blaisdell | Medium Intensity |
| Lostwood | Low Intensity |

Goal and Objective #2A - Next, please select (or have your teacher assign) one of the 5 data sets, including Belden 2012 (Bel 2012), Belden 2013 (Bel 2013), Blaisdell 2012 (Bla 2012), Blaisdell 2013 (Bla 2013), and Lostwood 2012 (Lost 2012). You will then watch a series of videos collected from nesting Sharp-tailed grouse, and attempt to classify the fate of each nest by identifying if it was successful (had at least one chick hatch), or if it was depredated (eaten by a predator). If the nest was depredated, please identify the predator that ate the eggs. Fill in the table below using the videos you watch from each study site. Once done, exchange data with other groups for the other 4 study sites so that everyone has all data from all 5 sites. This will be used in the 2B to calculate apparent next success, and n 2C to calculate ratios of different predators by site.

|  |  |  |
| --- | --- | --- |
| Folder | File | Description |
| Bel 2012 |  |  |
|  | 148.954\_48.11126\_102.440147.wmv | Chicks hatching |
|  | 149.085\_48.06332\_102.44829.wmv | Chicks Hatching |
|  | 149.495\_48.05411\_102.4242.wmv | Badger eating nest |
|  | 149.723\_48.12235\_102.38943.wmv | SKUNK??? |
|  | 149.733\_48.06872\_102.41512.wmv | Hawk |
|  | 149.772\_48.11158\_102.44098.wmv | Chicks Hatching |
|  | 149.783\_48.12148\_102.39020.wmv | Chicks Hatching |
|  | 149.801\_48.07501\_102.3787.wmv | Chicks Hatching |
|  | 149.823\_48.0599\_102.39538.wmv | Chicks Hatching |
|  | 149.892\_48.12108\_102.39192.wmv | Chicks Hatching - tough to see |
|  | 150.462\_48.10577\_102.43574.wmv | Chicks Hatching - tough to see |
|  |  |  |
| Bel 2013 |  |  |
|  | 148.203\_48.13689\_102.38178.wmv | Chicks Hatching |
|  | 148.222\_48.11228\_102.44405.wmv | Badger |
|  | 149.052\_48.13511\_102.38803.wmv | Chicks Hatching |
|  | 149.554\_48.11663\_102.47623.wmv | Chicks Hatching |
|  | 149.573\_48.1223\_102.3886.wmv | Skunk |
|  | 149.573\_48.12436\_102.38857.wmv | Chicks Hatching |
|  | 149.744\_48.145075\_102.39126.wmv | Chicks Hatching |
|  | 149.783\_48.12209\_102.38947.wmv | Chicks Hatching |
|  | 149.793\_48.14372\_102.38706.wmv | Chicks Hatching |
|  | 149.801\_48.075062\_102.380261.wmv | Badger |
|  | 149.823\_48.13639\_102.3874.wmv | Chicks Hatching |
|  | 150.242\_48.11884\_102.38034.wmv | Chicks Hatching |
|  | 150.261\_48.11042\_102.44061.wmv | Chicks Hatching |
|  | 150.342\_48.10705\_102.41093.wmv | Chicks Hatching |
|  | 150.432\_48.10356\_102.430624.wmv | Chicks Hatching |
|  | 151.564\_48.1238\_102.39722.wmv | Chicks Hatching |
|  | 151.644\_48.13074\_102.44943.wmv | Chicks Hatching |
|  | 151.675\_48.10591\_102.44745.wmv | Chicks Hatching |
|  |  |  |
| Bla 2012 |  |  |
|  | 148.574\_48.27494\_102.05381.wmv | Raccoon |
|  | 149.514\_48.27065\_102.05257.wmv | Hawk |
