Moose Biology and Management

-A Unit for Rural High School Students-

Alaska Department of Fish and Game
Division of Wildlife Conservation

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2004

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Mike Taras, ADF&G -2004

Introduction: This unit is designed to bring a local issue into the classroom by incorporating moose biology and management, decreasing moose populations, and the impact that cow harvest has on these populations. This interdisciplinary unit is divided into five sections targeting high school students. Each session should require approximately 3 hours although this may vary depending on the extent to which some of the activities are addressed. The unit encourages participation from community members who can share historical, biological, and political knowledge. The unit utilizes several activities from the ADF&G *Alaska Wildlife Curriculum Series*; these activities are included as part of the unit. Utilizing this unit is a wonderful opportunity to incorporate a local issue into the classroom while providing lessons in Math, English, Biology, Technology, and Culture.

Environmental Education Goals: Awareness, Knowledge, Attitudes, Skill, Participation.

Unit Goal: The goal of this unit is for students to gain a basic understanding of moose biology and management and to realize the disproportionate role that cow moose play in the overall dynamics of moose populations, how harvesting bulls vs. cows affect the population differently, and to be able to make informed decisions about which animal they choose to harvest and how that effects the future of their resources.

Environmental Education Objectives:

- Understand basic population dynamics.
- Understand the living environment to be comprised interrelated, dynamic systems.
- Understand the influence of individual and group actions on the environment, and how groups can work to promote and balance interests.
- Understand cultural perspectives and dynamics and apply their understanding in context.
- Understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.
- Understand that humans are able to alter the physical environment to meet their needs and that there are limits to the environment's ability to absorb impacts or meet human needs.
- Understand that the importance and use of resources change over time and vary under different economic and technological systems.
- Evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems.
- Identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.

- Engage others in peer review conducted in the spirit of open inquiry.
- Communicate, evaluate, and justify their own views on environmental issues and alternative ways to address them.
- Decide whether action is needed in particular situations and whether they should be involved.
- Plan for action based on their research and analysis of an environmental issue.
- Understand the importance of exercising the rights and responsibilities of citizenship.
- Understand that their actions can have broad consequences, accept responsibility for those consequences, and change their actions when necessary.

Activities and Material Included with this Unit:

- <u>Video</u> – "Interior Alaska Moose Management", Alaska Department of Fish and Game and U.S. Fish and Wildlife Service.

- <u>Cow Moose Circle Curriculum</u>- Alaska Department of Fish and Game and U.S. Fish and Wildlife Service.

- <u>CD Rom</u>- Cow Moose Circle Curriculum PowerPoint.

- <u>Alaska Wildlife Curriculum Activities</u>:

  - "Science, Technology, Society, and Wildlife"
  - "Population Explosions"
  - "Oh, Moose!"
  - "I propose"

- <u>Moose Management Puzzler and answer sheet.</u>

- <u>Background material from Alaska Wildlife Curriculum</u>

  - Wildlife Facts
    - Hunting regulation Vocabulary
    - Tracking Wildlife Regulations
    - Checks and Balances for Wildlife Regulations

  - Alaska Department of Fish and Game Wildlife Notebook Series – moose pages.

- <u>Region- specific and other relevant background material-</u> contact Alaska Department of Fish and Game to obtain relevant local materials.

<u>Examples include:</u>

  - Regional Advisory Committee contact information.
  - Moose Management Plan.
  - Moose Planning Newsletters.
  - Board of Fisheries and Game Newsletter, *All You Can Eat*
  - Federal Subsistence Management in AK.

Session 1- Building a foundation of moose knowledge

Purpose: Allow students to share and increase their knowledge about moose biology/ecology.

Objectives: At the end of this lesson students will be able to:
- Describe moose habitat
- List preferred moose foods
- Describe the subsistence importance of moose to their community
- Identify other various biological information about moose

State Standards Addressed: Science A-14, A-15, D-1, D-3, D-4
                                                       History B-3, C-1, C-4,

Teaching Strategy:

➢ Gets the students "hooked" into the unit by asking students to discuss moose issues in their region. How much do they know about moose biology and management? Stimulate them into seeking answers about moose populations, harvest, etc.

* One option may be to start with the "Science, Technology, Society and Wildlife" issue activity in section 4 of this unit and use that as your starting point. Others may want to build up basic knowledge before attempting this activity.

➢ Brainstorm with students. Have them list everything they know about moose. What don't they know? What would they like to know? How can they find out? Have students investigate and come up with answers to the unknown questions.

Materials: Dry-erase board**,** flip chart, markers, etc., interview sheet, Alaska Wildlife Notebook Series, Internet, books, other wildlife publications, etc. for research.

Procedure:
- Have students list everything they know about moose on a board or flipchart.
- Determine what they want to know about moose that they don't already know.
- Create a series of questions and develop a questionnaire of items they want to know.
- Have students interview someone at home, a knowledgeable hunter, Elder, etc. about moose, cow moose, reproduction, history of moose hunting, treatment of cow moose vs. bull moose in the past, etc. Whatever they generate from their question list.
- Investigate answers using the internet, Alaska Wildlife Notebook Series, or other resources that cover moose biology.
- Invite an elder to come in and talk about moose in the area, the historic uses and numbers of moose, any issues they are aware of about moose, etc. What is the difference between moose hunting today and 50 years ago? 100 years ago?
- Invite a biologist to come in and talk about moose and moose management, about regulations and why they exist.
- Review answers and provide information from biologists about moose biology, history in AK, populations, etc.

Evaluation: Use the student generated knowledge list and create a written exam.

Session 2 – Setting the Stage for Understanding Population Dynamics.

Purpose: Develop an understanding of factors that influence animal populations.

Objectives: At the end of this lesson students will be able to:
- Define predator, prey, carrying capacity, limiting factor, habitat
- Describe three possible reasons for population fluctuations
- Identify the basic principles of predator/prey relationships.
- Students will be able to graph fluctuations in moose populations using an activity-based model.

State Standards Addressed: Math A-3, A-4, A-6,
Science A-14

Teaching Strategy:

> ➢ Start out by engaging the students in the following activity from the *Alaska Wildlife Curriculum*:

> **Population Explosions** from *Alaska's Wildlife for the Future*. This activity will provide for a basic understanding of population dynamics, exponential growth, limiting factors, etc.

Brainstorm with students and write down everything they know about predators and prey and other factors that affect animal populations. You can ask them to:

> ➢ List all the predators they can think of in their area.
> ➢ List all the prey they can think of in their area.
> ➢ List pairs of predator / prey animals that are closely connected in their area. For example: lynx-hare, weasel-vole, wolf-moose, goshawk-hare, etc.
> ➢ Define predator, prey, habitat, limiting factors.
> ➢ Perform the following included activities taken from The Alaska Wildlife Curriculum, 2001.

> ***Oh, Moose** from *Alaska's Ecology*- this activity will allow students to explore habitat requirements, limiting factors on moose populations, the effects of predators on populations, and the natural fluctuations in populations and reasons why they might occur.

*(you may not have enough students to perform this activity. If not, try combining with other classes, include all ages, or have older students learn and facilitate the activity for the younger students.)

Materials: Alaska Wildlife notebook series, guest speakers, computer and internet for research, Alaska Wildlife Curriculum activities.

Session 3- What Do Cows Have To Do With It?

Purpose: The purpose of this lesson is to closely examine the role that cow moose play in the overall dynamics of the moose populations and to discover how many moose a cow is potentially responsible for in her lifetime.

Objectives: At the end of this lesson students will be able to:

- Describe that impact that not harvesting cow moose has on subsistence resources.
- Demonstrate the potential for population growth when cow moose are not hunted.
- Demonstrate knowledge of how cow moose reproduce in yearly cycles.
- Draw a pictorial demonstration of how many offspring a single cow is responsible for having in an average lifetime.
- Predict the consequences to moose populations from the effects of harvesting cow moose vs. bull moose.

State Standards Addressed: Math: A-6, B-2, C-1, C-2, C-3, D2, D-3
Reading: Performance Standard: 3, 7
Science: A-14, B-1,
Culture: E-2

Teaching Strategy: Utilize and guide the students through the **"Cow Moose Circle Curriculum"** CD PowerPoint developed by the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game. Also, view the seven and a half minute, **"Interior Alaska Moose Management Video"**.

Materials: Compact Disk: "Cow Moose Circle Curriculum", Computer, projector, VCR, Copies of handouts for each student**,** Video: "Interior Alaska Moose Management", the "Moose Management Puzzler" sheet.

Procedure:
- Follow the guidelines in the "Cow Moose Circle Curriculum" Guide. View the PowerPoint presentation with the students and watch the video.
- Have the students read the "Moose Management Puzzler." In pairs, have them come up with possible reasons for the puzzler.

Assessment: Given the biological assumptions in the curriculum, have students draw their own cow moose circle. Have the students write a summary of the video including their thoughts about how the **"Interior Alaska Moose Management Video"** may or may not apply to their own area.

Extensions: Have the students create different "Cow Moose Circles" using different biological scenarios. For example: change the calf survival rates and see what that does to the population.

Session 4 - Management of the resource

Purpose: To demonstrate how hunting regulations are developed through the Alaska Board of Game process, to demonstrate that individuals have an input into the regulatory process in their community, and to demonstrate how people can have different views about the same issue.

Objectives: At the end of this lesson students will be able to:
- Describe how regulations are developed through the Board of Game process.
- List community members who are on the local State Fish and Game Advisory Committee.
- Fill out a regulation proposal form.
- Define regulation vocabulary such as bag limit, board of game, drawing permit, game management unit, hunting regulations, permit hunt, and season.
- Describe why hunting regulations are put in place.
- Describe the role that local advisory committees play in management decisions.
- Prepare and propose solutions to low moose numbers in a given area.
- Participate in a big game household survey and describe how this information affects subsistence regulations (This was done in the Central Kuskokwim area).

State Standards Addressed: English: A-1, A-4, D-1, D-2,
Government: A-1, C-1, C-2, E-2, E-3, E-4, G-2, G-3, G-4
Culture: A-1, B-2, B-3, C-2, D-4, D-5, E-2

Teaching Strategy: Start a discussion about wildlife management and what role the public has in local management decisions.

Materials: *Alaska's Wildlife for the Future*, Wildlife Facts Sheets:
- Hunting Regulation Vocabulary
- Tracking Wildlife Regulations
- Checks and Balances for Wildlife Regulations

Alaska's Wildlife for the Future Activities:
- Science, Technology, Society, and Wildlife
- I propose… (extension activity)

Writing materials, research materials, web access, guest speakers.

Procedure: Ask students what they know about wildlife regulations. Why do they exist? Are they important? Review the Wildlife Fact Sheets: Hunting regulation vocabulary, Tracking Wildlife Regulations, and Checks and Balances for Wildlife Regulations. Invite a member of the local Advisory Committee to come speak to the class. Then perform the following activity using the issue: *A wildlife population that provides an important local harvest is declining. Should harvest be restricted? What would be the effect of restricted harvests on local people?*

Activity: Lead the students through:

> ➢ **"Science, Technology, Society, and Wildlife"** from The Alaska Wildlife Curriculum, 2001 in which students will analyze a wildlife management issue, investigate the issue and develop a solution.
> ➢ **"I Propose…!"** from The Alaska Wildlife Curriculum, 2001 in which students complete a sample regulation proposal form.
> ➢ **Subsistence Division Central Kuskokwim Big Game Survey –** teachers can incorporate the big game survey in this section. The students and teachers will receive training regarding the survey by ADF&G Subsistence Division Staff.

Assessment: Have the students draw a diagram of the regulatory process, including all of the steps and parties involved. Assess them on their participation in the Activity "Science, Technology, Society, and Wildlife."

Session 5- Deciding to take action

Purpose: For students to realize that community members play a role in resource decisions, to assess student's knowledge of this Unit by creating outreach material that will effectively inform the community about the role of cow moose in the overall health of moose populations.

Objectives: At the end of this lesson students will be able to:
- Express information about cow moose in a clear, concise manner.
- Use technology to express knowledge to the public.

State Standards Addressed: English: A-1, A-4, A-7, B-2, C1, C-2, C-5, D-1, and D-4
Arts: A-4
Technology: A-1, A-2, A-3, B-1, D-1, D-2

Teaching Strategy: Using all of the information they have learned, the students will create media, targeting their community, which conveys the message of cow moose in relationship to healthy moose populations.

Materials: Computer, PowerPoint, Publisher, Art Supplies, Poster board, printer.

Procedure: Have the students design, develop, and create some or all of the following:

- A Power Point presentation about cow moose and their role in recovering low density moose populations.
- Write an article for the regional newspaper about cow moose and their role in recovering low density moose populations.
- Create a brochure about cow moose and their role in the recovery of low density moose populations.
- Create a poster about cow moose and their role in the recovery of low density moose populations.

