

Overharvesting

Name: _____ Hour _____ Date: _____

Date Packet is due: _____ Why late? _____ Score: _____
Day of Week Date If your project was late, describe why

Overview: in this unit, you will be learning about how overharvesting can lead to the extinction of living organisms.

Main Questions

- What is overharvesting and how does it occur?
- What are examples of species that are threatened by overharvesting?
- How can the overharvesting of a keystone species cause a cascade effect?
- How do scientists know if a species' population is dwindling, and how do they determine what the appropriate population is for a species?
- How can the idea of Tragedy of the Commons explain why people will sometimes wipe out a species even when it is clearly in decline?

Weekly Schedule

Monday:

- Introduction to Extinction – Data Dive

Tuesday:

- Nutshell Video & Notes
- Class discussion & revisions of explanations

Wednesday:

- The Fishing Game

Thursday:

- Review
- Group Quiz

Friday:

- Weekly Reflection
- Career Connections

Semester Schedule

Week 1: Introduction & Lab Safety

Atoms to Ecosystems

Week 2: Matter & Energy

Week 3: Cell Biology

Week 4: Biodiversity & Ecosystems

Week 5: Biodiversity & Habitats

Week 6: Midterm Assessments

Causes of Extinction

Week 7: Extinction

Week 8: Habitat Loss

Week 9: Invasive Species

Week 10: Land & Water Pollution

Week 11: Atmospheric Pollution

Week 12: Overharvesting

Week 13: Midterm Assessments

Sustainable Societies

Week 14: Natural Resources Management

Week 15: Societies & Sustainability

Week 16: Individual Sustainability

Week 17: Personal Campaigns

Week 18: Personal Campaigns



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This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program, Grant No. DGE-1424871. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



Day 1: Data Dive – Overharvesting Case Studies

Introduction: In this activity, you will be considering ongoing case studies of overharvesting throughout the world. You will then consider data about current trends in regards to overharvesting to help you to develop ideas about long term trends on this topic.

Directions: As a group, use a computer, laptop, or personal device (if ok'd by your instructor) to look up information on your assigned cases using an internet search engine. Be prepared to summarize your group's examples for the rest of the class. You will also need to take time as a group to address the questions below prior to presenting. After each group has had a chance to present their cases, you will take time as a class to try to summarize any similarities or patterns that you might have observed that are common to most or all of the examples provided. *Note: internet searches on some of these topics may result in graphic images.*

Cases:

1. Chinese Pangolin
2. Beluga Sturgeon
3. Lydenburg Cycad
4. *Paphiopedilum urbanianum*
5. Ploughshare Tortoise
6. Bali Starling
7. Chinese Giant Salamander
8. African Elephant
9. Tiger (six remaining subspecies)
10. Burmese Python*
11. Black Rhinoceros
12. Giant Armadillo
13. Oceanic Whitetip
14. Cowan's Mantella
15. Elegance Coral
16. *Student Choice – if a student group has a pollution case study they'd like to investigate that is not listed above, they can do so if they receive instructor approval*

How to tell if a website is credible: BAR

Bias: who is the author of this website? Why did they write this? Was it purely to inform, or are they trying to persuade the reader for their own personal gain?

Accuracy: are their claims supported by valid data and/or logical arguments? Is the original primary source of this information cited? Are the authors sufficiently experienced and qualified to have reliable opinions on this topic? Is this website peer-reviewed, or can they post anything that they want regardless of its truthfulness?

Relevance: is this information valuable for my needs? Does the level of detail in this site hurt my ability to get this work done in a timely fashion? What do other sources say? Does this agree with sites that are credible?

Generally, government [.gov] and university [.edu] websites are more credible than private [.com] websites. Wikipedia and other open-source sites are less reliable because they can be changed but may provide potentially-credible sources in the citations.

Questions: Briefly summarize your case study species.

