

## Suggested answers to discussion questions.

### Game 1

- What happened to groups' red drum populations over time in Game 1? Did trends match students' predictions? *The red drum population decreased over time, either reaching zero or heading in that direction.*
- Why did the red drum population decrease? *It decreased because we harvested more fish per season than could be replaced by natural production (reproduction). There are two opposing forces at work: harvest (negative) and reproduction (positive). When the harvest rate is much greater than the reproductive rate, it leads to overharvesting, an example of an unsustainable practice.*
- What does sustainable mean? *Sustainable means that something can be harvested over time without being depleted. If we had harvested red drum in a sustainable way, then we would have been able to use some of the resource without causing its decline over time. Wildlife scientists spend much of their time trying to determine the harvest rates that will balance organisms' reproductive rates so that humans can harvest them sustainably.*
- How could we have harvested sustainably? How many fish per season could each group have taken and still maintained the total population at a constant number? *To harvest sustainably, we would only be able to harvest the total number of young-of-the-year (births) added each season, or a number less than this. Births represent the surplus population, and as long as we do not exceed this number, the red drum population would remain unchanged over time as we harvested.*
- From an individual's perspective, why did we overharvest the red drum, even though we could see that our actions were causing the population to decrease? *Students overharvested the red drum because each person acted in his or her own self-interest, and there were no rules or regulations to enforce sustainable practices. To the individual, the benefit of taking one more fish exceeded the negative consequences of doing so because the negative consequences were spread out and shared among all fishermen. This led to a tragedy of the commons, in which the common property resource (red drum) was inevitably overexploited as each student acted in his or her best interest.*
- How can we prevent a tragedy of the commons? *We can give agencies like the National Marine Fisheries Service the jurisdiction to manage these resources for the public. Agencies like this use management tools and scientific research to prevent tragedies of the commons from occurring.*

### Game 2

The following lists pros and cons for each type of management tool used in Game 2. Use this information to help with the discussion.

- Bag/creel limits: *An effective tool used by many states. For example, Georgia red drum regulations state that each person can take five red drum per day, as long as they fall between 14 and 23 in. (36 and 58 cm) total length. A group may be tempted to set a bag limit of one: Why would this be difficult to implement? It may alienate the recreational fishing community by making them feel robbed of the fish they catch.*

- Open/closed seasons: *This is also an effective tool, though it can be controversial. In Georgia, the red drum recreational fishery is always open. A student group may be tempted to implement only one open season every third season, and again discuss why this could be difficult to implement in practice.*
- Access quotas: *This technique is typically not practiced in recreational fisheries, though similar methods are frequently used in commercial fisheries management (e.g., total catch quotas).*
- Stocking: *This is a controversial technique because of concerns with hatchery stock outcompeting natural stocks or genetically homogenizing the natural population. However, in this game, it probably holds the greatest potential to increase the red drum population over time*

### **Wrap-up and conclusions.**

- Summarize how this activity illustrated a tragedy of the commons. What was the common property resource and why? What were the costs and benefits to each individual person? *Red drum was the common property resource because no one owned the fish, but everyone had access to them. Game 1 resulted in a tragedy of the commons when groups overharvested their red drum populations. To the individual, the benefit of taking one more fish exceeded the negative consequence of doing so because the negative consequence was spread among all fishermen.*
- Summarize how this activity illustrated a solution to the tragedy of the commons. *Management tools like stocking, access quotas, seasons, and bag/creel limits can be used to help prevent overharvest.*
- When you go fishing, can you keep each fish you catch? *No. Each state sets its own fishing regulations governing commercial and recreational harvest. These regulations help the state prevent overharvest, much like we saw in Game 2. Students should be able to make the connection between Games 1 and 2 and their own recreational fishing activities.*
- What can you do to help keep the red drum population (or your area's fish population) a stable one? *There are many answers to this question, such as*
  1. *Follow state and federal fishing regulations.*
  2. *Conserve fresh water: Take shorter showers and turn off the faucet when brushing teeth in an effort to maintain freshwater input to estuarine systems and maintain estuarine health.*
  3. *Maintain zones of vegetation between water bodies and developed land to slow pollutant runoff. These are called riparian buffers.*
  4. *Practice smart gardening: Use fertilizers sparingly, and use in the correct ratios to reduce runoff into estuarine systems.*
  5. *Stay informed and teach others!*