Assessment: Design a rubric for each of the above creations. They are the final assessment for the unit.

Bibliography

Alaska Department of Education (2003). *Content Standards for Alaska Students.*
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Alaska Department of Fish and Game (2001). *Alaska's Ecology, Alaska Wildlife Curriculum Teacher's Guide*. Wizard Works Publishing.
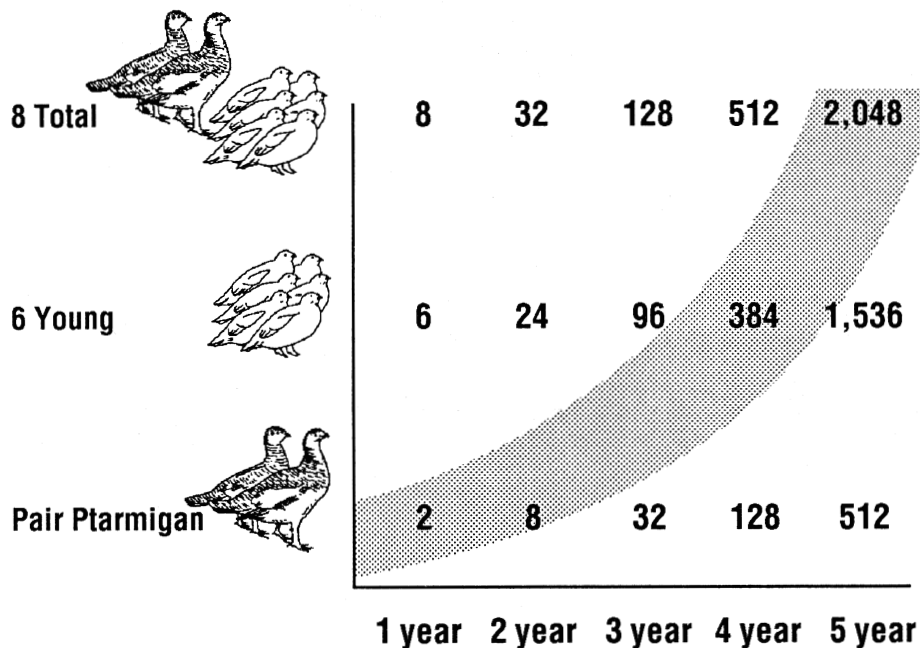
Alaska Department of Fish and Game (2001) *Wildlife for the Future, Alaska Wildlife Curriculum Teacher's Guide*. Wizard Works Publishing.

Alaska Department of Fish and Game/ U.S. Fish and Wildlife Service (2003). *Cow Moose Circle Curriculum, "Save the Cow Moose and Save the Culture"*. Internal publication.

Alaska Native Knowledge Network (1998). *Alaska Standards for Culturally-Responsive Schools.* Published by the Alaska Native Knowledge Network.

Population Explosions
2 EXTENSIONS

8 Total	8	32	128	512	2,048
6 Young	6	24	96	384	1,536
Pair Ptarmigan	2	8	32	128	512
	1 year	2 year	3 year	4 year	5 year

Grade level: 6 - 8

State Standards: M A-3, M A-4, M A-6

Subjects: Math, science

Skills: Addition, calculation, division, graphing, multiplication

Duration: 1 period

Group size: 1-3

Setting: Indoors

Vocabulary: Axis, exponential, graphs, linear, potential, reproductive rates, rate of population increase

Objectives:

1. Students will describe the potential for exponential growth in populations.

2. Students will list two factors that determine the rate of population growth.

Teaching Strategy:

Students discover the concept of exponential growth while calculating population sizes.

Complementary Activities:

"Graphic Populations" *and* "How Many Bears Can Live in this Forest?" *in this section*. "Gone Forever" *in Section 3*.

Materials:

For each student: graph paper, pencils, copies of "Population Explosion Problems Worksheet" and "Population Explosion Discussion Worksheet" (*following*).
OPTIONAL: calculators.

Background:

See INSIGHTS S*ection* 2, B*iodiversity and* P*opulations* – *Alaska's* D*ynamic* W*ildlife*: "P*opulation* E*xplosions*" **and "C*arrying* C*apacity*" **F*act* S*heets*.**

NOTE: In this activity your students assume that no deaths occur so that they can witness the implications of exponential growth. Other activities in this section illustrate the factors which slow or limit growth and stabilize or cause declines in populations.

Procedure:

1. Hand out the "Population Explosion Problems Worksheets." Students can work individually or in groups with calculators.

2. Ask students to discover what would happen to the two wildlife populations if animals continued to be born, but no animals died.

3. Students calculate the number of animals in each population for several years (assuming that no animals die and half of the young born in each generation are females) and graph their results.

4. Write the following equations on the board:

Reproductive rate =
   Number of young produced/female/year

Rate of population increase =
   Number of animals in the population in Year X

   Number of animals in the population in Year X- I

5. Students use these equations to determine and compare the reproductive rates and rates of population increase for each animal.
For example, a female vole produces six young three times a year, so the reproductive rate is 18 young/ female/ year. In Year 2, the rate of increase of the vole population will be 8,194 voles (number of voles at the end of Year 2) divided by 128 (number of voles after Year 1) for a 6,400 percent rate of increase.

6. Follow-up Discussion: The student groups should complete the "Population Explosion Discussion Questions" worksheet to prepare for a class discussion.

7. The class reviews the answers to the worksheets together.

Evaluation:
1. Describe the shape of the curve on a graph that showed the potential growth of a wolf population (or of another species). (A*ll students should draw the "J- shaped" curve associated with exponential growth.*)

2. Describe three factors that affect the rate of population growth. (N*umber of young born each year, how often female gives birth, age of female when she first gives birth.*)

EXTENSIONS:
A. **Research human population trends.** Students research human population growth and trends. Predict what will happen to the population in their community, in Alaska, the United States, the world. Create mathematical equations using the human population. Discuss how our growth affects wildlife.

B. **Calculate and graph salmon, eagle, whale populations.** Students calculate the number of animals in the following populations (*answers are given in italics*). Graph the growth for each population. Be sure to label each graph. Compare the growth rate of these populations with the vole and ptarmigan populations.

• A female **silver salmon** can lay 2,400 - 4,500 eggs once in her lifetime. Silver salmon only lay eggs when they are 4 years old and die soon after they spawn. Assuming all eggs survive to adulthood, each female salmon laid 3,000 eggs, and half of the eggs are female, how many salmon would there be after 2, 3, 4, or 5 years if there was 1 pair in Year 1?

(B*ecause silver salmon don't spawn until they are 4 years old, there will be 3,000 salmon in Years 1,2 and 3. During Year 4, 1,500 females will produce 3,000 eggs each for a total of 4,500,000 eggs. The total salmon in Year 4 would be 4,500,000 since the original breeding adults die almost immediately after spawning. In Year five the total population of silver salmon is 4,500,000.*)
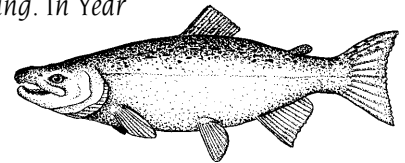
Note**:** The next two problems are more difficult because of the lag time before animals begin reproducing. You may want to work them out as a class, following each generation and its reproduction through several years or give them as extra-credit problems. The "Tables for Eagle and Whale Populations" (*following*) will help students keep track of the populations.
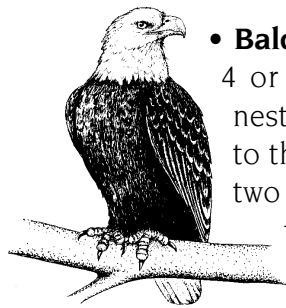
• **Bald eagles** first nest when they are 4 or 5 years old. Once they begin nesting, a pair of adults can raise up to three chicks each year, but one or two young is more common. Assume that eagles pair up and nest when they are 5 years old, after which they nest every year. Each pair of nesting birds produces two healthy eaglets. Starting with one pair of eagles which breed in Year 1, how many eagles would there be after 2, 4, 8, 12 years? Remember that only half of the young will be female.

(T*he eagle population will be 6 at the end of Year 2, 10 at the end of Year 4, 30 after Year 8, and 90 after Year 12.*)

• **Humpback** whales can raise only one calf every two years. Young whales don't breed until they are 6 -12 years old. Assume they begin breeding when they are 9 years old. One pair of whales breeds in Year 1 and produces a female calf. Assuming only half the calves are females, how many whales would there be at the end of Year 2? Year 4 ? Years 6? Year 12? *Don't forget the lag time between birth and breeding - and that only females give birth to calves*. The first calf will be ready to breed in 9 years, however, it will have to wait for a second calf of the opposite sex, before it can breed**.**

(The whale population will be 3 after Year 2, 4 after Year 4, 6 after Year 8, 9 after Year 12. It would take 12 years to produce two calves old enough to breed; one would be 9 years old at the end of Year 9 and the second would be 9 years old at the end of Year 11.)

Credits:
Adapted from *Alaska Wildlife Week: Wildlife for the Future*, Alaska Department of Fish and Game, Anchorage, AK, 1985; and *Teach About Geese*. US Fish and Wildlife Service, Anchorage, AK, 1988.

Curriculum Connections:
(See appendix for full citations)

The Bald Eagle Returns (Patent)

Biodiversity (Patent)

Come Back Salmon (Cone)

Endangered Animals: 140 Species in Full Color (Kest)

Websites:
Alaska Science Forum <www.gi.alaska.edu/ ScienceForum> Articles of particular interest: *Double Trouble* #838 and *Innumerable Whales* #1178 and numerous articles on salmon populations.
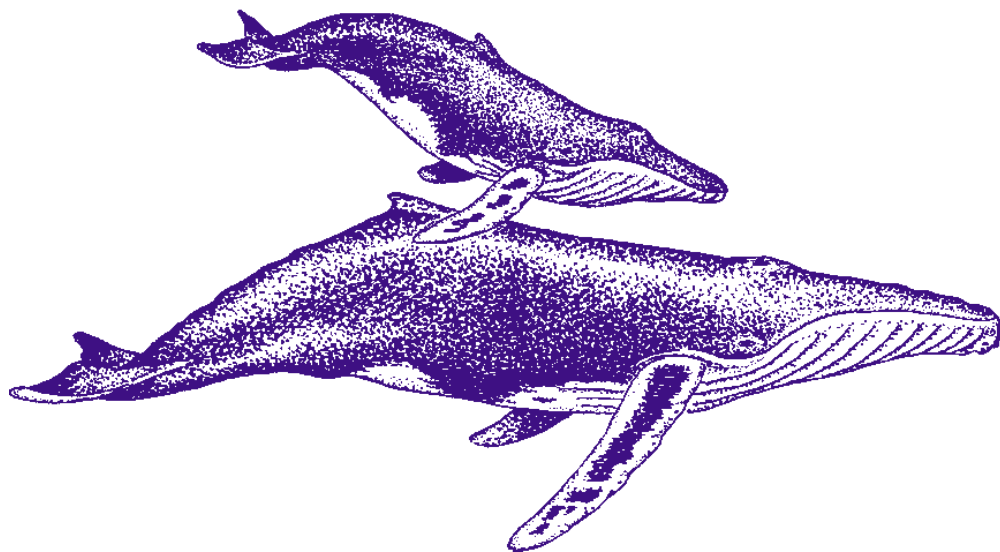
Animal Diversity Web **<**animaldiversity.ummz.umich.edu>
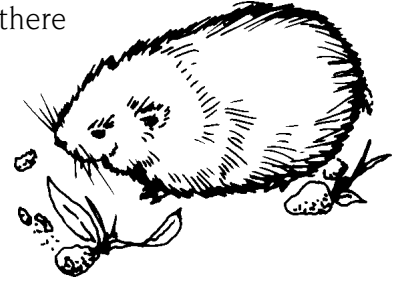
World Population Awareness <www.overpopulation.org>

Teacher Resources:
(See appendix)

Population Explosion Problems Worksheet

1. What would happen to a population of **red-backed voles**? In Year 1, there are 2 voles, a male and female. Each female can produce 5-9 young each time she bears a litter and she can bear young 3-4 times each year. Young voles can breed at 3 weeks of age (so they are ready for the next breeding in this exercise). How many voles will there be at the end of year 1, 2, 3, 4 and 5? **(Assuming no voles died, each female had 6 young in each litter, and each vole alive at the beginning of the summer bred 3 times.)**

YEAR 1:

lst breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females)   x 6= _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults)
_____ adults produced _____ young, total of _____

2nd breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 6 = _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults)
_____ adults produced _____ young, total of _____

3rd breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 6 = _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults)

YEAR 2:

lst breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 6 = _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults)

2nd breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 6 = _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults)

3rd breeding
_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 6 = _____ (number of young)
_____ (number of young) + _____ (number of adults) = _____ (total adults at end of year 2)

(*repeat for Years 3, 4 and 5*)

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Population Explosion Problems Worksheet

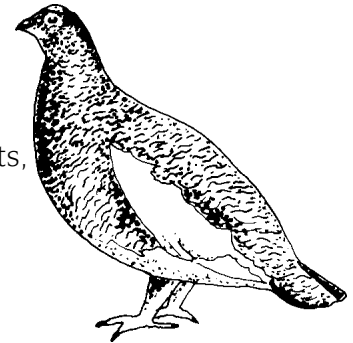**VOLESCONTINUED**

Year 3 - total adults at end of:

1st breeding _____ 2nd Breeding _____ 3rd breeding _____

Year 4 - total adults at end of:

1st breeding _____ 2nd Breeding _____ 3rd breeding _____

Year 5 - total adults at end of:

1st breeding _____ 2nd Breeding _____ 3rd breeding _____

2. What happens to this ptarmigan population? In Year 1 there are 2 adults, I male and 1 female. Ptarmigan can begin nesting when 1 year old, and each female lays 8 eggs. How many ptarmigan will there be at the end of Year 1_____, Year 2_____, Year 3_____, Year 4_____, Year 5_____?