|  | 149.523\_48.30938\_102.13190.wmv | Chicks Hatching |
|  | 149.704\_48.31793\_102.21283.wmv | Skunk |
|  | 149.744\_48.31460\_102.13560.wmv | Coyote or Fox |
|  | 149.851\_48.27302\_102.07603.wmv | Skunk |
|  | 150.011\_48.26365\_102.10049.wmv | Chicks Hatching |
|  | 150.022\_48.30297\_102.13860.wmv | Badger |
|  | 150.101\_48.29605\_102.20289.wmv | Badger |
|  | 150.121\_48.31679\_102.21333.wmv | Chicks Hatching |
|  | 150.183\_48.31303\_102.19262.wmv | Chicks Hatching |
|  | 150.202\_48.29144\_102.14163.wmv | Chicks Hatching |
|  | 150.232\_48.29914\_102.13702.wmv | Chicks Hatching |
|  | 150.261\_48.28890\_102.13067.wmv | Chicks Hatching |
|  | 150.441\_48.29417\_102.08427.wmv | Chicks Hatching |
|  | 150.592\_48.31908\_102.20883.wmv | Chicks Hatching |
|  | 150.742\_48.29950\_102.12988.wmv | Chicks hatching AND RUNNING |
|  | 150.761\_48.27290\_102.06213.wmv | Chicks Hatching |
|  | 150.781\_48.30264\_102.13810.wmv | Fox |
|  | 151.564\_48.27240\_102.05879.wmv | Skunk |
|  | 151.664\_48.27504\_102.06100.wmv | Raccoon |
|  |  |  |
| Bla 2013 |  |  |
|  | 148.083\_48.316793\_102.139091.wmv | Skunk |
|  | 148.144\_48.223319\_102.983576.wmv | Chicks Hatching |
|  | 148.183\_48.227321\_101.978768.wmv | Chicks Hatching |
|  | 148.333\_48.250338\_101.986414.wmv | Chicks Hatching |
|  | 148.603\_48.275052\_102.054266.wmv | Chicks Hatching |
|  | 149.103\_48.301747\_102.136489.wmv | Skunk |
|  | 149.433\_48.230512\_101.968899.wmv | Chicks Hatching |
|  | 149.483\_48.303390\_102.143740.wmv | Chicks Hatching |
|  | 149.535\_48.264052\_102.099581.wmv | Skunk |
|  | 149.584\_48.273320\_102.103740.wmv | Coyote |
|  | 149.863\_48.311217\_102.121439.wmv | Badger |
|  | 149.973\_48.316282\_102.140299.wmv | Badger |
|  | 150.292\_48.254638\_101.982571.wmv | Raccoon |
|  | 150.452\_48.226955\_101.983856.wmv | Chicks Hatching |
|  | 151.632\_48.316050\_102.141333.wmv | Raccoon |
|  | 151.654\_48.319730\_102.221072.wmv | Skunk |
|  |  |  |
| Lost 2012 |  |  |
|  | 148.043\_48.52878\_102.49752.wmv | Chicks Hatching |
|  | 148.473\_48.65523\_102.43999.wmv | Raccoon |
|  | 149.503\_48.65188\_102.43567.wmv | Chicks Hatching |
|  | 149.554\_48.52755\_102.49201.wmv | Chicks Hatching |
|  | 149.564\_48.61229\_102.43444.wmv | Badger |
|  | 149.654\_48.64902\_102.44421.wmv | UNABLE TO TELL |
|  | 150.512\_48.53613\_102.42688.wmv | Chicks Hatching |
|  | 150.622\_48.52777\_102.45663.wmv | Chicks Hatching |
|  | 150.832\_48.52606\_102.47702.wmv | Chicks Hatching |
|  | 151.632\_48.65865\_102.42151.wmv | Chicks Hatching |
|  | 151.683\_48.52316\_102.47265.wmv | Chicks Hatching |

Goal and Objective 2B – Using the data above, calculate apparent overall nest success for each site, and overall apparent nest failure rates for each site for each year. Fill this out in the space below. Calculations for each site can be done by doing the following:

