



Marine Ecosystems: The Role of Sharks

Lesson Plan for Grades: 9th grade (Biology), 11th-12th grade (Aquatic Science) Length of Lesson: 96 mins. (This can be spilt into two days)
Authored by: UT Environmental Science Institute Date created: 05/10/2019
Subject area/course: <ul style="list-style-type: none">• Biology• Aquatic Science
Materials: <ul style="list-style-type: none">• board/projector for Engage warm-up and part b of the exploration (for teacher)• 1 blank paper of any kind to write on (1 per student)• computers/laptops/iPads with access to internet (1 per student)• 1 large sized blank paper or poster-sized board (1 group of 2-3 students)• 2-3 different colored markers (per group of 2-3 students)
TEKS/SEs: <p>§112.34. Biology (One Credit), Adopted 2017. (c) Knowledge and skills. (3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to: (B) communicate and apply scientific information extracted from various sources such as current events, published journal articles, and marketing materials; (12) Science concepts. The student knows that interdependence and interactions occur within an environmental system. The student is expected to: (C) analyze the flow of matter and energy through trophic levels using various models, including food chains, food webs, and ecological pyramids; (E) describe how environmental change can impact ecosystem stability.</p>
Lesson objective(s): Students Will Be Able To (SWBAT): <ul style="list-style-type: none">• create food webs/chains for different marine ecosystems that include sharks• analyze differences between different inter-species energy models including food webs, chains, and ecological pyramids.• assess consequences to human interactions with the ocean and its ecosystems
Differentiation strategies to meet diverse learner needs: <ul style="list-style-type: none">• The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills. There will be links attached in the resource section of the lesson plan with videos about food chain and food web.• ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.



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ENGAGEMENT (5 minutes)

- The teacher will pose the following question as a warm-up: “Why are sharks important to us?”
- Possible student responses: *as a food resource (shark soup), the role they play in ecosystems (as predators), they balance ecosystem, etc.*
- The teacher should have this question written on the board/projector and displayed to the students. The teacher should explain that this warm-up is a Think-Pair-Share activity, where students will write down their thoughts on a piece of paper (1 minute), then share their responses with their classmate sitting next to them (1 minute), and then finally share with the class (1 minute). (Students can be in groups and each group shares one thing that that each separate group found.)
- The teacher will then go over the agenda for the day (learning about food webs, inter-species relationships, and human impact on marine ecosystems, as the main topics for the lesson) and transition to the Exploration. (1 minute)

EXPLORATION (41 minutes)

Part 1: Food Webs/Chains:

A: Mini-Lecture/Review on Food Chains: (10 mins)

- The teacher will begin by asking students to recall from prior knowledge about what makes up a food chain/web. The teacher will write student Responses on the board about what they think constructs a food chain.
- The teacher will specifically be looking for terms such as primary producer, primary consumer, secondary consumer, tertiary consumer, decomposers, source of energy (the sun), herbivores, autotrophs, carnivores, and omnivores.
- The teacher will then ask students to explain what each term means (a short definition 2-3 words) and to categorize them into groups in a food chain. (For example, primary consumers with herbivores or primary producers with autotrophs.)
- The teacher should also ask students to help create a food chain based on the words and give examples of each. (It can be a very simple structure in order to lead into student being able to construct their own Food webs in part B)
- The teacher should explain the relationships between levels in the food chain. (Energy flows from one organism to another)
- Lastly, the teacher will clarify the concept of energy flow (the relationship between levels), and trophic levels.

B: Working with partners then Think-Pair-Share on Food Webs: (10-11 mins)

- In this activity, students will be paired up with partners to create a food web based on their knowledge of food chains and the review.
- The students will be given a set organisms and energy source (examples: the sun, grass, mouse, snake, and hawk) to start out their food webs or they can choose their own organisms. They will be instructed to incorporate 5-10 other organisms into the food web and connect them based on all possible relationships they see with in their webs. (5 minutes)



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- Next, students will share their food webs with other pairs. They should give reasons for how and why they arranged their food webs. (1-2 minutes)
- Lastly, the teacher will then ask one group to volunteer their food web for the class to go over on the projector. Then the teacher will ask about the relationships between the organisms and probe the students until they get to understanding that multiple chains connect due to relationships between organisms. (2min)
- The last question the teacher will ask the students is what the difference between a food web and food chain is, which is more useful for looking at relationships, and their reasonings. (Food webs should be the most useful due to showing multiple chains between organisms interconnecting with each other) (2min)

Part 2: Researching Sharks within their Food Webs (20 mins)