YEAR 1:

_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 8 = _____ (number of young)
_____ (number of young) + 2 (number of adults) = _____ (total adults)

YEAR 2:

_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 8 = _____ (number of young)
_____ (number of young) + 2 (number of adults) = _____ (total adults)

YEAR 3:

_____ (number of adults) ÷ 2 = _____ (number of females)
_____ (number of females) x 8 = _____ (number of young)
_____ (number of young) + 2 (number of adults) = _____ (total adults)

(repeat for Years 4 and 5)

Option: how many ptarmigan will there be after year 10?

B. Graph the growth for each population. Be sure to label each graph.

How are the graphs similar?

How are the graphs different?

Why are they different?

What factors determine the reproductive rate of a species?

Population Explosion Answers

1. What would happen to a population of **red-backed voles**? In Year 1, there are 2 voles, a male and female. Each female can produce 5-9 young each time she bears a litter and she can bear young 3-4 times each year. Young voles can breed at 3 weeks of age (so they are ready for the next breeding in this exercise). How many voles will there be at the end of year 1, 2, 3, 4 and 5? **(Assuming no voles died, each female had 6 young in each litter, and each vole alive at the beginning of the summer bred 3 times.)**
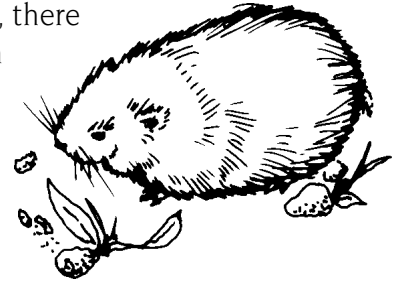
YEAR 1:

lst breeding
  __2__ (number of adults) ÷ 2 = __1__ (number of females)
  __1__ (number of females) x 6 = __6__ (number of young)
  __6__ (number of young) + __2__ (number of adults) = __8__ (total adults)
  __2__ adults produced __6__ young, total of __8__

2nd breeding
  __8__ (number of adults) ÷ 2 = __4__ (number of females)
  __4__ (number of females) x 6 = __24__ (number of young)
  __24__ (number of young) + __8__ (number of adults) = __32__ (total adults)
  __8__ adults produced __24__ young, total of __32__

3rd breeding
  __32__ (number of adults) ÷ 2 = __16__ (number of females)
  __16__ (number of females) x 6 = __96__ (number of young)
  __96__ (number of young) + __32__ (number of adults) = __128__ (total adults)

YEAR 2:

lst breeding
  __128__ (number of adults) ÷ 2 = __64__ (number of females)
  __64__ (number of females) x 6 = __384__ (number of young)
  __384__ (number of young) + __128__ (number of adults) = __512__ (total adults)

2nd breeding
  __512__ (number of adults) ÷ 2 = __256__ (number of females)
  __256__ (number of females) x 6 = __1,536__ (number of young)
  __1,536__ (number of young) + __512__ (number of adults) = __2,048__ (total adults)

3rd breeding
  __2,048__ (number of adults) ÷ 2 = __1,024__ (number of females)
  __1,024__ (number of females) x 6 = __6,144__ (number of young)
  __6,144__ (number of young) + __2,048__ (number of adults) = __8,192__ (total adults at end of year 2)

(repeat for Years 3, 4 and 5)

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Population Explosion Answers

VOLES CONTINUED

Year 3 - total adults at end of:

1st breeding __32,778__   2nd Breeding __131,072__   3rd breeding __524,288__

Year 4 - total adults at end of:

1st breeding __2,097,152__   2nd Breeding __8,388,608__   3rd breeding __33,554,432__

Year 5 - total adults at end of:

1st breeding __134,217,728__   2nd Breeding __536,897,912__   3rd breeding __2,147,483,648__

2. What happens to this ptarmigan population? In Year 1 there are 2 adults, I male and 1 female. Ptarmigan can begin nesting when 1 year old, and each female lays 8 eggs. How many ptarmigan will there be at the end of Year 1 __10__ , Year 2 __50__ , Year 3 __250__ , Year 4 __1,250__ , Year 5 __6,250__ ?
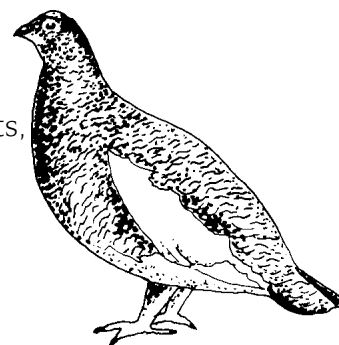
YEAR 1:

__2__ (number of adults) ÷ 2 = __1__ (number of females)

__1__ (number of females) x 8 = __8__ (number of young)

__8__ (number of young) + 2 (number of adults) = __10__ (total adults)

YEAR 2:

__10__ (number of adults) ÷ 2 = __5__ (number of females)

__5__ (number of females) x 8 = __40__ (number of young)

__40__ (number of young) + __10__ (number of adults) = __50__ (total adults)

YEAR 3:

__50__ (number of adults) ÷ 2 = __5__ (number of females)

__25__ (number of females) x 8 = __200__ (number of young)

__200__ (number of young) + __50__ (number of adults) = __250__ (total adults)

(repeat for Years 4 and 5)

Option: how many ptarmigan will there be after year 10? __19,531,250__

B. Graph the growth for each population. Be sure to label each graph.
How are the graphs similar? **(Both show exponential growth.)**

How are the graphs different? **(The voles increase more rapidly than the ptarmigan.)**

Why are they different? **(The voles breed three times each year.)**

What factors determine the reproductive rate of a species? **(Number of breeding females, how often they breed each year, number of young born each time a female gives birth, the age at which a female first gives birth. Mortality (deaths) also determines the number of animals added in each generation)**

Population Explosion
Discussion Questions

1. Compare the graphs and the annual rates of increase in each population. Describe the differences in the shape of the curves on the graphs. How does the rate of increase affect the shape of the curve?

2. What were the factors that affected the rate of population increase?

3. The results in the graphs assume that no animals died in any of the populations. How would you expect animal deaths to change the graphs?

4. If a catastrophe killed 90% of both the vole and ptarmigan populations, which population would recover more quickly? Why?

Population Explosion
Discussion Answers

1. Compare the graphs and the annual rates of increase in each population. Describe the differences in the shape of the curves on the graphs. How does the rate of increase affect the shape of the curve?

(The curve is J-shaped for each animal, but the curve takes longer to appear when the rate of increase is lower.)

2. What were the factors that affected the rate of population increase?

(1) number of young animals produced by each female, (2) how often the females had young, (3) the age at which the females began producing young, and (4) the population size.

3. The results in the graphs assume that no animals died in any of the populations. How would you expect animal deaths to change the graphs?

(It depends on the rate at which animals die in relation to the rate at which they are born. If more animals die than are added to the population each year, the curve will turn downward; if more are added than die, the curve will be upward, but not as steeply because the curve in the exercise assumes no deaths.)

4. If a catastrophe killed 90% of both the vole and ptarmigan populations, which population would recover more quickly? Why?

(The vole population would recover more quickly because the rate of increase for voles is greater than the rate of increase for ptarmigan. Voles produce more young each year and begin reproducing at an earlier age.)

Table for Eagle and Whale Populations

Eagle Table

Year	# of Adults - Female	# of Adults - Male	# of Juveniles Year 1	Year 2	Year 3	Year 4	Year 5	Total Population
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Whale Table

Year	# of Adults - Female	# of Adults - Male	# of Juveniles Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total Pop.
1											
2											
4											
6											
8											
10											
12											

POPULATION EXPLOSIONS

Linear or Exponential Growth?

EXAMPLE: Students. If a population were to increase linearally, it would grow at a constant rate. For example, if your class size increased at the linear rate of 2 students per year, at the end of 5 years, there would be 2 times 5, or 10 new students.
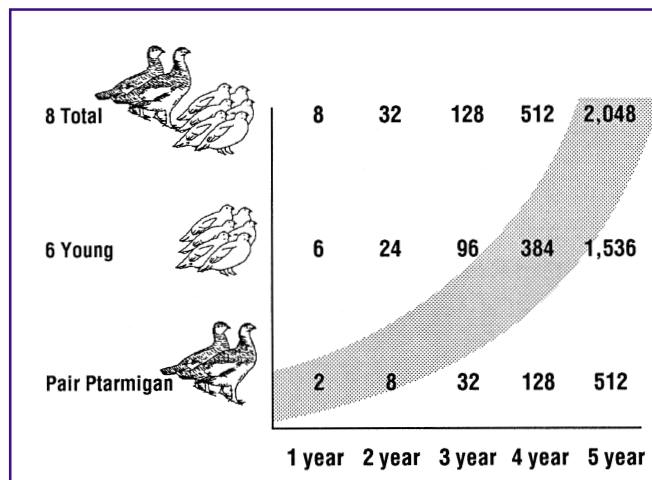
If, however, the number of students in your classroom increased **exponentially**, each year there could be two new students for each existing student. A class of 25 students would add 50 new students the first year. In the second year the 25 original and 50 new students (75 total) would increase by 150 new students. Those 225 students would grow to 675 and then to 2025 by the fifth year. **Exponential growth occurs at an increasing rate through time.**

Potential Rates

Most animal populations grow at an exponential rate because each female has the **potential** to give birth to more than one offspring in each generation. Thus, the number of females ultimately determines how fast the population can grow.

EXAMPLE: Ptarmigan. A pair could nest and raise 6 chicks in one year. The next year, if half of the chicks were female and all survived, the 3 chicks and the original female would each raise 6 chicks, 3 of which would be female who would, in turn, each raise 6 chicks.

At the end of two years, *assuming no deaths occurred*, the original population of 2 would have grown to 32. After 3 years there would be 128, in 5 years there would be 2,048, and after 9 years this imaginary ptarmigan population would have grown to include over a million birds.

Actual Rates

The larger the population is, the faster it grows. The faster it grows, the larger the population becomes. Although all animal populations have the potential to grow at an exponential rate, the actual **growth rate** for each species varies because each has a different pattern of births. The pattern or rate of births is influenced by:

(1) the time between generations
(2) the length of gestation (pregnancy)
(3) the number of young born each time a female gives birth
(4) the age at which a female first gives birth
(5) the average reproductive life of females.

- Female red-backed voles produce 4 - 8 young up to 6 times each year and give birth to their first young at 3 - 6 weeks of age. In one year, one female red-backed vole can give birth to 24 - 48 young. That's a lot of voles!

- In contrast, humpback whales produce 1 calf every 2 years and begin breeding at 6 to 12 years old.

Factor in Deaths

In reality, animal populations do not grow as rapidly as their reproductive rate would predict because deaths occur. The size of a population at any point is a result of both births and deaths.

	1 year	2 year	3 year	4 year	5 year
8 Total	8	32	128	512	2,048
6 Young	6	24	96	384	1,536
Pair Ptarmigan	2	8	32	128	512

For example, a biologist surveys a moose population each winter. The change in the size of the population from one winter to the next is a result of both the number of calves that were born into the population and the number of adults and young that died.

PREDATOR-PREY

Predators often limit the population growth of the animals they eat. Prey populations, in turn, limit the size of predator populations if they are the only source of food available. If the prey animals eat plants, then plants also can affect this relationship.