1. Count the total number of nests by site that were monitored.
2. Count the number of nests that were successful.
3. Count the number of nests that were depredated.
4. Divide #2 / #1 to get apparent nest success rates.
5. Divide #3 by #1 to get apparent nest failure rates.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bel 2012 |  | proportion | percent |  | Bel 2013 |  | proportion | percent |
| Success | 8 | 8/11 | 0.727 |  | Success | 15 | 15/18 | 0.833 |
| Depredated | 3 | 3/11 | 0.273 |  | Depredated | 3 | 3/18 | 0.167 |
|  |  |  |  |  |  |  |  |  |
| Bla 2012 |  | proportion | percent |  | Bla 2013 |  | proportion | percent |
| Success | 11 | 11/21 | 0.524 |  | Success | 7 | 7/15 | 0.467 |
| Depredated | 10 | 10/21 | 0.476 |  | Depredated | 8 | 8/15 | 0.533 |
|  |  |  |  |  |  |  |  |  |
| Lost 2012 |  | proportion | percent |  |  |  |  |  |
| Success | 8 | 8/11 | 0.727 |  |  |  |  |  |
| Depredated | 3 | 3/11 | 0.273 |  |  |  |  |  |

Next, combine the data for both years for Belden (Bel 2012 and 2013), and use this to fill in the first table, Bel Total. Do the same for Blaisdell, and fill in the second table (Bla Total). You can copy the data from Lostwood because severe snowfall and lack of resources combined to prevent any data from being collected in 2013 at that study site.

|  |  |  |  |
| --- | --- | --- | --- |
| Bel Total |  | proportion | percent |
| Success | 23 | 23/29 | 0.793 |
| Depredated | 6 | 6/29 | 0.207 |
|  |  |  |  |
| Bla Total |  | proportion | percent |
| Success | 18 | 18/36 | 0.500 |
| Depredated | 18 | 18/36 | 0.500 |
|  |  |  |  |
| Lost Total |  | proportion | percent |
| Success | 8 | 8/11 | 0.727 |
| Depredated | 3 | 3/11 | 0.273 |

Based on the above, do differences in the intensity of gas and oil development seem to have an impact on the nest success of Sharp-tailed Grouse?

Yes. Belden (High intensity gas and oil development) had the highest overall nest success, followed by Lostwood (Low intensity gas and oil development), with Blaisdell (medium intensity gas and oil development) having the lowest level of nest success.

How does this align with your prediction in the Part 1 Brainstorm above?

Answers will vary, but for the most part, students will likely be surprised.

Goals and Objectives 2C – Calculate the ratios of different predators depredating nests. Go back to your data where you attempted to identify the predators that were depredating nests. Use this information to fill out the summary tables in the space below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel 2012 |  |  |  | Bel 2013 |  |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching | 8/11 | 0.727 |  | Chicks Hatching | 15/18 | 0.833 |
| Badger | 1/11 | 0.091 |  | Badger | 2/18 | 0.111 |
| Skunk | 1/11 | 0.091 |  | Skunk | 1/18 | 0.056 |
| Hawk | 1/11 | 0.091 |  |  |  |  |
|  |  |  |  |  |  |  |
| Bla 2012 |  |  |  | Bla 2013 |  |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching | 11/21 | 0.524 |  | Chicks Hatching | 7/15 | 0.467 |
| Hawk | 1/21 | 0.048 |  | Skunk | 3/15 | 0.200 |
| Skunk | 3/21 | 0.143 |  | coyote | 1/15 | 0.067 |
| Coyote? | 1/21 | 0.048 |  | badger | 2/15 | 0.133 |
| Fox | 1/21 | 0.048 |  | Raccoon | 2/15 | 0.133 |
| Badger | 2/21 | 0.095 |  |  |  |  |
| Raccoon | 2/21 | 0.095 |  |  |  |  |
|  |  |  |  |  |  |  |
| Lost 2012 |  |  |  |  |  |  |
| Fates: | Proportion | Percent |  |  |  |  |
| Chicks hatching | 8/11 | 0.727 |  |  |  |  |
| Raccoon | 1/11 | 0.091 |  |  |  |  |
| Badger | 1/11 | 0.091 |  |  |  |  |
| Unknown | 1/11 | 0.091 |  |  |  |  |