1. Describe the species – what are its key characteristics and unique attributes?
2. Why are its numbers declining?
3. What is the key factor that is causing it to be harvested so rapidly and extensively?
4. Is this problem being effectively addressed? Why or why not?
5. What is the most likely outcome for this species at the moment?
Complete #6 after presentations have concluded
6. What commonalities did you notice across the different case study presentations?
7. What kinds of actions might most effectively protect species threatened by overharvesting?



Key overharvesting legal protections: The list below provides a brief description of each piece of legislation. Use an internet search engine to learn more about these laws and their protections.

- In the United States, the Endangered Species Act (ESA) is the key form of legal protection for species at risk of extinction due to overharvesting.
 - o Local and State regulations are also important for preventing overharvesting, especially of game species.
- Internationally, the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora (or *The Washington Convention*) is the most important legal protection for preventing the overharvesting of species.

Questions:

1. Briefly summarize how the legal protections listed above function to protect overharvested species from going extinct. (You may want to re-visit earlier units to get a brief refresher on the ESA; you'll need to use internet sources to learn more about CITES).
2. Are these legal protections sufficient to prevent widespread extinctions from overharvesting? Why or why not?
3. Are extinctions by overharvesting a thing of the past, or should more be done to address this problem?

**Note: the Burmese python is both overharvested and an invasive species. In short, the species is overexploited for food and for its skin. They can also be illegally trapped and sold as pets; this has resulted in some pet owners releasing it into the wild after realizing how large it can grow. Because of a similar climate in Florida, this has resulted in the unique and ironic phenomenon of an overharvested species also becoming an invasive species – its native populations are too low, but its invasive populations are too high.*



Day 2: Notes & Discussion

Introduction & Directions: In this activity, you will begin by watching a short video about **overharvesting**. This will help to clarify some of the questions you may have had yesterday. After the video, you will look at a short slideshow presentation that will provide you with specific information about this topic. Your instructor may decide to deliver the presentation as a classroom lecture or they may allow you to read the notes individually or in small groups (depending on your previous experience and capabilities with this content). After you have watched the video and finished with the slideshow, you will work in small teams to answer the questions listed below. You should take notes in a notebook, on a dry erase board, or on scratch paper so that you are prepared to deliver your responses during the class discussion that will follow. *Note: your instructor may assign your group to answer specific questions if time is limited.*

URL Links

YouTube Video: <https://www.youtube.com/watch?v=WNdR808jMSA>

Slideshow Presentation: https://www.factsnsf.org/uploads/1/4/0/9/14095127/2018-6-3_facts_overharvesting.pdf
(or visit factsnsf.org and use the menu bar).

Discussion Questions:

1. What is overharvesting? Does it only involve hunting and fishing?
2. Is overharvesting still occurring or was it primarily a past concern?
3. What are examples of species threatened by overharvesting?
4. How does overharvesting become more problematic if the species in question is also a keystone species?
5. What is the “cascade effect”? How does this relate to the overharvesting of keystone species?
6. How can government regulation prevent overharvesting?
7. How can scientists estimate the population of a species to determine if it is at risk of overharvesting?
8. Use the Mark-Recapture Method formula for determining the population of a species based on provided data.
9. What are “Boom and Bust Cycles”? How can this complicate the task of determining a species’ population?
10. How does a species’ survivorship type (Type 1, 2, or 3) affect its population management?
11. How does the carrying capacity of a species relate to population management? Are there exceptions to this?
12. What is the “Tragedy of the Commons”? How does it relate to the overharvesting of species?
13. Why does the Tragedy of the Commons occur? What are possible solutions for fixing this?

Be sure to revisit your explanations from the previous day’s activity and add details or corrections as needed.



Day 3: The Fishing Game

Overview: In this activity, you will be playing a game that serves as a model for how Tragedy of the Commons occurs. Before starting, show the following video: <https://www.youtube.com/watch?v=CxC161GvMPc>

Materials: game pieces (such as poker chips, pieces of paper, paperclips, pennies, etc.).