Alaska's best example of a predator-prey-plant relationship is the cycle of lynx and snowshoe hare populations.
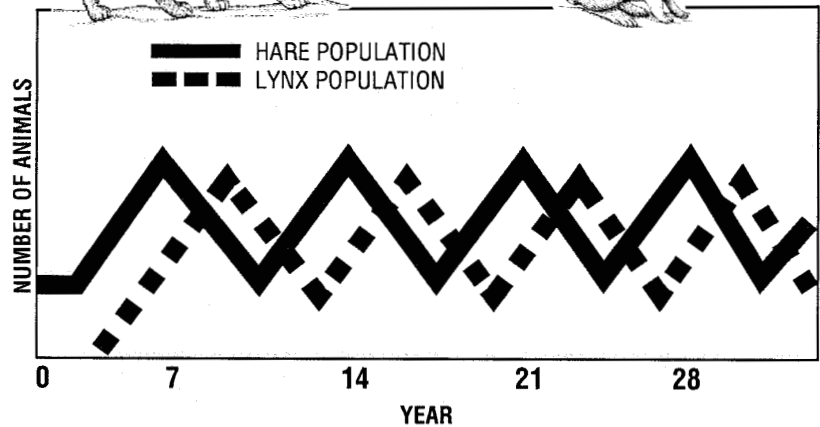
Snowshoe Hare Explosions

Snowshoe hares prefer early successional stages of forests (*see* Alaska's Forests &Wildlife). They need branches of willow, birch, and aspen at heights they can reach. Hares reproduce "like rabbits!" and multiply rapidly.

As their population increases, they begin to destroy the plants they eat. In defense, gnawed willow and birch produce chemicals that either taste bad or affect the hare's ability to digest food. Without being able to eat their favorite foods and consuming all others, many hares starve. Others may become diseased. Their once-high population drops ("crashes") to a low level within 2 - 3 years.

Without the pressure of browsing hares, the vegetation recovers. But it takes 3 - 5 years before snowshoe hares will have enough food to increase again.

Lynx is Right Behind

And what's happening to the lynx? Lynx are uniquely adapted to prey on snowshoe hares, their main food source. As hare numbers increase, more lynx kittens are born and survive. The lynx population will continue to rise until snowshoe hares crash.

The peak in the lynx population is usually a year behind the peak of snowshoe hares. Lynx can support themselves and their kittens on the still relatively abundant hares for an extra year or two, which adds to the hares' swift decline. Then, as hares become scarce, the lynx population crashes.
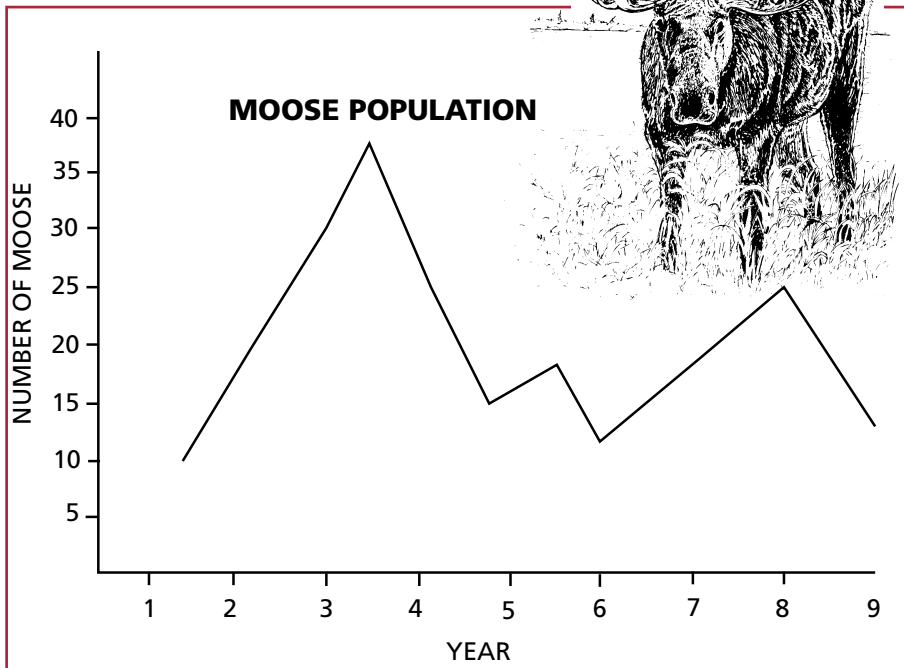
Predictable Cycles

The cycle of population explosion and crash in this predator-prey-plant-food chain may take 8 -14 years but is usually 9 - 11 years. This cyclic pattern, recorded for more than 200 years, occurs across most of northern North America with remarkable regularity.

Oh Moose!
3 EXTENSIONS

MOOSE POPULATION

NUMBER OF MOOSE

YEAR

Objectives:

1. Students will identify at least three things in an ecosystem necessary for an animal to survive.
2. Students will define "limiting factors," and identify which parts of an ecosystem can limit the growth of a population.
3. Students will describe how and why a population changes as its ecosystem changes.

Teaching Strategy:

Students participate in a game which shows how populations change in relation to the supply of food, water, and shelter.

NOTE: This activity is simplified to cover the basic concepts of habitat and limiting factors. For older students, please refer to the Extensions on page 17.

Complementary Activities:

"Create a Classroom Compost Box" *in this section.* "Investigating Mammals" *in Section 3. Also* "Create and Destroy" and "Spinning a Yarn about Ecosystems" in Section 4.

Materials:

Large area for running or walking; flip chart or chalkboard; writing materials.

Background:
See INSIGHTS S*ection 2, E*cosystems – Community Connections.

Procedure:

1. Ask students what animals need to survive? Review that all animals need **habitat** (*food, water, shelter, and space in which to live*). If animals do not have these necessities, they will die. Tell students that this activity involves finding these essentials for moose.

2. Separate the class so that 1/4 of the class becomes "moose" and 3/4 become the "habitat" components. Mark two lines parallel to each other and 10 to 20 yards apart. The moose stand behind one line. All habitat students stand behind the other line.

3. Each moose needs to find three habitat essentials: food, water, shelter. I*n this game, assume that moose have adequate space to live (represented by the* 10 *to* 20 *yard space between the moose and habitat*).

- FOOD: When a moose is looking for food, it holds its hands (*hooves*) over its stomach.
- WATER: When a moose is looking for water, it holds its hands over its mouth.
- SHELTER: When a moose is looking for shelter, it holds its hands over its head.

4. At the beginning of each round of the game, a moose can decide what to look for. Once each moose has chosen what to look for, it cannot change until the beginning of the next round. This is very important for the activity to be successful.

5. Each player in the habitat group randomly chooses to be one of the essentials – food, water, or shelter – at the beginning of each round. Once chosen, the habitat essential cannot be changed until the next round. These students use the same hand gestures as the moose to indicate their identity. I*f all the habitat players decide to be water one round, they could represent a flood year in that ecosystem.*

NOTE: For younger students, there may be a problem with changing roles during a round. You could hand out color-coded tokens to represent food, water, and shelter. Students choose the color corresponding to their habitat essential at the beginning of each round and return it to the supply at the end.

6. At the beginning of a round, all the students line up on their lines with their backs facing the players on the opposite line.

7. The teacher or leader asks all the players to make the appropriate hand gestures for food, shelter or water.

8. Count "One, Two, Three," and all the students turn around to see the other group. Moose continue to hold their hand gestures and walk to a player at the other line displaying the same habitat hand gesture. They escort the habitat essential person (food/water/shelter) back to the moose line.

- *Successful moose survive and are able to reproduce. If a moose does not obtain its needed essential, it "dies" and turns into a habitat component for the next round.*

- *If more than one moose picks the same habitat element, the one arriving first is the survivor.*

- *If habitat components are not used by the moose, they stay at their line for the next round, when they can choose to represent a different habitat component.*

9. Have one student keep track of the number of moose at the beginning of each round of play. Play the game for 8-15 rounds, keeping track of the numbers of moose.

10. At the end of the game, ask the players to tell what they observed happening to the moose population during the game.

- *They should note that the moose population increased for several rounds, while the herd found plenty of food/water/shelter.*

- *After a few rounds, however, the larger herd would not find enough to satisfy its needs. The moose herd would decrease due to lack of water, food, or shelter.* The causes of the moose population decline are called **limiting factors**.

11. Individually or as a group, students graph the numbers of moose as if each round was a year. The graph will show the ups and downs of the moose population as the supply of food/water/shelter changed. I*t is important to realize that a healthy habitat means a healthy wildlife population.*

12. In class discussion, ask what animals need to survive. How does the supply of each habitat component affect the population of moose? Does a population always stay the same? Or is there some other pattern to describe what happens over time? How does the idea of "balance" in nature apply to the habitat and population of an organism? Is there actually a constant balance in an ecosystem or is there another way to describe what actually happens?

Evaluation:
1. Students give three examples of factors that limit the size of a particular population and describe what is meant by the term "limiting factor."

2. Students graph the changes in population numbers over time.

3. Students define a balanced population or "the balance of nature."

EXTENSIONS:

A. **Play the game with predators.** As the game progresses, introduce one predator such as a wolf, bear, or human who has to hop or skip (*for safety*). A predator can "catch" (*tag*) its moose prey with two hands as the moose runs toward the food/ water/ shelter.

Once the moose is tagged, the predator takes the moose off the playing field, to a designated area to eat, cache, or butcher the animal. The "dead" moose then become an additional predator and both predators return to the game.

As with the moose, if a predator does not obtain food, it dies and becomes a habitat component. Have the student recorder keep track of the number of predators as well as the number of moose. Later, this information can be added to the graphs.

With older students, study concepts of predator/prey relations as they effect population, in depth. Have students investigate and discuss the complexities of predator management in Alaska. Allow time for research, opinion writing, and possible debate. For assistance with such resource, contact your local Fish and Game office or the Division of Wildlife Conservation's Wildlife Education Program.

B. **Discuss reproductive capacity (with older students).** In the above activity all moose are treated as females capable of only one offspring. Contact your local Fish and Game office for more information on moose reproduction. Have older students re-design the activity taking reproduction into account with some moose as male, others as female. Identify years where reproductive rates are high or low to illustrate the impacts of reproductivity on population.

C. **Discuss and graph local population data.** Population records may be available for certain species in your area. Contact your local ADF&G office to request this data for use in the activity. Discuss past trends and changes in your local population.

D. **Describe limiting factors for other species.** Students describe some limiting factors of other species including humans. What habitat components are affected by flood, fire, volcanic eruption, pollution, human development, and human recreational activity? How do hunting/trapping/ viewing affect wildlife populations?

Credits:
Adapted from "Oh, Deer!" Project WILD Activity Guide. Western Regional Environmental Education Council, 1992.

Curriculum Connections:
(See appendix for full citations)

Books:
Deneki (Berry)

Disappearing Lake: Nature's Magic in Denali National Park (Miller)

Moose for Kids (Fair)

Our Endangered Planet: Life on Land (Hoff)

Out Among Wolves (Murray) (Essay "The Importance of Predators" by David Rains Wallace and "Thinking Like a Mountain" by Aldo Leopold)

Wolves, Bears, and Their Prey in Alaska by the Committee on management of Wolf and Bear Populations in Alaska.

Media:
Into the Forest, Krill, Onto the Desert, Predator (Nature's Food Chain Games) (Ampersand Press)

The Wolf Kit. Contact the Division of Wildlife Conservation/Wildlife Education for loan information at (907) 267-2168.
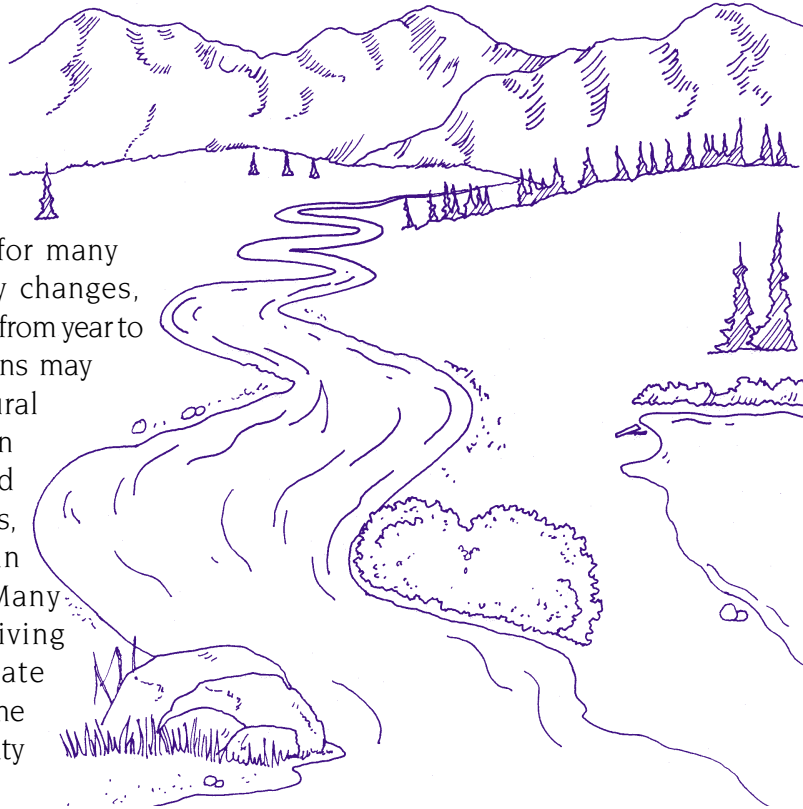
Teacher Resources:
(See appendix)

CARRYING CAPACITY

Carrying capacity may be defined as the number of plants or animals of a given species that an area of land or water can support. It is the largest **population** a unit of **habitat** can support on a year-round basis, or during the most critical period for the species.