Now use the above data to create summarized data tables in the space below like you did above for the Success and Depredated Totals.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel Total |  |  |  | Bla Total | |  |
| Fates: | Proportion | Percent |  | Fates: | Proportion | Percent |
| Chicks hatching | 23/29 | 0.793 |  | Chicks hatching | 18/36 | 0.028 |
| Badger | 3/29 | 0.103 |  | Hawk | 1/36 | 0.028 |
| Skunk | 2/29 | 0.069 |  | Skunk | 6/36 | 0.167 |
| Hawk | 1/29 | 0.034 |  | Coyote? | 2/36 | 0.056 |
|  |  |  |  | Fox | 1/36 | 0.028 |
| Lost Total |  |  |  | Badger | 4/36 | 0.111 |
| Fates: | Proportion | Percent |  | Raccoon | 4/36 | 0.111 |
| Chicks hatching | 8/11 | 0.727 |  |  |  |  |
| Raccoon | 1/11 | 0.091 |  |  |  |  |
| Badger | 1/11 | 0.091 |  |  |  |  |
| Unknown | 1/11 | 0.091 |  |  |  |  |

Use the above to answer the following questions:

1. Which site had the most diversity in the number and/or type of predators? Blaisdell, which was the Medium intensity gas and oil development.
2. Look back the map (oilpads\_nests(2).jpg). One of the biologists involved in this project hypothesized that the reason Blaisdell has the highest number and diversity of predators was because the predators were essentially being pushed out of areas that had intense gas and oil development, and into surrounding, less pressured areas. Do you agree, why or why not? Answers will vary.
3. What data or evidence would you like to test the above hypothesis? Answers will vary.

Pause and Debrief

Goals and Objectives #3 - At this point, using JUST the metric of apparent nest success it would appear that intense gas and oil (79.3% nest success) has higher nest success than moderate (50.0% success), or low intensity (72.7% success) gas and oil development. Is apparent nest success the best, or only, method of evaluating what a population of Sharp-tailed Grouse is doing?

Brainstorm an answer in the space below. Hopefully students come to the conclusion “No”. Not only do chicks need to hatch, but they need to survive if they are going to become part of the population. So looking at chick survival will provide a valuable insight as to overall population growth.

In order to try and address the question of chick survival, biologists conducted what are called “flush counts”, where a biologist tracks a radio collared hen, and “flushes” her, or got her to run/fly, to see if her brood of chicks has survived. Data for this is summarized in the tables below. The last date where information was available for each hen was used to construct the following tables. Use this information to calculate summary data at the end of this section.

|  |  |  |
| --- | --- | --- |
| Bel 2012 | Date | Notes |
| 148.954\_48.11126\_102.440147.wmv | 27-Sep | \*\*1 chick |
| 149.085\_48.06332\_102.44829.wmv | 23-Aug | no chicks |
| 149.495\_48.05411\_102.4242.wmv | 14-Aug | \*\*1 chick |
| 149.723\_48.12235\_102.38943.wmv | 6-Jul | Nest Dep |
| 149.733\_48.06872\_102.41512.wmv | 26-Jul | Mortality |
| 149.772\_48.11158\_102.44098.wmv | 1-Sep | \*\*9 chicks |
| 149.783\_48.12148\_102.39020.wmv | 20-Jul | \*\*1 chick |
| 149.801\_48.07501\_102.3787.wmv | 27-Sep | no chicks |
| 149.823\_48.0599\_102.39538.wmv | 23-Aug | No chicks |
| 149.892\_48.12108\_102.39192.wmv | 26-Jul | No chicks |
| 150.462\_48.10577\_102.43574.wmv | 1-Sep | no chicks |

|  |  |  |
| --- | --- | --- |
| Bel 2013 | Date | Notes |
| 148.203\_48.13689\_102.38178.wmv | 26-Oct | no chicks |
| 148.222\_48.11228\_102.44405.wmv | 24-Jul | no chicks |
| 149.052\_48.13511\_102.38803.wmv | 5-Aug | \*\*4 chicks |
| 149.554\_48.11663\_102.47623.wmv | 26-Jul | no chicks |
| 149.573\_48.1223\_102.3886.wmv | 5-Jul | No chicks |
| 149.573\_48.12436\_102.38857.wmv | 5-Jul | No chicks |
| 149.744\_48.145075\_102.39126.wmv | 31-Jul | \*\*4 chicks |
| 149.783\_48.12209\_102.38947.wmv | 13-Jun | no chicks |
| 149.793\_48.14372\_102.38706.wmv | 31-Jul | no chicks |
| 149.801\_48.075062\_102.380261.wmv |  | No data |
| 149.823\_48.13639\_102.3874.wmv | 5-Aug | no chicks |
| 150.242\_48.11884\_102.38034.wmv | 31-Jul | no chicks |
| 150.261\_48.11042\_102.44061.wmv | 1-Jul | no chicks |
| 150.342\_48.10705\_102.41093.wmv | 17-Jul | no chicks |
| 150.432\_48.10356\_102.430624.wmv |  | No data |
| 151.564\_48.1238\_102.39722.wmv | 5-Aug | no chicks |
| 151.644\_48.13074\_102.44943.wmv | 25-Oct | no chicks |
| 151.675\_48.10591\_102.44745.wmv | 5-Aug | no chicks |