Directions: You should play the game in groups of three or four. Each person in the group will be fishing for large fish in the same ocean. Put 20 “fish” in the middle of the table (use whatever your instructor has provided as game pieces as your fish). This is the *carrying capacity* for large fish in your ocean.

In each round, each person can fish for a certain number of large fish. You can fish in the following ways:

1. Harpoon fishing: take one fish.
2. Long-line fishing: take two fish.
3. Free-for-all long-line fishing: take three fish.



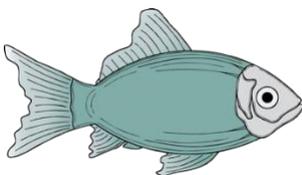
After each round when each player has taken their fish, the group needs to let their fish population “reproduce” to replenish the population with new baby fish. To do so, take the number of fish you have at the end of the round and divide by 4 to determine how many to add.

For example, if you have 12 fish left at the end of the round, you would add 3 fish ($12 \div 4 = 3$). If you do not get a whole number, round down to the nearest whole number. For example, if you had 14 fish left at the end of the round, you would still only add 3 fish ($14 \div 4 = 3.5 = 3$). Each game ends after 10 rounds, or when the fish population is completely depleted, whichever comes first.

You have two goals. The first is to individually collect as many fish as possible over the course of each game. The second is to have as many fish as possible remaining at the end of each game. **If your fish population reaches zero before the end of the game, you all lose the game.** Use scratch paper or a dry erase board to keep track of your fish population after each round and at the end of the game.

You will be playing four versions of this game:

1. Game 1: Everyone chooses a fishing method (harpoon, long-line, or free-for-all) at the start and cannot change.
2. Game 2: Everyone chooses a fishing method (harpoon, long-line, or free-for-all) at the start and but they can change their method after each round.
3. Game 3: Government Regulation – everyone is limited to one fish per turn regardless of their method.
4. Game 4: Pollution & Reduced Carrying Capacity – you can choose any method and switch that method after each turn, but now the fish are reproducing at 10% rather than 25% due to pollution and ocean acidification (so divide by 10 and round down instead of dividing by 4).





Questions: For the questions below, each person should take a turn writing an answer. The rest of the group should help develop the answers together.

1. Complete the tables below to record your results:

	Player 1 Total	Player 2 Total	Player 3 Total	Player 4 Total	Fish remaining at end of game	Winner
Game 1						
Game 2						
Game 3						
Game 4						

Player totals should be calculated by adding up the number of fish each player caught during each round. Remember, if you deplete your fish population, there is no winner for that game.

2. What method was most effective in maximizing the fish population after 10 rounds?

Why do you think this method was more effective than all the rest? Explain:

3. What method was *least* effective in maximizing the fish population after 10 rounds?

Why do you think this method was *less* effective than all the rest? Explain:

4. Was there at least one round where you knew that you were going to run out of fish? _____

Why didn't you voluntarily reduce your catch to prevent your fish from running out?

5. If there were businesses that depended on fishing, how do you suppose they would be affected if the population of fish were completely eliminated? Explain:



6. What impact do you think the loss of these fish would have on the biodiversity of this area?

7. If these fish included a keystone species, how might the loss of this species affect the ecosystem? (Use the term *cascade effect* in your response).

8. What kind of survivorship type would you say that these fish have? Why? How might the game change if the survivorship of the fish was changed?

9. How did pollution and ocean acidification affect your ability to successfully play this game?

10. If you had to add a player to your group (i.e. *human population growth*), how might that have affected the outcome of your game? Would you be more or less likely to avoid depleting your fish population?

11. Based on this game, who do you think should have the final say about the use of natural resources? Are individuals better at self-regulation, or is better to laws to regulate human behavior?

Note: these materials are based on The Fish Game by The Cloud Institute, which is licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 United States License.