- Next, the teacher will give students 2 mins to decide on a shark species to research (by themselves), in order to create a food web for their species. Students can refer to the list of shark species provided on <https://www.sharks.org/species>, to select their species. Each student will be instructed to pick a different shark species, if possible.
- Websites students can use for research include the Shark Research Institute, <https://www.sharks.org/species>; the World Wildlife Fund, <https://www.worldwildlife.org/species/shark>; the Smithsonian - Ocean, <https://ocean.si.edu/ocean-life/sharks-rays/sharks>; the Florida Museum, <https://www.floridamuseum.ufl.edu/discover-fish/teaching-resources/shark-classroom-activities/shark-species-in-depth/>; Sea World, <https://seaworld.org/animals/all-about/sharks-and-rays/diet/>; and NOAA Fisheries, <https://www.fisheries.noaa.gov/fish-sharks>. NOAA is also a great resource for what other species (not sharks) diet includes, which can help in creating an accurate food web for students. These websites will be provided to students (either online or as a list on a paper).
- If students wish to use websites other than those listed, they must first seek approval from the teacher.
- Students will spend the remaining time of the activity creating their food webs.
- The instructions for the food webs will be included on the Shark Food Web handout (Exploration Part 2 handout) for the teacher and student. The teacher will handout the Shark Food Web handout for the students. All requirements that students must research, include, and construct should be on this handout.

EXPLANATION (30 minutes)

Part 1: Group Food Web with Multiple Shark Species (15 mins)

- Student's will be instructed to form groups with classmates who chose different shark species than themselves, in order to have small presentations (among the groups). (It would be best if these sharks were to live in the same areas of the World). Each group will consist of 2-3 students, with each student spending approximately 2 minutes explaining their species and food web. The students will present to their groups (not to the class).



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- After 4-6 minutes of the presentations, students will collectively (in their groups), be handed a large sized paper/poster board, and will be given the objective to synthesize their individual food webs into a larger web that encompasses all the species mentioned on all the individual food webs. Students will also be instructed to add in additional symbols (using different colored markers/colored pencils), depending on whether a species is endangered or threatened.
- In order to determine the status of each species, students can use the World Wildlife Fund website <https://www.worldwildlife.org/species/directory>. Students who chose to use another website must seek approval from teacher.
- The teacher will allocate the researching of endangered or threatened status for 5-7 minutes.

Formative assessment for this activity:

- While students are working together, the teacher will circulate around the room and ask probing questions like: “Do you think each shark species has a similar diet?”, “What might explain the differences in diet, in your opinion?”, “What do you think it means for a species to be classified as endangered? As threatened?”, “Does your food web contain every source from where your shark species receives energy? Why or why not?”

Part 2: Group Presentations (15 mins)

- Each group will present their group food web as well as which sharks were included in their collective food web and what species were endangered or threatened in the entire food web.
- Each group will have 2 minutes to present and throughout the presentations, the teacher will ask probing questions like, “Do you think it’s possible to make a food web large enough to encompass all the shark species in the class? In the world? All marine species in the world? All species currently alive, on land or water?” (*These questions will be staggered in asking order, to give students scaffolding for leading them to think that for looking at zoomed in species interactions, food webs/chains are useful as a visual aid, but for large, real-life ecosystems, their complexity and size can make it difficult to spot patterns or trends.*)

ELABORATION (20 minutes)

First 5 min (Elaboration activity):

- The teacher will hand out to each group a picture of the Energy Pyramid (reference sheet) and ask students what they think it means and what they think it shows.
- The Teacher will extend on the relationships between organisms through an energy pyramid. (Refer to the Teacher handout for the elaboration activity called Energy pyramid)

Last 15 min:

- The teacher will hand out the Student Handout for Elaboration.
- In their same groups, students will work collectively the Student Handout for Elaboration called Human Interactions (15 minutes). They can use their energy pyramid handout as a reference/aid for this handout.



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- The teacher will circulate as students work (either individually or in their groups) and ask probing questions (relating to human interaction or to check retention on class discussion of energy/ecological pyramid).
- Lastly, the teacher will collect the Handouts.

EVALUATION (throughout entire lesson)

- This will occur throughout the lesson, through either Formative or Summative assessments.
- Formative Assessment:
 - Teacher actively listening to students, while circulating the room during activities
 - Student responses to the warm-up question (Engage) and group discussion or mini-lecture on reviewing food chains (start of Explore Part 1).
 - Student presentations (within the group), and presentations (towards the class)
- Summative Assessment:
 - Student responses to the Handouts for the Exploration part 2 and Elaboration.