Carrying capacity for many species constantly changes, both seasonally and from year to year. Yearly variations may be caused by natural disasters, changes in rainfall and temperature patterns, or human interventions. Many populations of living things fluctuate naturally around some level. Carrying capacity affects that level.

other and brown bears. Adult bears run adolescent bears out of the area or occasionally kill them. These young bears must keep moving until they find an area vacated by the death of an adult. If they do not find an area for themselves, eventually they will die.

A population may be *below* carrying capacity, such as in the spring following a hard winter, or temporarily *above* it. The latter situation inevitably results in a decline of the population by deaths through disease, emigration, and/or lowered reproductive rate until it drops below carrying capacity.

Black Bear Example

Black bear habitat limits populations especially through the influences of shelter, food supply, and the social tolerances or territoriality of the animal.

- **Shelter** or **cover** is a prime **limiting factor**. Black bears need thick cover to hide from each

- When **food** supplies are reduced, competition becomes more intense. Some adult bears might temporarily move to seldom-used portions of their home ranges, sometimes many miles away. Most bears, however, must live on what food is available in their area. These individuals may become thin, occasionally starve, or in the case of young bears, be killed or forced from the area by more aggressive adults.

Through these "adjustments," the total bear population remains within the carrying capacity of the habitat.

Science, Technology, Society, and Wildlife

Grade Level: 7 - 9
State Standards: L D-1, L D-2, CS B-2
Subjects: Science, social studies
Skills: Analyzing, drawing conclusion, inferring, communicating, research, speaking, writing
Duration: Varies
Group Size: Varies
Setting: Indoors
Vocabulary: Assumptions, beliefs, consensus, controversy, facts, interpretation, opinions, society, technology, values, wildlife
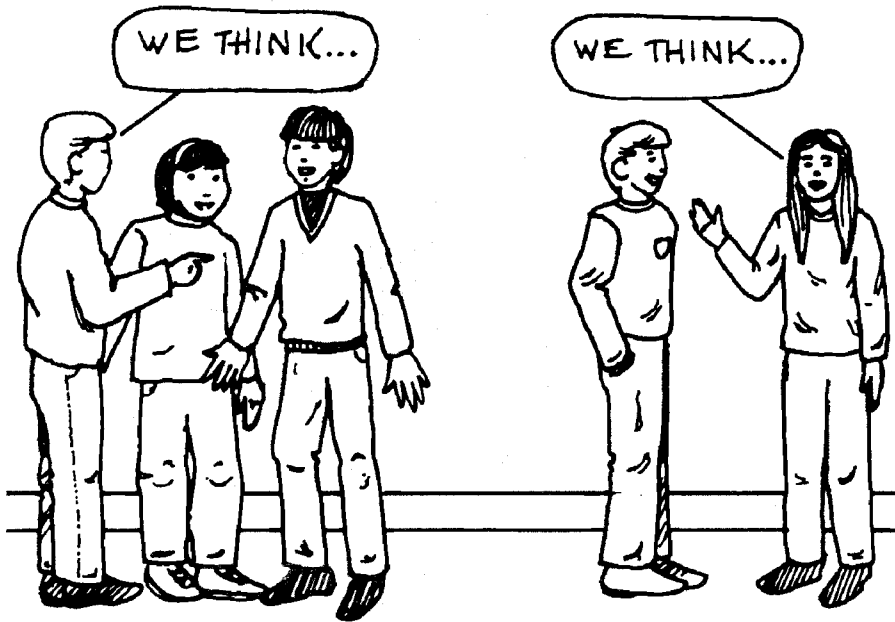
Objectives:

1. Students will analyze a wildlife management issue.

2. Students will investigate the issue.

3. Students will devise a solution(s).

Teaching Strategy:

Students select a wildlife management issue and develop an extended case study involving science processes, issue analysis, investigation, and problem-solving.

Complementary Activities:

"Eye of the Beholder," "Our Place in the Food Web," "Moose on the Loose" *and "Can Do!" in this section.*

Materials:

Writing materials; research materials such as newspapers, magazines, books, Internet, and guest speakers.

Background:

See INSIGHTS *Section 4, **Wildlife Conservation Is Up to Us!** "Teacher's Guide for Dealing with Differing Viewpoints."*

Procedure:

1. Select a wildlife issue with these characteristics: (*a*) *it is of interest to your students,* (*b*) *it has a variety of "sides" to the issue, and* (*c*) *there are no clear right or wrong solutions.* If possible, let students choose a local issue or present them with options based on your knowledge of the availability of resources in your community.

The following are examples of issues that can be adapted to local situations:

- A *wildlife population that provides an important local harvest is declining. Should harvests be restricted? What would be the effect of restricted harvests on local people?*

- A *large-scale development project (for example, a large mine or landfill) is proposed on public land. This project may effect important wildlife habitat in your local area. Should the development be permitted? What are the costs and benefits of the project to wildlife and to people?*

- A *wildlife species has been listed as threatened or endangered under the Endangered Species Act. Should activities be*

prohibited that might affect the species? What should be done through management to increase the population?

• *Other current, specific, wildlife issues such as predator management, or human-bear conflicts*

2. Find out what students already know and feel about the issue. Ask students to list the "**facts**" they know individually, then compare their list with one other person. The pair of students need to come to **consensus** on the "facts."

3. Each pair joins another pair to compare their list of "facts," and so on until a class list of "facts" is created.

4. Discuss the difference between facts, **assumptions**, and **interpretations**. Ask students to verify the accuracy of the fact list through research on the Internet, in the library, and by contacting experts. Discuss the role interpretation can play in determining how people think about an issue.

5. Through discussion, help students realize that facts often evoke positive and negative feelings people have about an issue, and these feelings can affect their ability to believe a fact and to make decisions. *This type of discussion can teach students to distinguish between facts which are true or false, and feelings/ beliefs/ and opinions which are only "false" if based on incorrect information.*

6. Brainstorm aspects of science, technology, and society that are involved in the issue (*see concept maps in this activity*). Each field has contributions to make to help to resolve the issue.

7. Students work in small groups to develop concept maps for each aspect of the issue. Correlate and develop a class concept map.

8. Identify the positions, beliefs, and values of the various players involved in the issue. Bring in guest speakers and provide research materials that address different opinions about an issue. *Be sure to balance the presentations among the various viewpoints and encourage active listening and responses.*

9. Develop an "issue web" concept map. Place the issue in the center and connect each viewpoint and its position, beliefs, and values back to the issue. The completed web gives the "big picture" of the issue and can be used to generate more questions for further research.

10. Help students research information about the issue and identify how citizens can become involved in a public decision-making process. The following are some examples:

• *Research how to develop a proposal for the Board of Game to change or create a hunting regulation (refer to flow chart in INSIGHTS Section 4).*

• *Find out who is responsible for gathering scientific data about a declining wildlife population and request information.*

• *Research traditional ecological knowledge about a declining wildlife population. Interview elders and active hunters.*

• *Research what has been planned and done so far to restore a threatened or endangered species. Or, find out what has been done to maintain a healthy population of animals. Write testimony and present it at a public meeting about the issue.*

• *Write a letter to the wildlife manager or public official who makes decisions about an issue, seeking additional information and creating a dialogue.*

11. Students develop several positions on the issue after they have gathered factual information and considered a variety of opinions, beliefs, and values that influence possible decisions. Split the class into smaller groups and have each group present one of the positions in either a written statement or debate format. Have them identify both the positive and negative consequences of their positions for both wildlife and different groups in society.

12. Discuss with the class the different solutions. Encourage students to reach consensus on a class position for the issue and develop an "action plan" to communicate their position. *Students should have the opportunity to develop individual "action plans" which fit their level of concern if the class is not in agreement.*

Evaluation:

Students develop a position on the issue and communicate it, using the public decision-making processes they have identified.

Curriculum Connections:

(See appendix for full citations)

Books:

Guardians of Wildlife (Chandler)

Put on Some Antlers and Walk Like a Moose (Sayre)

Websites:

Alaska Board of Game <www.state.ak.us/adfg>

Alaska Science Forum <www.gi.alaska.edu/ScienceForum>

Alaska Statewide Databases, accessed through your local library website or <sled.alaska.edu>
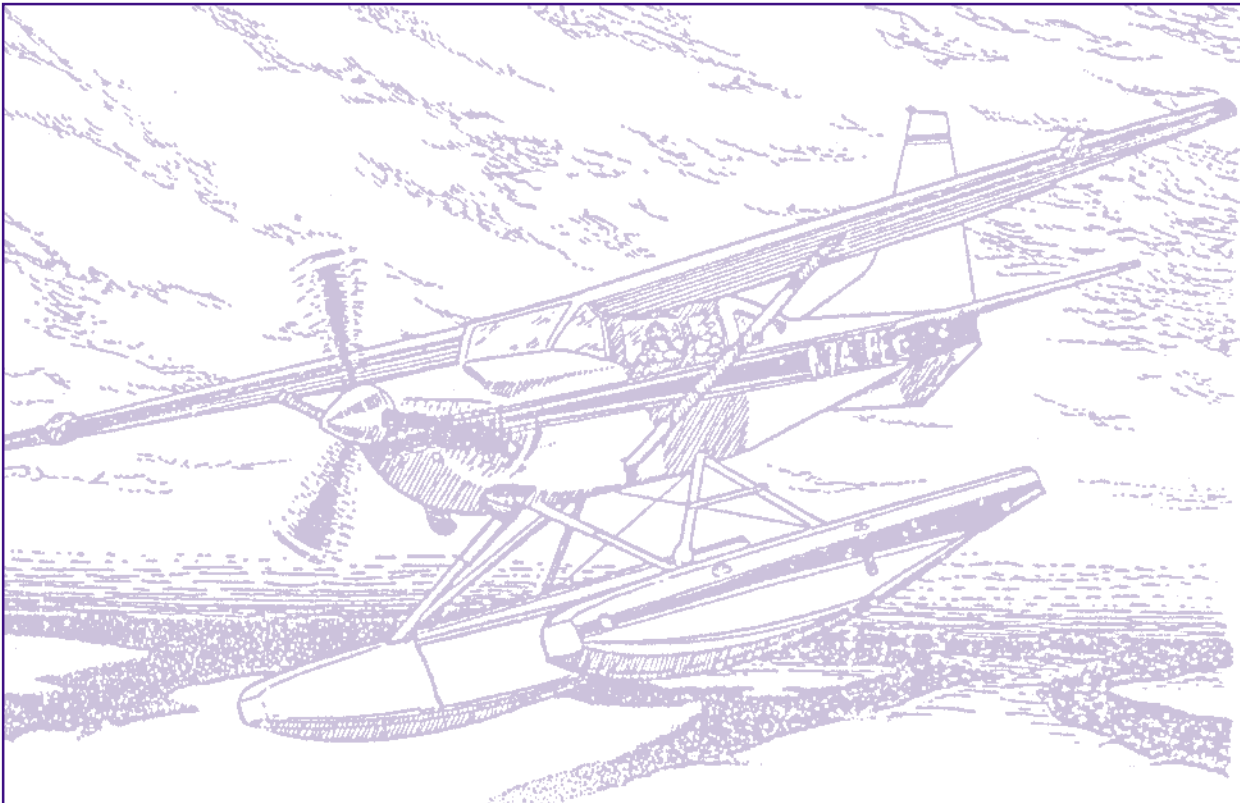
Current wildlife issues information <www.state.ak.us/adfg> and <www.r7.fws.gov>
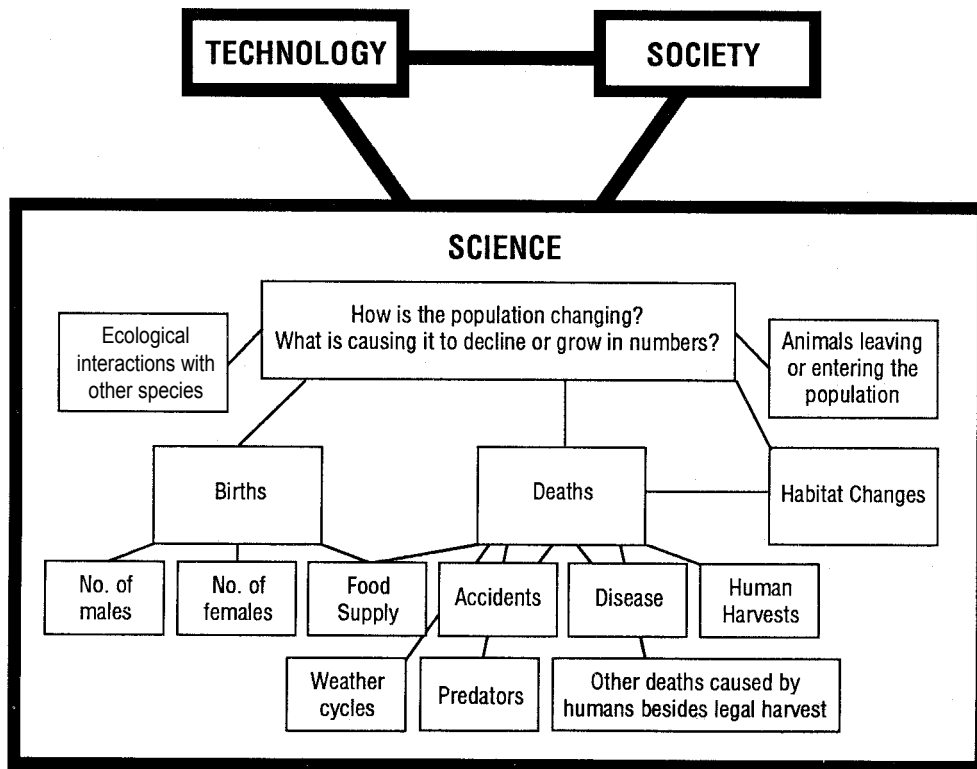
Environmental News Network <www.enn.com>