|  |  |  |
| --- | --- | --- |
| Bla 2012 | Date | Notes |
| 148.574\_48.27494\_102.05381.wmv | 13-Jun | \*\*10 Chicks |
| 149.514\_48.27065\_102.05257.wmv | 14-Sep | Mortality |
| 149.523\_48.30938\_102.13190.wmv | 10-Oct | \*\*8 chicks |
| 149.704\_48.31793\_102.21283.wmv | 27-Jul | \*\*1 Chick |
| 149.744\_48.31460\_102.13560.wmv | 2-Aug | no chicks |
| 149.851\_48.27302\_102.07603.wmv | 24-Jul | \*\*Chicks, #unkn |
| 150.011\_48.26365\_102.10049.wmv | 2-Aug | no chicks |
| 150.022\_48.30297\_102.13860.wmv | 9-Jul | \*\*5 chicks |
| 150.101\_48.29605\_102.20289.wmv | 2-Aug | no chicks |
| 150.121\_48.31679\_102.21333.wmv | 6-Jul | \*\* 11 chicks |
| 150.183\_48.31303\_102.19262.wmv | 24-Jul | \*\*Chicks, #unkn |
| 150.202\_48.29144\_102.14163.wmv | 28-Jun | \*\*1 Chick |
| 150.232\_48.29914\_102.13702.wmv | 13-Sep | \*\*flushed w 5 chicks |
| 150.261\_48.28890\_102.13067.wmv | 20-Aug | \*\*Chicks, #unkn |
| 150.441\_48.29417\_102.08427.wmv | 9-Jul | \*\*8 chicks |
| 150.592\_48.31908\_102.20883.wmv | 27-Aug | no chicks |
| 150.742\_48.29950\_102.12988.wmv | 25-Aug | no chicks |
| 150.761\_48.27290\_102.06213.wmv | 14-Sep | no chicks |
| 150.781\_48.30264\_102.13810.wmv |  | No Data |
| 151.564\_48.27240\_102.05879.wmv | 27-Aug | No chicks |
| 151.664\_48.27504\_102.06100.wmv | 23-Aug | No chicks |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bla 2013 | | Date | Notes | |
| 148.083\_48.316793\_102.139091.wmv | | 1-Aug | no chicks | |
| 148.144\_48.223319\_102.983576.wmv | | 26-Aug | \*\*4 chicks | |
| 148.183\_48.227321\_101.978768.wmv | | 25-Aug | \*\*4 chicks | |
| 148.333\_48.250338\_101.986414.wmv | | 5-Jul | no chicks | |
| 148.603\_48.275052\_102.054266.wmv | | 18-Aug | \*\*Chicks #unkn | |
| 149.433\_48.230512\_101.968899.wmv | | 25-Aug | no chicks | |
| 149.483\_48.303390\_102.143740.wmv | | 25-Jul | no chicks | |
| 149.535\_48.264052\_102.099581.wmv | | 24-Aug | no chicks | |
| 149.584\_48.273320\_102.103740.wmv | | 24-Aug | no chicks | |
| 149.863\_48.311217\_102.121439.wmv | | 7-Aug | No chicks | |
| 149.973\_48.316282\_102.140299.wmv | | 24-Aug | \*\*2 chicks | |
| 150.292\_48.254638\_101.982571.wmv | | 12-Jul | \*\*9 chicks | |
| 150.452\_48.226955\_101.983856.wmv | | 5-Aug | \*\*3 chicks | |
| 151.632\_48.316050\_102.141333.wmv | | 15-Jul | no chicks | |
| 151.654\_48.319730\_102.221072.wmv | | 17-Jul | Mortality | |
| Lost 2012 | Date | | | Notes | |
| 148.043\_48.52878\_102.49752.wmv | 19-Jun | | | Mortality | |
| 148.473\_48.65523\_102.43999.wmv |  | | | No data | |
| 149.503\_48.65188\_102.43567.wmv |  | | | No data | |
| 149.554\_48.52755\_102.49201.wmv | 6-Aug | | | \*\*Chicks, #unkn | |
| 149.564\_48.61229\_102.43444.wmv | 2-Jul | | | \*\*flushed with 1 | |
| 149.654\_48.64902\_102.44421.wmv | 23-Aug | | | No chicks | |
| 150.512\_48.53613\_102.42688.wmv | 25-Jul | | | \*\*flush brood | |
| 150.622\_48.52777\_102.45663.wmv | 30-Jul | | | No chicks | |
| 150.832\_48.52606\_102.47702.wmv | 17-Jul | | | \*\*flushed with 2 chicks | |
| 151.632\_48.65865\_102.42151.wmv | 13-Aug | | | \*\*flushed with 1 chick | |
| 151.683\_48.52316\_102.47265.wmv | 16-Aug | | | No chicks | |

