Unlocking the Power of Targeted Grazing

Grazing with sheep to address environmental challenges.

Supported by the Western Sustainable Agriculture Research and Education program under award number SW-22-938

Curriculum developed by Raechel E. Hunsaker and April Hulet, Brigham Young University

Learning Objectives

Students will:

1. Understand the concept of targeted grazing and its environmental benefits.
2. Learn about the role of sheep in targeted grazing.

Curriculum is designed for middle school aged students.

Duration: 90 minutes

Preparation and Supplies:

- Print one copy of 'AGRAZING Race' game instructions for each group (groups should consist of 3-4 players).
- Print one 'AGRAZING Race' gameboard for each group.
- Print and cut-out one set of 'AGRAZING Race' game cards for each group. Cards should be printed double-sided so the cards have a back with "GRAZING GAMBLES" or "RANGE REWARDS"
- Provide 1-2 dice for each group.
- Provide game player pieces for each student (*e.g., buttons, coins, plastic animals, erasers)*
- Open "Targeted Grazing" PowerPoint presentation.

Introduction (15 minutes; use PowerPoint presentation to supplement discussion):

- Show pictures of sheep grazing on rangelands.
- Begin by asking the class,

  "How do you think sheep could benefit the environment?"

  "Have you ever wondered how ranchers and land managers use sheep to help take care of our environment?"

- Examples may include weed control, fire mitigation, enhancing biodiversity, and reducing herbicide use (discussed in more detail below).
- Explain that rangelands face many challenges, ranging from invasive weed species to increasing frequency and severity of wildfires. These challenges provide opportunities for innovative solutions, such as targeted grazing with sheep.
- Explain that today's lesson will explore a practice called targeted grazing, where ranchers and land managers use sheep as eco-friendly helpers to solve specific environmental challenges.

What is targeted grazing? (20 minutes; use PowerPoint presentation to supplement discussion):

- Have a discussion with the class about targeted grazing. Ask, "*What is a "target*?" Use the analogy of a target board:
  - Imagine the landscape as a large field, similar to the outer rings of an archery target.
  - But instead of arrows, we have sheep!
  - Land managers and ranchers are like archers, sending out sheep to hit the bullseye, which represents specific plants sheep need to eat.
- Targeted grazing is a land management strategy that involves using grazing animals, such as sheep, to control vegetation in specific areas for various purposes[1,2,3].

- Discuss different ways sheep can hit the "bullseye" through targeted grazing.

  Weed Control: Grazing sheep can be used to target and control invasive, non-native plant species[4]. For example (*select two or three species to discuss with the class)*:
  - Cheatgrass is a type of grass that invades areas quickly, especially after events like fire, drought, or overgrazing by livestock. It competes with native plants by using up soil moisture and nutrients early in the growing season before native plants are ready to grow. Sheep grazing can help control cheatgrass, allowing native plants access to soil water and nutrients.
  - Leafy spurge, an invasive forb (a forb is an herbaceous flowering plant), is highly palatable and sheep can graze it down reducing its growth and spread. Over time, grazing weakens leafy spurge's root system inhibiting its ability to regrow[5].
  - Dalmatian toadflax is a widespread invasive forb that competes with desirable native plants. Sheep grazing can reduce the presence of this weed, allowing more nutritious native plants to grow[6].
  - White locoweed, a native forb, poses potential toxicity if consumed by grazing livestock and wildlife. Sheep, however, have the ability to metabolize these toxins. Thereby, sheep grazing can reduce the risk of white locoweed poisoning in other animals[7].
  - Spotted knapweed is an invasive forb that often forms monocultures. Sheep grazing can reduce the presence of this species, saving ranchers and land managers money, while also fostering greater biodiversity in the plant community[8,9].

  Fire Mitigation: Targeted grazing can decrease the severity of wildfires by reducing the amount of fuel (i.e., plants) available to burn. For example, cheatgrass often grows rapidly in the spring and dries out early in the summer, providing fuel for wildfires[10]. By grazing sheep in the spring, cheatgrass is consumed, reducing the overall amount of fuel on the rangeland.

  Enhancing Biodiversity: Targeted grazing can diversify vegetation by selectively grazing certain areas, which allows different plant species to thrive[11]. This can prevent any single species from dominating the landscape, hence, providing a variety of habitats and food sources for various wildlife species, including pollinators[12].
  - Having a mosaic of different vegetation structures can make a rangeland site more ecologically resilient because different plant communities respond to disturbance in different ways[13].
  - Biodiversity also provides more food sources for pollinators, a wider variety of habitat and forage for wildlife, and more competition against invasive plant species.
  - A variety of root structures and depths that take up nutrients in the soil makes it more difficult for invasive plant species to establish[14].