Staff-written Alaska newspaper articles: Anchorage *Daily News* Archives <www.adnsearch.com> or Fairbanks *Daily News-Miner* <www.newsminer.com>

Teacher Resources:

(See appendix)

CONCEPT MAP

TECHNOLOGY ——— **SOCIETY**

SCIENCE

How is the population changing?
What is causing it to decline or grow in numbers?

Ecological interactions with other species

Animals leaving or entering the population

Births

Deaths

Habitat Changes

No. of males

No. of females

Food Supply

Accidents

Disease

Human Harvests

Weather cycles

Predators

Other deaths caused by humans besides legal harvest

Concept Map A

Issue: A wildlife population that provides an important local harvest is declining. Should the harvest be restricted?

Weapons used

Economics of harvest

Cultural beliefs and attitudes

Attitudes toward fairness of harvest techniques

Access - airplane, ATV's, etc.

TECHNOLOGY

SOCIETY

Laws and law enforcement

Issue: Should a hunting regulation be changed to reduce harvest if a population is declining?

Equipment for gathering data about wildlife populations

Changes in numbers of hunters

Needs for food, fur, and other items

Biologists gather population data

Determine events that contributed to population decline

SCIENCE

Concept Map B

Issue: A large-scale development project is proposed on public land that will affect important wildlife habitat. Should it be permitted?

Cost of changing project to have less negative impacts on wildlife

Cost of pollution control

Jobs

Economics
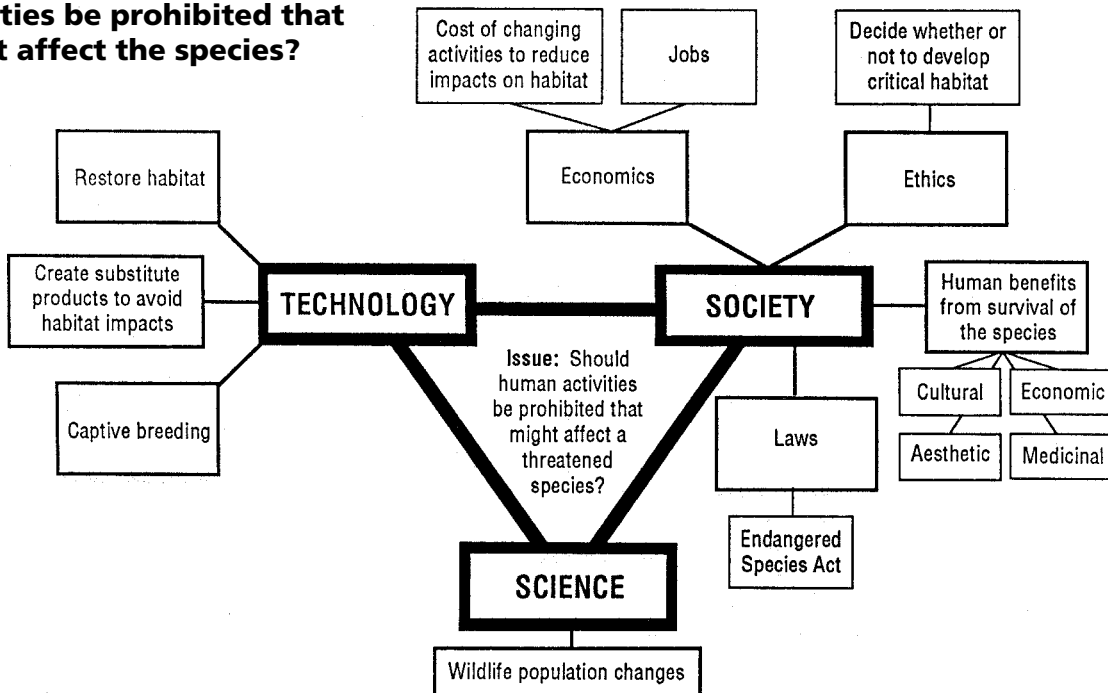
Land ownership rights

Pollution control

What can be done to reduce negative impacts on wildlife?

TECHNOLOGY

SOCIETY

Human values and attitudes

Restoring habitat after development

Issue: Should a large develoment project be permitted in an area of important wildlife habitat?

Laws

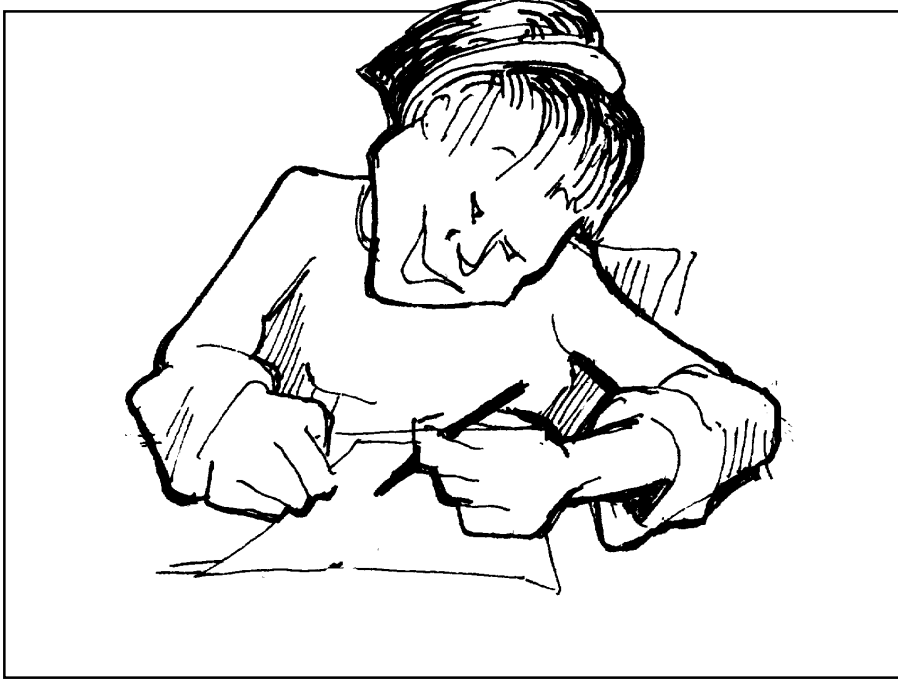Which species would be affected negatively?

SCIENCE

Concept Map C

Issue: A wildlife species has been listed as threatened under the Endangered Species Act. Should activities be prohibited that might affect the species?

Cost of changing activities to reduce impacts on habitat

Jobs

Decide whether or not to develop critical habitat

Restore habitat

Economics

Ethics

Create substitute products to avoid habitat impacts

TECHNOLOGY

SOCIETY

Human benefits from survival of the species

Captive breeding

Issue: Should human activities be prohibited that might affect a threatened species?

Cultural | Economic

Laws

Aesthetic | Medicinal

SCIENCE

Endangered Species Act

Wildlife population changes

I Propose ...!
3 EXTENSIONS

Grade Level: 9 - 12
State Standards: Gov A-1, Gov C-1, Gov C-2, Gov E-2, Gov E-3, Gov E-4, Gov G-2, Gov G-3, Gov G-4, L A-1, L A-4
Subjects: Government & citizenship, social studies, language arts
Skills: Reading, writing, problem-solving, and re-searching an issue
Duration: 3-4 sessions
Group Size: Small groups/ whole class
Setting: Indoors
Vocabulary: Board of Game, Fish and Game Advisory Commit-tees, game, permit, regulations, season, statutes, wildlife

Objectives:
Students will explain how regulations are created through the Board of Game process.

Teaching Strategy:
Students study a wildlife management issue in depth, study the wildlife regulatory process, and present a mock (or real) proposal to the Board of Game.

Complementary Activities:
"Eye of the Beholder," "Science, Technology, Society, and Wildlife," *and* "Can Do!" *in this section*.

Materials:
Information provided on the Alaska Department of Fish and Game website <www.state.ak.us/adfg> (regarding regulations, Board of Game proposals, wildlife populations, and issues. Paper, pens, chalk board, copies of *Regulation Proposal Form* (*following*).

Background:
See INSIGHTS S*ection 4, Wildlife Conservation Is Up to Us! "Hunting Regulation Vocabulary," "Tracking Wildlife Regulations" and "Check & Balances for* *Wildlife Regulations" Fact Sheets*; **and** *"Teacher's Guide for Dealing with Differing Viewpoints."*

Procedure:
IN ADVANCE, If possible, invite a member of the Fish and Game Advisory Committee to explain to students the Board of Game (or Board of Fish) process and discuss locally pertinent wildlife concerns.

If you are planning this activity concurrently with the actual Board of Game meeting, begin once the "**Call for Proposals**" is available (contact your local Fish and Game office or search the Department's website). Use the current *"Call for Proposals."* If you are not conducting this activity concurrently, access old proposals on the same website.

IN ADVANCE, review the "Teachers Guide for Dealing with Differing Viewpoints."

DAY ONE:
1. Brainstorm fish and wildlife related issues, recording these on butcher paper or the chalk board. (If students focus on fish, rather than game, this

activity can be adapted for fish regulations and the Board of Fish.)

2. Discuss the role of hunting (and/or fishing) in Alaska as it relates to managing wildlife populations.

3. Present background information (*from* INSIGHTS *and the website*).

4. Once students are clear about the Board of Game process, provide information about their local Fish and Game Advisory Committee.

5. Give the following assignment: Identify a local or regional wildlife issue or issues that each student wants to research and address.

DAY TWO:
1. On the chalk board, list all issues identified by students.

2. Divide into interest groups that will work together for the remainder of the project.

3. Using the following resources, students research the issue in depth, making sure to include their scientific and social influences:
• newspapers and other media
• the Internet
• the school library
• phone contacts/e-mails with Fish and Game Advisory Committee members, ADFG biologists, community members, etc.
• other sources identified by the students.

4. From that research, each student drafts a proposal for her or his group's issue.

5. Ask each group to integrate its drafts into one proposal. If there are distinctly different proposals, let the groups splinter into smaller groups. A*s with the actual Board of Game, there may be many approaches to a specific issue.*

DAY THREE:
1. Students present their finished proposals to the class. If there are several proposals relating to one issue, clump these together and conduct a discussion when all have been presented.

2. As a class, discuss the strengths and weaknesses of each proposal, both in presentation and content.

3. If possible, come to resolution on those solutions the class deems acceptable.

Evaluation:
1. Describe the process by which Alaska wildlife regulations are created and changed.

2. Write a strong regulation proposal with scientific and accurate background information.

EXTENSIONS:
A. **Submit proposals to the Board.** If student-generated proposals are deemed feasible by the class AND if students have permission from their parents (*and you from your administration*), students submit their proposals to the Board of Game and follow them through the process.

B. **Attend meetings and take notes.** Attend Fish and Game Advisory Committee and/or Board of Game meetings. Students record meeting notes and their observations of people providing testimony as well as the committee/ board members. Back in class, students share their observations and discuss their views on the process.