Day 4: Review & Assessment

Directions: you will begin by reviewing the unit objectives in your small groups. For each objective, rank it as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comfort with that objective. After a few minutes of review, your instructor will lead a whole-class review. This is your chance to ask any questions you still might have about the concepts in this unit. Begin with anything you ranked as a “1”.

After you have completed the unit review, you will be taking an individual multiple choice quiz and/or a group short answer quiz. These quizzes may be graded in class to help you better understand the question and the correct answer.

Unit Objectives:

1. What is overharvesting? Does it only involve hunting or fishing?
2. Is overharvesting still occurring or was it primarily a past concern?
3. What are examples of species threatened by overharvesting?
4. How does overharvesting become more problematic if the species in question is also a keystone species?
5. What is the “cascade effect”? How does this relate to the overharvesting of keystone species?
6. How can government regulation prevent overharvesting?
7. How can scientists estimate the population of a species to determine if it is at risk of overharvesting?
8. Use the Mark-Recapture Method formula for determining the population of a species based on provided data.
9. What are “Boom and Bust Cycles”? How can this complicate the task of determining a species’ population?
10. How does a species’ survivorship type (Type 1, 2, or 3) affect its population management?
11. How does the carrying capacity of a species relate to population management? Are there exceptions to this?
12. What is the “Tragedy of the Commons”? How does it relate to the overharvesting of species?
13. Why does the Tragedy of the Commons occur? What are possible solutions for fixing this?

Day 5: Career Connections

Directions: Begin with a group and class discussion about the topics of this week. What is still unclear? What is still confusing? What seemed most important to remember? How does this relate to Natural Resources? How does this relate to your potential future career?

You are now at a point in the semester where you should have most of your out-of-class career experiences completed. You should meet briefly with your instructor today to discuss your progress, what you still need to accomplish, and what you have learned so far (this could be done individually or in small groups). When you are not meeting with your instructor, this would be an ideal time to complete any missing work that you may have.

If you have no missing assignments, you should try to be productive by working on projects for other classes, quietly reading, or other responsible actions. Please be sure to help your students who may have missing work by preventing distractions – they will thank you in the long run for this.



Overharvesting Individual Quiz

Name: _____ Hour _____ Date: _____ Score: _____ /

Directions: This quiz should be completed on an individual basis. A 3x5 notecard with handwritten notes can be used on this quiz.

1. Which of the following best describes overharvesting?

- a. When the loss of one species causes the extinction of a series of other species.
- b. When a species' population repeatedly exceeds their carrying capacity, causing a subsequent plummet in their population, repeating over and over.
- c. When two species occupy the same niche, one will eventually out-compete & displace the other.
- d. When more of a species is removed than can be replaced by reproduction.
- e. A situation in which people trying to gain as much individual benefit from a publicly-available resource as possible causes that resource to eventually become depleted.

2. Which of the following best describes a Cascade Effect?

- a. When the loss of one species causes the extinction of a series of other species.
- b. When a species' population repeatedly exceeds their carrying capacity, causing a subsequent plummet in their population, repeating over and over.
- c. When two species occupy the same niche, one will eventually out-compete & displace the other.
- d. When more of a species is removed than can be replaced by reproduction.
- e. A situation in which people trying to gain as much individual benefit from a publicly-available resource as possible causes that resource to eventually become depleted.

3. Which of the following best describes a Boom and Bust cycle?

- a. When the loss of one species causes the extinction of a series of other species.
- b. When a species' population repeatedly exceeds their carrying capacity, causing a subsequent plummet in their population, repeating over and over.
- c. When two species occupy the same niche, one will eventually out-compete & displace the other.
- d. When more of a species is removed than can be replaced by reproduction.
- e. A situation in which people trying to gain as much individual benefit from a publicly-available resource as possible causes that resource to eventually become depleted.

4. Which of the following best describes Tragedy of the Commons?

- a. When the loss of one species causes the extinction of a series of other species.
- b. When a species' population repeatedly exceeds their carrying capacity, causing a subsequent plummet in their population, repeating over and over.
- c. When two species occupy the same niche, one will eventually out-compete & displace the other.
- d. When more of a species is removed than can be replaced by reproduction.
- e. A situation in which people trying to gain as much individual benefit from a publicly-available resource as possible causes that resource to eventually become depleted.