SOURCES AND RESOURCES

- Dr. Greg Stunz's *Hot Science – Cool Talks #119*, “Save the...Sharks!?”, https://youtu.be/deD0b_xlt68
- Shark Research Institute, <https://www.sharks.org/species>
- World Wildlife Fund, <https://www.worldwildlife.org/species/shark>
- Smithsonian - Ocean, <https://ocean.si.edu/ocean-life/sharks-rays/sharks>
- Florida Museum, <https://www.floridamuseum.ufl.edu/discover-fish/teaching-resources/shark-classroom-activities/shark-species-in-depth/>
- Sea World, <https://seaworld.org/animals/all-about/sharks-and-rays/diet/>
- NOAA Fisheries, <https://www.fisheries.noaa.gov/fish-sharks>

Good resources for accommodating students(suggestions):

- Ecosystem Ecology: Links in the Chain, <https://www.youtube.com/watch?v=v6ubvEJ3KGM>
Explains the difference between food chains/food webs
- Coastal Food Webs, <https://www.youtube.com/watch?v=LVJ5BKcAhAg>
- Food Chain, <https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/a/food-chains-food-webs>



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TEACHER HANDOUT FOR EXPLORATION PART 2:

Name: _____ key _____

Shark Food Webs:

Directions:

Students will be conducting research over a certain shark species that is being chosen by them. (resource: They will be creating a food web around their shark species. They must also research food sources that connect towards the primary sources a shark may consume. The goal is to create a food web that shows multiple different relationships. (Their food webs will be drawn on the back of this handout)

Shark Species Name: _____

Research requirements:

Shark:

1. Region the shark lives in

Answers may vary

2. Dietary habits

Answers may vary

3. Three direct food sources

Answers may vary

4. Role they play in their ecosystem

Answers may vary

Three direct food sources:

1. Species name

Answers may vary

2. Food sources (at least 1-2)

Answers may vary



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Food Web:

Information from the front page should able students to create their own food webs below. Requirements for their food webs:

- They should use arrows to show the relationships between species and the transfer of energy between them.
 - Arrows must be show in the proper direction.
- They should include a primary source of energy and a decomposer.
- Food webs should show interconnecting relationships between their organisms.



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STUDENT HANDOUT FOR EXPLORATION PART 2:

Name: _____

Shark Food Webs:

Directions:

You will be conducting research over a certain shark species that you have chosen. You will be creating a food web around your shark species. You must also research food sources that connect towards the primary sources a shark may consume. The goal is to create a food web that shows multiple different relationships. (Draw your food webs on the back of this handout.)

Shark Species Name: _____

Research requirements:

Shark:

1. Region the shark lives in
2. Dietary habits
3. Three direct food sources
4. Role they play in their ecosystem

Three direct food sources:

1. Species name
2. Food sources (at least 1-2)



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Food Web:

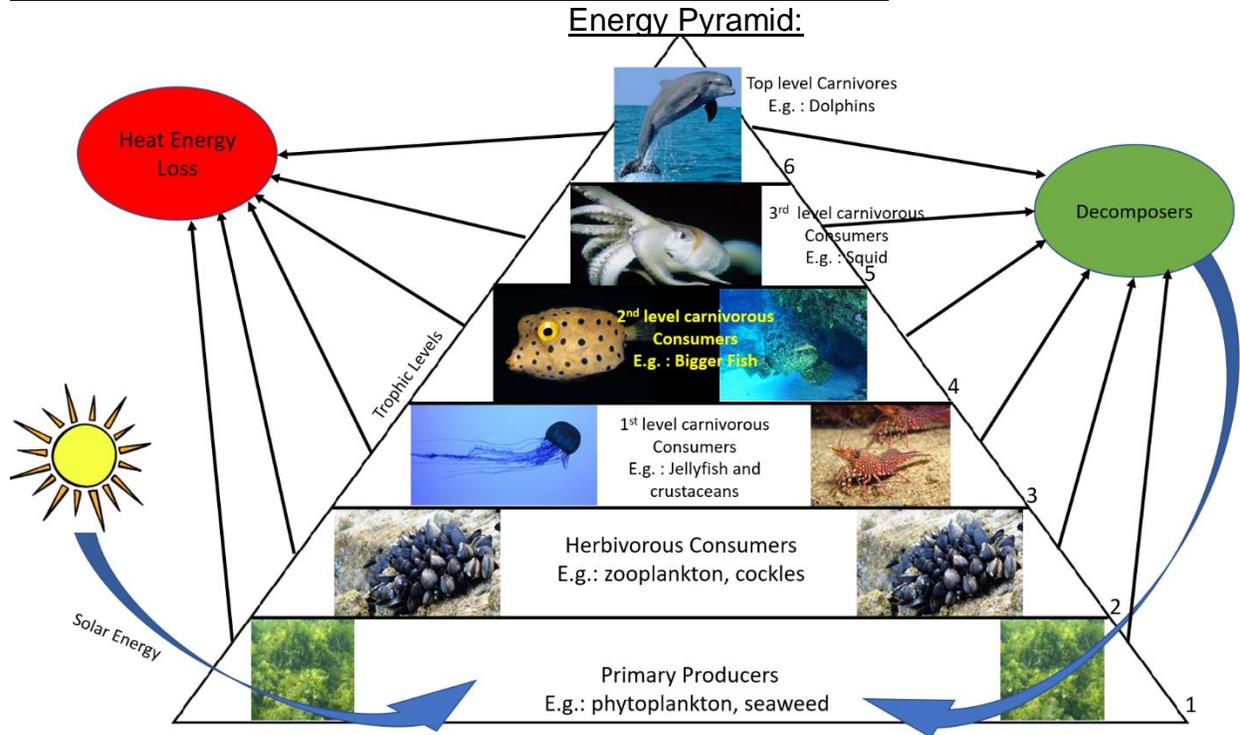
Make sure to use the information you researched from the front page to construct your web down below.