C. **Civic lesson.** Introduce the concept of "checks and balances" in the democratic process. Using the "Checks & Balances for Wildlife Regulations" chart (*from* INSIGHTS S*ection* 4), ask students to find places within the Board of Game process where checks and balances exist. Ask students to identify areas where they think the process is effective or problematic. Compare this public process to other public processes to further identify strengths and weaknesses.

Credit:
Contributed by Robin Dublin, Alaska Department of Fish and Game, Anchorage, Alaska.

Curriculum Connections:
(See appendix for full citations)

Books:
Guardians of Wildlife (Chandler)

Websites:
Alaska Board of Game <www.state.ak.us/adfg>

Alaska Hunting Regulations and other related materials <www.state.ak.us/adfg>

Alaska Native Heritage Center <www.alaskanative.net> Links to Native Organizations and subsistence articles. Select Education, then Resources for links.

Alaska Outdoor Council <www.alaskaoutdoorcouncil.org> Official state affiliate of the NRA.

Alaska Science Forum <www.gi.alaska.edu/ScienceForum>

Alaska Statewide Databases, accessed through your local library website or <sled.alaska.edu>

Alaska Wildlife Alliance <www.akwildlife.org> For current wildlife issues.

Current wildlife issues information <www.state.ak.us/adfg> and <www.r7.fws.gov>

Office of Subsistence Management, Alaska Region <www.r7.fws.gov/asm/home.html>

Staff-written Alaska newspaper articles: Anchorage *Daily News* Archives <www.adnsearch.com> or Fairbanks *Daily News-Miner* <www.newsminer.com>

University of Alaska Justice Center <www.uaa.alaska.edu/just/links/natives.html> Links and information on the subsistence issue.

Teacher Resources:
(See appendix)

Sample Regulation Proposal Form

ALASKA BOARD OF FISHERIES AND ALASKA BOARD OF GAME
REGULATION PROPOSAL FORM, P.O. BOX 25526, JUNEAU, ALASKA 99802-5526

BOARD OF FISHERIES REGULATIONS		BOARD OF GAME REGULATIONS	
☐ Fishing Area _____		Game Management Unit (GMU) _____	
☐ Subsistence	☐ Personal Use	☐ Hunting	☐ Trapping
☐ Sport	☐ Commercial	☐ Subsistence	☐ Other _____
JOINT BOARD REGULATIONS		☐ Resident	
☐ Advisory Committee ☐ Regional Council ☐ Rural		☐ Nonresident	

> **Please answer all questions to the best of your ability. All answers will be printed in the proposal packets along with the proposer's name (address and phone numbers will not be published). Use separate forms for each proposal.**

1. Alaska Administrative Code Number 5 AAC_____   Regulation Book Page No._____

2. What is the problem you would like the Board to address?

3. What will happen if this problem is not solved?

4. What solution do you prefer? In other words, if the Board adopted your solution, what would the new regulation say?

5. Does your proposal address improving the quality of the resource harvested or products produced? If so, how?

6. Solutions to difficult problems benefit some people and hurt others:

A.   Who is likely to benefit if your solution is adopted?

B. Who is likely to suffer if your solution is adopted?

7. List any other solutions you considered and why you rejected them.	DO NOT WRITE HERE

Submitted By: Name _____
Individual or Group

Address_____ Zip Code_____ Phone_____

Exploring Wildlife Issues
3 EXTENSIONS

Grade Level: 9 - 12

State Standards: L A-1, L A-2, L A-4, L A-5, L B-1, L E-1, L E-2, L E-3, T E-4

Subjects: Language arts

Skills: Reading, writing, analyzing, categorizing, public speaking

Duration: 3-7 periods

Group Size: 1-4

Setting: Indoors

Vocabulary: Bias, values

Objectives:
1. Students will learn to read critically.
2. Students will use the Internet and library to gather supporting facts and opinions on a wildlife conservation issue.
3. Students will study a controversial issue related to wildlife conservation to learn that issues are often complex, requiring creative solutions.
4. Students will clarify their opinions regarding an issue and support their opinions with factual information.

Teaching Strategy:
Students research a wildlife conservation issue and write "Letters to the Editor" that are supported with pertinent and accurate information.

Complementary Activities:
"Eye of the Beholder" *in this section*.

Materials:
Newspaper articles related to a specific wildlife conservation issue; access to websites, biologists, community groups, books, and research papers, etc. Paper, pens, computers.

Background:
See INSIGHTS S*ection 4, Wildlife Conservation Is Up to Us!* "*Tracking Wildlife Regulations*" and "*Teacher's Guide for Dealing with Differing Viewpoints.*"

Procedure:
IN ADVANCE, gather news articles on a variety of wildlife conservation-related issues, ideally local. Review the "Teacher's Guide for Dealing with Differing Viewpoints."

DAY ONE
1. After students have browsed through your collection of news articles, ask them to decide on one issue for in-depth study.

2. Ask students to write a one-page paper **in class** stating their current opinions, knowledge, and feelings regarding this issue. Instruct them to include all facts that they know or believe to be true. *These papers should be written without additional research or discussion and will be reviewed when the project is completed.*

DAY TWO-FIVE *or* HOMEWORK
As a class, spend the next week or so gathering as much relevant information, articles, copies of applicable laws and regulations, court cases, news releases, biological data, land ownership information, and Board of Game information.
• If governmental agencies are involved, investigate their agency's mission.
• If non-profit organizations and advocacy groups are involved in this issue, gather information from them as well.
• Interview people in the community who are close to the issue making sure to ask people with a variety of viewpoints.
• Seek out everything you can find related to this issue, leaving no stone unturned!

DAY SIX
1. Divide the class into small groups that will review the gathered materials, analyze the content, and summarize each piece based on what it provides, without adding opinions of the reviewers regarding **bias**, accuracy, or **values**. *This will be a challenge to students who may read and strongly agree or disagree with what they are reading.* Instruct students to address the following:
• Name of organization and source (publication, etc.)
• Facts and opinions stated as factual in the written piece
• A one- or two-sentence summary of the article, report, etc.

2. Ask students to categorize the articles so similar positions are together.

3. Create new groups and ask each group to read through a pile and prepare to speak from that point of view, using facts and information offered in the materials they now posses.

4. Lead a discussion where all views are stated and listened to in a respectful manner.

HOMEWORK
1. Students now write their own opinion pieces in the form of "Letters to the Editor." Keep all written materials available for students to refer as they write.

2. Review and comment on these drafts for content

and use of opinions substantiated by accurate information and facts. Also provide feedback regarding grammar, spelling, sentence structure. Explain that a poorly written letter has less impact than a well-written letter.

3. Return letters to students for a final re-write. When letters are completed, grade and return.

4. If students wish to submit their letters for publication, parental letters of permission are recommended.

CONCLUSION
1. Return the original one-page assignment from the first session.

2. Ask students how their opinions changed after studying the issue in detail.

3. Lead a discussion on how their written work changed from the start of the project to the current time. What conclusions have the students drawn?

Evaluation:
Students read their final letters to the class aloud. These letters should provide an opinion, supported by strong arguments and relevant factual information. They should be persuasive as well.

Credits:
Contributed by Mike Sterling, Sand Lake School, Anchorage, Alaska; and Fay Pye and Jayne Kimmet, Alaska Pacific University, Anchorage, Alaska.

Curriculum Connections:
(See appendix for full citations)

Books:
Guardians of Wildlife (Chandler)

Websites:
Alaska Board of Game <www.state.ak.us/adfg>

Alaska Hunting Regulations and other related materials <www.state.ak.us/adfg>

Alaska Native Heritage Center

<www.alaskanative.net> Links to Native Organizations and subsistence articles. Select Education, then Resources for links.

Alaska Outdoor Council <www.alaskaoutdoorcouncil.org> Official state affiliate of the NRA.

Alaska Science Forum <www.gi.alaska.edu/ScienceForum>

Alaska Statewide Databases, accessed through your local library website or <sled.alaska.edu>

Alaska Wildlife Alliance <www.akwildlife.org> For current wildlife issues.

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Office of Subsistence Management, Alaska Region <www.r7.fws.gov/asm/home.html>

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University of Alaska Justice Center <www.uaa.alaska.edu/just/links/natives.html> Links and information on the subsistence issue.
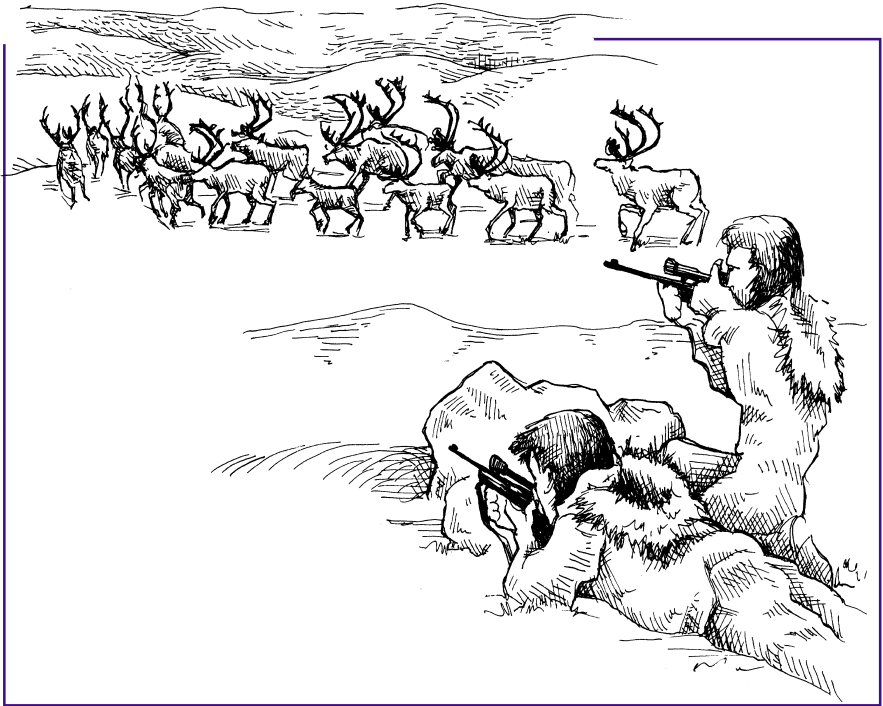
Teacher Resources:
(See appendix)

Hunting Regulation Vocabulary

Bag limit: the maximum number of animals of any one species a hunter can kill in a given area in a single season.

Board of Game: Governor-appointed, legislatively-approved board of Alaska citizens that uses public and agency information to set regulations regarding wildlife harvests.

Drawing permit: a permit issued to a limited number of hunters by means of a lottery. Hunters must apply and agree to obey the conditions spelled out in that permit.

Game Management Units: division of Alaska into 26 geographical units for managing game. Within these **GMUs**, there may be smaller units, identified with letters. For example, GMU 21B is an area north of Ruby and south of Tanana. Maps of the state's GMUs are available in the *Alaska Hunting Regulations* book and on the ADF&G website. When making proposals, it is important to familiarize yourself with the GMUs that are part of your concern.

Hunting Regulations: laws defined by the Board of Game and signed into law by Alaska's lieutenant governor.

Permit hunt: a hunt in which permits are required; may be drawing, registration, or Tier II permits.

Season: the period of time set to legally hunt a certain species. Hunting seasons are determined through the Board of Game process.

Statutes: laws passed by the state legislature that the Board of Game must follow. The Board of Game cannot create regulations outside of authority given to them by legislative statute.

Tier II: the Board of Game has identified specific game populations that are customarily and traditionally used for subsistence. In times of shortage, non-subsistence hunting is eliminated. If further hunting reductions are required, Tier II permits are given to hunters *based a predetermined scoring system*. Lots of hunters score the same; the lottery occurs only for the last few remaining permits when the number of hunters with identical scores exceeds the number of permits remaining.