  Reducing Herbicide Use: Targeted grazing can serve as an environmentally friendly alternative to herbicides for controlling unwanted vegetation[15].
  - Herbicides can have unintended consequences on non-target plants, animals, and ecosystems[16].
  - Over time, plants can develop resistance to herbicides, leading to the need for stronger or more frequent applications[17].
  - Excessive herbicide use can contribute to the loss of biodiversity by eliminating native plant species that provide habitat and food for wildlife.
  - Herbicides may provide short-term weed control benefits, however, there can be long-term economic costs associated with environmental damage, decreased land productivity, and the need for continual herbicide applications[18].

- Explain that sheep are good animals for targeted grazing because of their mouth structure, stomach, and their adaptability to rugged terrain[19,20,21].
  - Teeth: Sheep's front teeth (incisors) are adapted for cropping and shearing, enabling them to bite off leaves and twigs easily.
  - Mobile lips: Sheep have highly mobile lips that can grasp and manipulate plant parts with precision. This allows them to select specific plant species and graze more selectively.

- Rumen: Sheep have a special four compartment stomach. One of the compartments is called a rumen, which is like a big fermentation tank. The rumen helps sheep digest tough plants like grass and weeds that other animals might not be able to eat.
- Gut microbes: Sheep rumen also contain microbes that can break down certain toxins found in plants, allowing sheep to safely consume them in moderation. *It should be noted that not all toxic plants can be safely consumed by sheep. It is crucial for shepherds and land managers to be aware of the plants in the grazing area and ensure that sheep are not exposed to harmful levels of toxic plants.*
- Agility: Sheep can access and graze in areas that may be challenging for larger animals like cattle due to their smaller size and lighter weight. This includes areas with rough or steep terrain, rocky slopes, and dense vegetation.
- Herd Animals: Sheep are great for targeted grazing because they are herded by people and dogs, allowing for control over where they graze.

The 'AGRAZING Race' game (30 minutes)

Overview: The "Agrazing" Race is a fun and educational board game where players navigate their sheep through a rangeland, facing challenges and reaping rewards along the way. The objective is to be the first player to reach the end of the board and make it to the market or back to the ranch for winter!

- Divide the class into groups of 3-4 students.
- Provide each group with 1-2 dice, a gameboard, cards, and game instructions.
- Have each student select a sheep "player" to represent themselves on the board.
- Follow the 'AGRAZING Race' game instructions for game play.

'AGRAZING Race' Game Cleanup (10 minutes)

- Allow time to collect the gameboards and put away any distracting materials.

Reflection/Conclusion (15 minutes)

- Come back together as a class and discuss key concepts students learned throughout the lesson.
- Prompt students to reflect on their understanding of sheep targeted grazing and the potential benefits it can have on rangelands.
- Allow each student five minutes to share what they learned with the person sitting next to them.
- Answer any questions students may have about sheep and targeted grazing.

Vocabulary:

1. Annual grass: plants that complete their life cycle in a single growing season.
2. Biodiversity: refers to the diversity of species (plants, animals, and microorganisms).
3. Fire mitigation: steps to reduce the risk and impact of wildfire.
4. Forb: herbaceous flowering plant with broad leaves.
5. Habitat: the environment where an organism naturally lives and grows, including food, water, and shelter.
6. Herbicide: is a type of pesticide specifically designed to control, suppress, or kill unwanted plants.
7. Invasive plants: plants that have the ability to spread aggressively, often outcompeting native vegetation.
8. Rangeland: diverse ecosystems such as grasslands, shrublands, and savannas where livestock grazing occurs.
9. Wildfire frequency: the rate or occurrence of wildfires within a specific area over a given period of time.
10. Wildfire severity: the extent of damage caused by a wildfire, including its impact on vegetation, soil, and other ecological components within the affected area.

References:

1—Frost, R., Walker, J., Madsen, C., Holes, R., Lehfeldt, J., Cunningham, J., Voth, K., Welling, B., Davis, T.Z., Bradford, D., Malot, J., and Sullivan, J. 2012. Targeted Grazing: Applying the Research to the Land. *Rangelands* 34(1):2-10.

2—Macon, D. 2014. The Art and Science of Targeted Grazing – A Producer's Perspective. *Rangelands* 36(5):31-35.

3—Olson, B.E., and Lacey, J.R. 1994. Sheep: A Method for Controlling Rangeland Weeds. *Sheep Research Journal,* Special Issue: 105-112.