Use arrows to show the relationships between species and transfer of energy between them. Include a primary source of energy and decomposer.



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TEACHER HANDOUT FOR THE ELABORATION ACTIVITY:



The Teacher will extend on the relationships between organisms through an energy pyramid. Using a projector/board, the energy pyramid above should be posted.

The main goal of the teacher for the elaboration is to discuss processes/relationships that occur in the energy pyramid.

- Teacher should explain:
 - Energy transfer among trophic levels
 - 10% rule.
 - Energy is lost as we go up the pyramid because only 10% of energy is transferred between trophic levels.

Lastly, the teacher should ask the students to come up with a short definition of the energy pyramid:

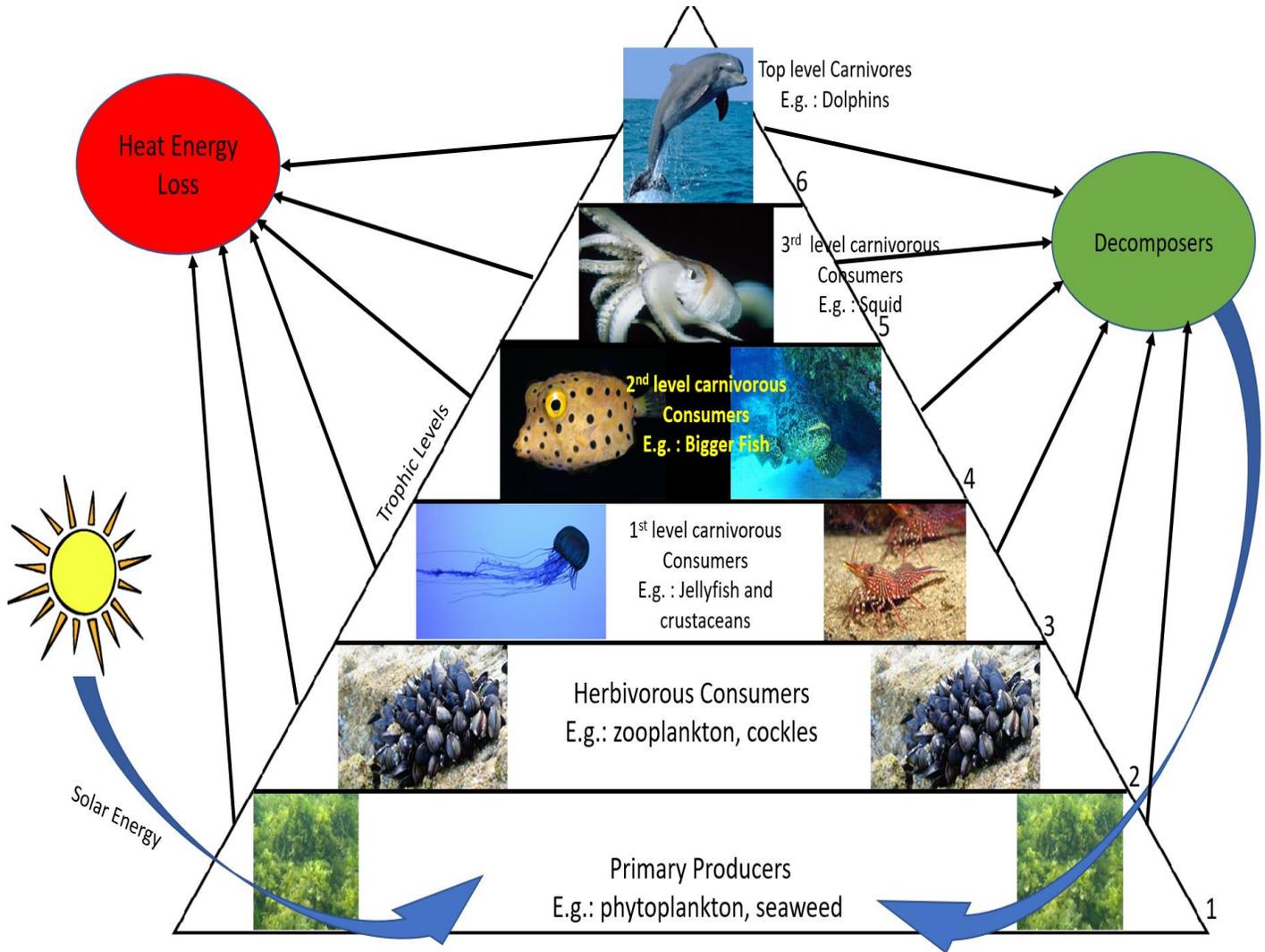
Energy pyramid- shows us how energy is transferred from one organism to another on a food chain/web.