Tracking Wildlife Regulations

In Alaska, **wildlife management** relies heavily on hunting to maintain healthy and productive wildlife **populations**. The wildlife management **regulations** that control hunting are created through extensive public involvement. Tracking the process involves many residents:

- **Alaska Board of Game (*or* B*oard of* F*ish*):** The Governor appoints seven public members who then must be confirmed by the Alaska State Legislature.
- **Fish and Game Advisory Committees:** About 80 communities have advisory committees with up to 15 elected members.
- **Alaska Department of Fish and Game:** Biologists and other staff from the Division of Wildlife Conservation and Division of Subsistence.
- General public.
- Commissioner of the Alaska Department of Fish and Game.
- Alaska Department of Law.
- Alaska Department of Public Safety, Division of Fish and Wildlife Protection.
- United States Fish and Wildlife (USFWS) liaison.
- Lieutenant Governor.
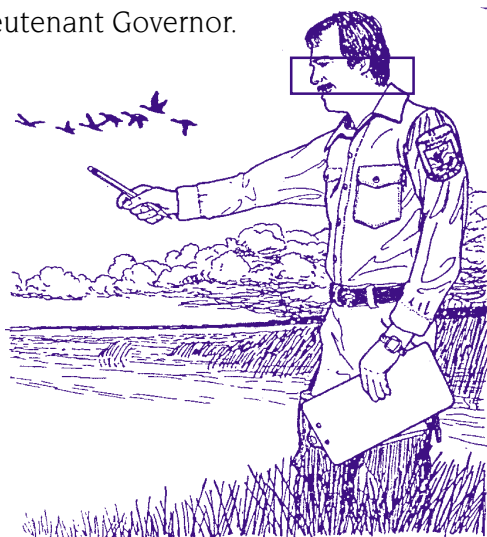
Board of Game
Meeting two to three times a year, the Board of Game sets hunting regulations. The board does not have time to consider every regulatory topic at each meeting. Instead, it deals with topics on a rotating basis. After setting the next meeting's agenda, the board issues a ***Call for Proposals*** and sends it to various agencies, groups, and individuals. The announcement is also published in Alaska newspapers.

Advisory Committees
Fish and Game Advisory Committees provide local forums to discuss fish and wildlife issues and make recommendations to the boards. There are approximately 80 community-based fish and game advisory committees. They meet prior to the *Call for Proposals* deadline to develop proposals that address the board's agenda. Advisory committees meet after proposals are published to comment and provide opposing or supporting arguments.

How to Make Proposals
Any individual or group in the state can propose a change to a hunting regulation:

1. Submit proposals using the R*egulation* P*roposal* F*orm* (sample provided for student use – *see activity "*I Propose…!*" in* S*ection* 4).
2. Write proposals using clear, concise language.
3. If possible, include the Alaska Administrative Code number (*for example*, 5AAC 92.990. DEFINITIONS) for the regulation addressed or provide the general heading and page number (*for example*, "DEFINITIONS" *page* 18-19) in the current regulation book.
4. State the problem and the reasons why the regulation should change.
5. Submit the proposal to the board before the deadline.

Tracking Wildlife Regulations (Cont.)

Tracking the Proposals

After all proposals are reviewed, they are printed and sent out for public comment. Any individual or group in the state may attend board meetings to express their views and ideas about the proposals.

Before the board votes on a proposal, members must consider written comments, public testimony, and biological information such as wildlife population health and environmental changes, social factors including historic use patterns, and all pertinent court rulings.
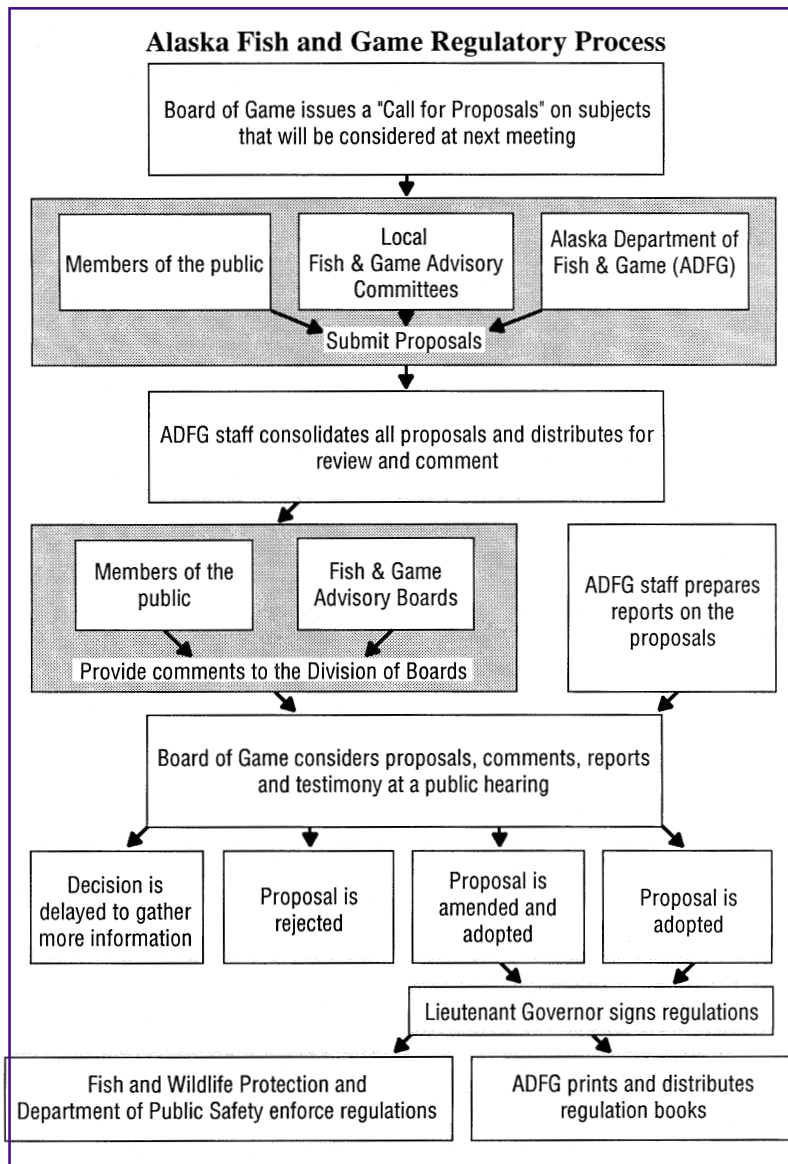
Next Step for Approval

After the board meeting adjourns, Alaska Department of Fish and Game staff draft the regulations to be entered into the Alaska Administrative Code. The Alaska Department of Law reviews these changes. If approved by the lawyers, the Lieutenant Governor signs the new regulations into law.
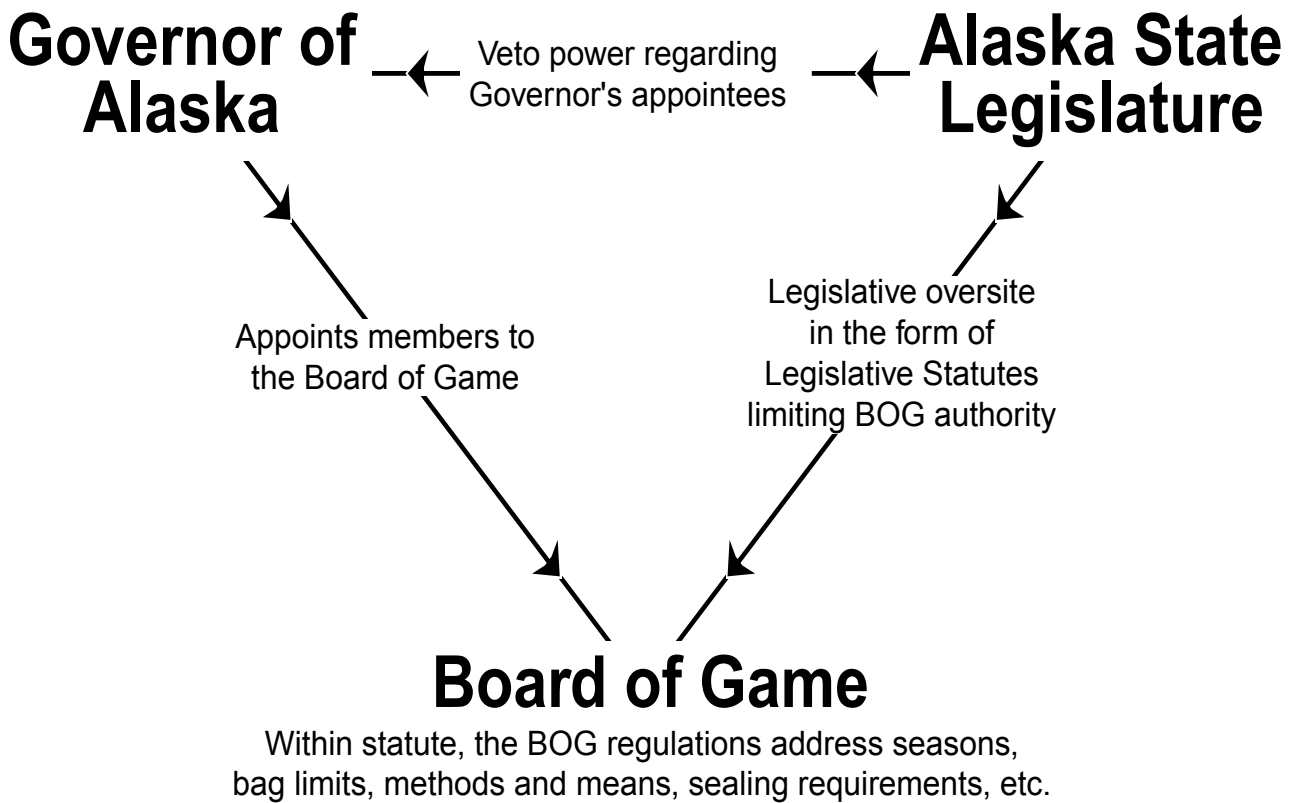
For Use by the Public

The Alaska Department of Fish and Game creates summaries and "public" versions, written in lay terms. These will become the "Alaska State Hunting Regulations" a publication available free to the public in print and website formats. Regulations are enforced by the Alaska Department of Public Safety's Division of Wildlife Protection.

NOTE: Waterfowl fit under a different process of regulation because Alaskans share these migratory birds with other states and other nations. The U.S. Fish and Wildlife Service sets harvest guidelines and then works with state waterfowl representatives to set rules and state allocations. Alaska is in the Pacific Flyway.

Alaska Fish and Game Regulatory Process

Board of Game issues a "Call for Proposals" on subjects that will be considered at next meeting

↓

Members of the public | Local Fish & Game Advisory Committees | Alaska Department of Fish & Game (ADFG)

Submit Proposals

↓

ADFG staff consolidates all proposals and distributes for review and comment

↓

Members of the public | Fish & Game Advisory Boards — Provide comments to the Division of Boards | ADFG staff prepares reports on the proposals

↓

Board of Game considers proposals, comments, reports and testimony at a public hearing

↓

Decision is delayed to gather more information | Proposal is rejected | Proposal is amended and adopted | Proposal is adopted

↓

Lieutenant Governor signs regulations

↓

Fish and Wildlife Protection and Department of Public Safety enforce regulations | ADFG prints and distributes regulation books

Checks & Balances for Wildlife Regulations

Governor of Alaska ← Veto power regarding Governor's appointees ← **Alaska State Legislature**

Appoints members to the Board of Game

Legislative oversite in the form of Legislative Statutes limiting BOG authority

Board of Game
Within statute, the BOG regulations address seasons, bag limits, methods and means, sealing requirements, etc.

Moose Management Puzzler

Part of the ADF&G Moose Management Unit. (2004)

You are learning about the important role that cow moose play in the overall health of moose populations. You are also learning about carrying capacity, limiting factors, predator/prey relationships, and population dynamics.

Based on your knowledge of moose biology and management, come up with possible explanations to the following scenario:

In your rural community, biologists are recommending that people not kill cow moose. In contrast, in management Unit 20A near Fairbanks, there is a yearly harvest allowed of cow moose. What are some possible explanations for the different strategies regarding moose management and harvest? How can the Department of Fish and Game recommend no cow harvest in one area and encourage cow harvest in another area? Try and use all the knowledge you have learned to formulate a hypothesis.

Moose Management Puzzler

Answer

The bottom line:

➢ **Unit 20A does not have a low moose density or declining population like there is in many rural-area moose populations.**

➢ **In Unit 20A the moose are actually exceeding their biological carrying capacity- there are more moose in the area than the habitat can support.**

- **High density moose populations tend to be <u>food limited</u> and the harvest of cows is needed to limit the population.**
- **In contrast, low density moose populations tend to be <u>limited by predators</u> and all cows are needed to contribute calves to the population.**

How can there be a high moose density in Unit 20A when there are so many people hunting it?

➢ **Although Unit 20A has a lot of hunting pressure because it is near a population center, the hunting pressure has been heavy primarily on bulls.**

➢ **There is a lot of trapping of wolves and harvest of bears in Unit 20A, reducing predators and maintaining high calf survival rates.**

➢ **Unit 20A has an excellent combination of habitat with summer and winter ranges in close proximity to each other (although the habitat is currently being stressed).**

➢ **Because moose numbers are high and exceeding the carrying capacity in Unit 20A, the moose are in poor physical condition and productivity is low as a result – cow twinning rates are low and cows are not giving birth at the age when they normally could. Harvest of cows is needed to bring the population down which will lead to better conditions for the moose population. At the least, this will prevent further declines in productivity (the number of moose entering the population each year), and possibly lead to higher productivity because moose will not be limited by their habitat.**