One problem with data like this is that it can be very hard to get an accurate count of the number of chicks with a hen in tall grass or other vegetation. As a result, Biologists usually just ask if at least a single chick survives from the clutch. Using this idea, please calculate the proportion and percent of clutch survival, clutch failure, and unknowns in the tables below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bel Total | Proportion | Percent |  | BlaTotal | Proportion | Percent |
| Clutch Survival | 6/29 | 0.207 |  | Clutch Survival | 17/36 | 0.472 |
| Clutch Failure | 21/29 | 0.724 |  | Clutch Failure | 18/36 | 0.500 |
| unknown | 2/29 | 0.069 |  | unknown | 1/36 | 0.028 |
|  |  |  |  |  |  |  |
| Lost Total | Proportion | Percent |  |  |  |  |
| Clutch Survival | 5/11 | 0.455 |  |  |  |  |
| Clutch Failure | 4/11 | 0.364 |  |  |  |  |
| unknown | 2/11 | 0.182 |  |  |  |  |

1. Is there a difference in chick survival between High, Medium, and Low gas and oil development intensity? Yes. The High intensity area (Bel) had 20.7% chick survival, Medium (Bla) had 47.2% chick survival, and Low (Lost) had 45.5% chick survival.

2. Why might this be? Ans will vary, but could relate to predators, habitat loss, disturbance, and other related factors.

3. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall in areas like Belden where there is intense gas and oil development? We would expect them to decrease.

4. Based on the findings above, what would you expect to happen to the population of Sharp-tailed grouse overall areas like Blaisdell or Lostwood where there is moderate gas and oil development that is expected to progressively become more intense? Increase or stay steady.

5. Based on the findings above is nest success the best metric for what is happening to the population of Sharp-tailed Grouse in western North Dakota? Explain your answer. No, we need to account for survival after hatching.

6. Is there a pattern you notice based on number of chicks flushed, in addition to number of hens flushed with chicks, that might shed further insight about production and recruitment of individuals into the population based on sight/intensity of gas and oil development? Not only are there are a higher proportion of hens with chicks in medium and low intensity gas and oil areas, but they also tend to have more chicks (higher survival rate).

7. Propose a method for handling or dealing with this pattern. Students can propose a number of solutions to this, but in general, the best and likely most common way would be to average the number of chicks per flush, the number of chicks total. Both will support the observation in #6 above.

In North Dakota, Natural Resources are the third largest part of the economy. Hunting, fishing, and other related activities associated with ***renewable*** resources are estimated to account for roughly $70 million dollars each year in the state. Oil and gas are ***nonrenewable*** resources; once they are used up, they will be gone for good. Based on this fact, do you think that laws or regulations should be in place to limit the rate and or intensity of gas and oil development? Explain your answer.

Answers will vary, but hopefully yes. Balancing human we needs for energy and economic development needs to be handled in a sustainable fashion that preserves the renewable resources we have for future generations.