4—Sheley, R.L. and Petroff, J.K. 1999. Biology and Management of Noxious Rangeland Weeds. *Natural Resource Management.*

5—Bangsund, D.A., Nudell, D.J., Sell, R.S., Leistritz, F.L. 2001. Economic analysis of using sheep to control leafy spurge. *Journal of Range Management* 54:322-329.

6—Sing, S.E. and Peterson, R.K.D. 2011. Assessing Environmental Risks for Established Invasive Weeds: Dalmatian (*Linaria dalmatica)* and Yellow (*L. vulgaris)* Toadflax in North America. *International Journal of Environmental Research and Public Health* 8(7): 2828-2853.

7—Goodman, L.E., Cibils, A.F., Lopez, S.C., Steiner, R.L., Graham, J.D., McDaniel, K.C., Abbott, L.B., Stegelmeier, B.L., and Hallford, D.M. 2014. Targeted Grazing of White Locoweed: Short-Term Effects of Herbivory Regime on Vegetation and Sheep. *Rangeland Ecology and Management* 67(6):680-692.

8—Mosley, J.C., Frost, R.A., Roeder, B.L., Mosley, T.K., and Marks, G. 2016. Combined Herbivory by Targeted Grazing and Biological Control Insects to Suppress Spotted Knapweed (*Centaura stoebe). Invasive Plant Science and Management* 9(1):22-32.

9—Thrift, B.D., Mosley, J.C., Brewer, T.K., Roeder, B.L., Olson, B.E., and Kott, R.W. 2012. Prescribed Sheep Grazing to Suppress Spotted Knapweed on Foothill Rangeland. *Rangeland Ecology and Management* 61(1):18-25.

10—Bradley, A., Curtis, C.A., Fusco, E.J., Abatzoglou, J.T., Balch, J.K., Dadashi, S., and Tuanmu, M. 2018. Cheatgrass (*Bromus tectorum*) distribution in the intermountain Western United States and its relationship to fire frequency, seasonality, and ignitions. *Biological Invasions* 20:1493-1506.

11—Bailey, D.W., Mosley, J.C., Estell, R.E., Cibils, A.F., Horney, M., Hendrickson, J.R., Walker, J.W., Launchbaugh, K.L., and Burritt, E.A. 2019. Synthesis Paper: Targeted Livestock Grazing: Prescription for Healthy Rangelands. *Rangeland Ecology and Management* 72(6):865-877.

12—Masin, E., Nelson, C.R., and Valliant, M.T. 2018. Can sheep control invasive forbs without compromising efforts to restore native plants. *Rangeland Ecology and Management* 71(2):185-188.

13—Fuhlendorf, S.D., Fynn, R.W.S., McGranahan, D.A., and Twidwell, D. 2017. D.D. Briske (ed.), Heterogeneity as the basis for rangeland management. *Rangeland Systems,* Springer Series on Environmental Management. 10.1007/978-3-319-46709-2_5

14—Bakker, L.M., Mommer, L., and Ruijven, J. 2019. Using root traits to understand temporal changes in biodiversity effects in grassland mixtures. *Oikos* 128(2):208-220.

15—Lehnhoff, E.A., Rew, L.J., Mangold, J.M., Seipel, T., Ragen, D. 2019. Integrated Management of Cheatgrass (*Bromus tectorum)* with Sheep Grazing and Herbicide. *Agronomy* 9:1-21.

16—Ruuskanen, S., Fuchs, B., Nizzinen, R., Puigbo, P., Rainio, M., Saikkonen, K., and Helander, M. 2023. Ecosystem consequences of herbicides: the role of microbiome. *Trends in Ecology and Evolution* 38(1):35-43.

17—Powles, S.B. and Yu, Q. 2010. Evolution in action: plants resistant to herbicides. *Annual Review of Plant Biology* 61:317-347.

18—Chee, Y.K. and Faiz, A. 1991. Sheep grazing reduces chemical weed control in rubber. In *Forages for plantation crops. ACIAR Proceedings* 32:120-123.

19—Northey, R.D. and Hawley, J.G. 1974. The tooth to pad relationship in sheep – some mechanical considerations. *New Zealand Journal of Agricultural Research.* https://doi.org/10.1080/00288233.1975.10421014.

20—Bartolome, J. W. (2004). Integrated Weed and Grazing Management. University of California Division of Agriculture and Natural Resources. Publication 8112.

21—University of Idaho. (n.d.). RX-410: Integrated Weed Management. Retrieved from https://www.webpages.uidaho.edu/rx-grazing/handbook.htm