5. Which of the following is true?

- a. While overharvesting used to be a significant cause of extinction, today legal protections for endangered species have eliminated this problem.
- b. Due to hunting and fishing regulations, overharvesting is rare.
- c. Overharvesting is still one of the leading causes of extinction.
- d. Overharvesting is a problem for aquatic animals but not those within the borders of countries.



6. Briefly summarize how the effects of overharvesting are worsened if the overharvested species is a keystone species.
-
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7. A wildlife ecologist is trying to determine the population of an endangered songbird in an area. To do so, they set up a net that safely entangles the birds until they can be banded and released. A week later, the ecologist sets up the nets again to see how many of the entangled birds are banded from the previous time. In the first round, 10 birds were caught and banded. In the second round, another 10 birds were caught and banded. Of these, five birds had a band (meaning they were caught twice). What is the population of songbirds in this area? Show your work below.

- a. 4 birds b. 500 birds c. 50 birds d. 20 birds e. 25 birds

Show your work:

8. This is a method of determining population that involves collection of genetic material to determine the presence of a species.
- a. Complete Counts b. Incomplete Counts c. Indirect Counts d. DNA Testing
9. This is a method of determining population that involves aerial surveys and visual counts.
- a. Complete Counts b. Incomplete Counts c. Indirect Counts d. DNA Testing
10. This is a method of determining population that involves using calls, tracks, and nests determine the presence of a species.
- a. Complete Counts b. Incomplete Counts c. Indirect Counts d. DNA Testing
11. This is a method of determining population that involves counting the number of species in a representative area and multiplying to estimate the population for the entire area.
- a. Complete Counts b. Incomplete Counts c. Indirect Counts d. DNA Testing
12. You are trying to determine the number of pheasants in a local preserve. You set traps and capture 20 pheasants. You mark and release them. You then reset the traps and capture 20 individuals again. 10 of these are marked from your first trapping. How many pheasants are in this preserve?
- a. $20 \times 20 \times 10 = 4000$
b. $10 \div 20 \times 20 = 10$
c. $20 \times 20 \div 10 = 40$
d. $20 \times 10 \div 20 = 10$
13. You are trying to determine the number of walleye in a local lake. You set capture 7 walleye and notch their fins. You release them and return a week later. You catch 10 fish, of which 4 have notched fins. How many walleye are in this lake?
- a. $10 \times 4 \div 7 = 5$ or 6 walleye
b. $10 \times 7 \div 4 = 17$ or 18 walleye
c. $7 \times 4 \div 10 = 2$ or 3 walleye



14. A large ocean fish (Species A) does not reproduce until it is 10 years old. When it does reproduce, it produces a small number of eggs. Most of these survive to adulthood.

Another large ocean fish (Species B) reaches reproductive capacity within two years. It produces large amounts of eggs, most of which do not survive to adulthood.

Which species has a Type 1 survivorship? Which has Type 3? Which is at greater risk for extinction from overharvesting?

- a. Species A has a Type 1 survivorship, and Species B has Type 3. Species A is at more risk.
- b. Species A has a Type 3 survivorship, and Species B has Type 1. Species A is at more risk.
- c. Species A has a Type 1 survivorship, and Species B has Type 3. Species B is at more risk.
- d. Species A has a Type 3 survivorship, and Species B has Type 1. Species B is at more risk.

15. Species X is moderately endangered, while Species Y is a greater risk for extinction. Species X is a keystone species; species Y is not. Which species is a higher priority for protection?

- a. Species Y should be a higher priority because it is more endangered.
- b. Species X should be a higher priority because it would cause more additional extinctions if lost than Species Y.
- c. Both species should get equal priority for protection.