STUDENT HANDOUT FOR THE ELABORATION ACTIVITY:

Procedure: Students will be handed 1 of these handouts as a reference and will be told to use this handout and the internet, if needed, to help them answer the Energy Pyramid Handout Questions.



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Energy Pyramid:



Energy Pyramid definition: _____



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STUDENT HANDOUT FOR ELABORATION:

Name: _____

Energy Pyramid and Human Interactions:

1. What is the original source of energy for your food web?
2. What directly consumes energy from your response to Question 1? What do we call this? (Hint: Look at the bolded names on each level of the provided Food Pyramid)
3. Where does your individual shark fall on your energy pyramid (using your group food web and the Energy Pyramid reference handout)?
4. What are three differences between an energy pyramid and food web? (Using the visual models and Internet, if needed).

Energy Pyramid:

Food Web:

5. How can humans affect your shark directly?
6. How can humans indirectly affect your shark? (Hint: consider the lower levels (on the pyramid), or separate bubbles representing other non-shark species connected to your shark)



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7. Part A: Looking at the picture below of plastic in the ocean, as well as the Internet and your group food web, how do you think pollution in the ocean affect your food web?



Source: <https://pixabay.com/photos/plastic-contamination-garbage-waste-3151246/>

Part B: How about for the endangered and threatened species?



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TEACHER HANDOUT FOR ELABORATION:

Name: _____ Key _____

Energy Pyramid and Human Interactions:

8. What is the original source of energy for your food web?

The Sun

9. What directly consumes energy from your response to Question 1? What do we call this? (Hint: Look at the bolded names on each level of the provided Energy Pyramid)

Phytoplankton, seaweed, etc. (student answers may vary)

10. Where does your individual shark fall on your energy pyramid (using your group food web and the Energy Pyramid reference handout)?

Top Carnivore (student answer may vary, if shark is atypical)

11. What are three differences between an energy pyramid and food web? (Using the visual models and Internet, if needed).

(Answers may vary)

Energy Pyramid: 1. shows energy movement, 2. is in the shape of a pyramid, 3. categorizes species (like primary producer, top carnivore)

Food Web: 1. shows species relationships, 2. is in the shape of a web, 3. shows complex relationships between multiple species within the same model

12. How can humans affect your shark directly?

Answers may vary

13. How can humans indirectly affect your shark? (Hint: consider the lower levels (on the pyramid), or separate bubbles representing other non-shark species connected to your shark)

Answers may vary, but should relate to other species (not the shark) being affected, which leads to negative effects in shark population.



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14. Part A: Looking at the picture below of plastic in the ocean, as well as the Internet and your group food web, how do you think pollution in the ocean can affect your food web?



Source: <https://pixabay.com/photos/plastic-contamination-garbage-waste-3151246/>

Plastic and other pollutants can affect small fish populations (as they choke on the plastics), fish and other prey may move away from contaminated waters, changing shark movements in the ocean, etc. (student responses may vary)

Part B: How about for the endangered and threatened species?

Student responses may vary according to specific endangered/threatened species listed for each group.