16. Which of the following could be an example of Tragedy of the Commons?

- a. When everyone decides it is more convenient to drive alone than to carpool or take mass transit, traffic jams become more common and roads become more damaged in unusable.
- b. If everyone exceeds the fishing limits by even a small amount, it can cause the entire fish population to collapse.
- c. When ranchers over-graze their cattle on public land, it can cause the grassland ecosystem to collapse and become depleted.
- d. All of the above could be examples of Tragedy of the Commons because they involve the depletion of a publicly available resource due to individuals maximizing their personal gain.

17. How can we prevent the overharvesting of endangered species as a result of Tragedy of the Commons? List & describe three ways in which TOC can be stopped in the space below:

1. _____

2. _____

3. _____



2. Many overharvested species are apex predators and/or keystone species. Past and current examples include the American bison, tigers, and sharks. In the space below, explain why overharvesting of an apex predator or keystone species would be especially harmful to an ecosystem using an example. Include a definition of the term “cascade effect” in your response.

Writer's Name:

3. In order to determine if a species requires legal protections, scientists must have a general understanding of the level and trends in that species' population. In the space below, describe the various options for how a population level of a species can be determined. Also, be sure to provide an explanation for when a species *should* have a low population, and address when a species should get highest priority for protection.

Writer's Name:



Appendix: Overharvesting Case Studies

Introduction: due to well-known examples such as the American bison and the bald eagle, sometimes students have a tendency to believe that overharvesting is a problem that has been largely solved. The purpose of the overharvesting case studies is to help students understand that a) overharvesting is an ongoing problem that is still prevalent in our society, and b) that overharvesting is often affected by choices made by consumers. Furthermore, this is to help students appreciate the need for social and legislative action to address the causes and implications of overharvesting.

Directions: students should work in their assigned groups for this activity. They will need internet access via computers, laptops, or their personal devices (*if permitted*). It might be advisable to use your school computer and a projector to go through an example with them. This would be particularly helpful for enabling students to better understand what constitutes as a credible source online. Critiquing a website with students can be a valuable means for guiding their understanding of what online sources they can trust. (*Note that this topic is covered in more detail later in the semester.*)

It is your decision as to how topics should be assigned. You may want to select groups at random (such as by drawing names or shaking a die) and either go in order of the cases or have the randomly-chosen group pick their top choice of cases. Students may also want to investigate a different case; this could be very valuable, particularly for local or state examples of overharvesting.

Students should be prepared to answer the questions listed below the cases in front of the class. Because time is limited for this activity, it would be wise to encourage students to choose their roles before seeking information, and to share valuable sites that they find with the rest of their group.

If time allows, students should also consider the legal protections available for overharvested species. It may be particularly valuable to discuss the limitations of these laws to prevent the misconception that the existence of a law also always means the sufficient enforcement of that law. If time is limited, the instructor may want to provide a brief summary for the class in lieu of group work.



Appendix: The Fishing Game

Overview: In this activity, students will be taking part in a simulation of the factors that lead to the Tragedy of the Commons.

Materials: the packet; game pieces that will represent “fish”, such as poker chips, paper clips, scraps of paper, pennies, or anything of that nature. Groups will about 60 pieces each to be safe.

Directions: see the packet for detailed instructions. In short:

- Each group starts with 20 “fish” in their ocean (the surface of a desk works fine).
- Each student can harvest fish based on the rules of each of the four games. Whether or not they can change their method (and the number of fish caught) depends on the rules of each of the four games.
- After each student has collected their fish, the fish need to reproduce. Take the number remaining, divide by four, and add that number to the ocean (if not a whole number, round down to the next whole number – e.g. $3.5 = 3$).
- There are two goals: to collect as many fish as possible on an individual basis and to have as many fish remaining at the end of the game as possible. If the fish population reaches zero, everyone loses.

Note: using pieces of candy as your “fish” can add an extra incentive for your students but may not be appropriate for all classes or situations. Check the safety regulations of your school and department first.