

To Culture or Not to Culture

OVERVIEW

Aquaculture, like any other industry, has its costs and benefits, as well as its proponents and opponents. Students will discuss some of the pros and cons related to aquaculture. As a class, the students will discuss the hypothetical case studies provided. In cooperative learning groups, students will engage in an aquaculture debate in the style of a town meeting.

OBJECTIVES

Students will:

Describe impediments to aquaculture development.

Describe the pros and cons of an aquaculture industry in their community.

Describe the position of several community groups regarding aquaculture development.

GRADE LEVEL:

6-12

SUBJECTS

Science

Social studies

Environmental studies

VOCABULARY

aquaculture, carnivorous, herbivorous, mangrove, sustainability

TIME

2 class session

MATERIALS

Copies of student handouts Two Florida Communities and Aquaculture Pros and Cons

NATIONAL SCIENCE STANDARDS

This activity supports the following National Academy of Science science education standards.

Grades 5-8:

Unifying Concepts and Processes—Systems, order and organization

Standard C: Life Science—Populations and ecosystems

Standard E: Science and Technology—Understandings about science and technology

Standard F: Science in Personal and Social Perspectives—Populations, resources, and environments

Standard F: Science in Personal and Social Perspectives—Risks and benefits

Standard F: Science in Personal and Social Perspectives—Science and technology in society

Grades 9-12:

Unifying Concepts and Processes—Systems, order and organization
Standard F: Science in Personal and Social Perspectives—Natural resources
Standard F: Science in Personal and Social Perspectives—Environmental quality
Standard F: Science in Personal and Social Perspectives—Science and technology in local, national, and global challenges

NATIONAL SOCIAL STUDIES STANDARDS

This activity supports the following National Council for the Social Studies standards.

Middle Grades:

Standard I: Culture—a, d
Standard III: People, Places, & Environments—k
Standard IV: Individual Development & Identity—h
Standard V: Individuals, Groups, & Institutions—g
Standard VII: Production, Distribution, & Consumption—f
Standard VIII: Science, Technology, & Society—b, d, e
Standard IX: Global Connections—d
Standard X: Civic Ideals & Practices—c, d, g

High School:

Standard I: Culture—a
Standard III: People, Places, & Environments—k
Standard IV: Individual Development & Identity—h
Standard VII: Production, Distribution, & Consumption—f
Standard VIII: Science, Technology, & Society—d, f
Standard IX: Global Connections—d
Standard X: Civic Ideals & Practices—c, d

BACKGROUND

Aquaculture—the production of aquatic organisms for human use—is an increasingly important source of seafood. Many believe that it can help fill the gap between the growing demand for seafood and what can be caught in the wild. It can also provide jobs and rejuvenate the seafood processing industry in some places.

Aquaculture exists in almost every country in the world, but the US produces relatively little. Even though national policy is aimed at encouraging aquaculture initiatives, there are still many barriers to starting new aquaculture ventures including:

Economics

Starting a new aquaculture venture is expensive, it requires a large initial capital investment, and it may be quite some time before entrepreneurs begin to see a profit. Banks may be skeptical about loaning large sums of money to small aquaculture entrepreneurs. As a result, new aquaculture enterprises often favor large businesses over smaller, community operations.

Siting issues

Not every body of water can serve as a site for an aquaculture facility and many species are farmed inland in human-made ponds or raceways. Very specific requirements must be met. For example, to raise Pacific White shrimp, pond water must remain near 75-85 degrees for three to four months while the shrimp grow to full size. For salmon or other finfish grown in net-pens in the ocean, you must have very strong tides to disperse the waste produced from the finfish or you risk polluting the surrounding waters. For oysters, mussels and other mollusks, you must have nutrient-rich water. Culturing mollusks and aquatic plants usually has minimal negative environmental consequences.

Aquaculture operations in the ocean and on the coast are always at the mercy of Mother Nature. Storms and other oceanographic and meteorological conditions can wreak havoc on one's fish, mollusk, or shrimp farm. A specific threat related to farmed bivalves is a tiny organism called fecal coliform bacteria which can enter the water via sewage, particularly during times of flooding. Because these bacteria can contaminate the bivalves and threaten the health of consumers, mollusks must be grown in clean waters. In spite of all these hazards, excellent environments for aquaculture operations across the U.S. do exist.

Environmental issues

Aquaculture production of some species and in some areas is being done in a way that minimizes environmental impact. Several conservation organizations such as Monterey Bay Aquarium, Environmental Defense, and Blue Ocean Institute publish seafood cards that rate farmed catfish and tilapia, for example, "green" (the best designation). But many people are concerned that some forms of aquaculture can create more problems than they alleviate. On fish farms, species such as shrimp and salmon are fed high-protein pellets which include high percentages of fishmeal and fish oil made from small wild fish such as anchovies. There is a range of scientific opinion about exact conversion ratios, but fisheries experts agree that raising carnivorous species currently consumes more fish than it produces, putting pressure on wild fish populations.

To make way for modern aquaculture operations, farm fields may be flooded for catfish ponds, shrimp farms may be adjacent to sensitive coastal forests, and waters in coastal areas may be fenced to raise "crops" of salmon, mollusks, and seaweed.

Dead fish, uneaten food, and excrement wash directly into waterways from many modern aquaculture operations. And the antibiotics, vaccines, and chemicals that many farmers use to fight disease get flushed away, too, with unknown effects on wild fish and their habitat. The U.S. Environmental Protection Agency recently established national standards to control the effluent from aquaculture operations.

Fish farms often raise fish that aren't native to the area. Farmed fish are usually stocked in cages when disease-free. They often catch diseases that are naturally occurring in the water and on wild fish, and then amplify the disease or parasite due to high stocking densities. Now the disease can become a much larger threat to wild fish that swim by the net-pens. When farmed fish escape, they can become established in the wild, and

compete with or prey on native fish. Up to 50% of salmon caught in certain rivers in Norway are of farmed origin, and on average they estimate that 1/4 of all salmon in the wild are of farmed origin (not just escapees, but also offspring of escapees).

Opposition

Among the biggest barriers to starting new aquaculture ventures in the U.S. is a lack of appropriate areas for mariculture or culture of species along the coast combined with local public opposition. Although there are many people who support and encourage a growing aquaculture industry, there are others who oppose growth in this industry if it does not appear sustainable.

A long-term goal of the aquaculture industry and government proponents is to help offset the annual \$8 billion seafood trade deficit (as of 2005). For example, the US is the largest importer of farmed shrimp, and currently, over 70% of the seafood that Americans consume is imported, and at least 40% of our seafood imports are aquaculture products. Success with aquaculture in the United States requires high rate and high yield production systems that are both environmentally and economically sustainable and yield a high quality product.

BEFORE YOU BEGIN

1. Make copies of the Two Florida Communities handout for each student.
2. If desired, make copies of the Aquaculture Pros and Cons handout for each student.

WHAT TO DO

Before the Activity

1. Prior to class, have the students read the Two Florida Communities handout.

The Activity

1. As a class or in cooperative learning groups, review the Two Florida Communities handout describing the hypothetical case study about Gull Island and Tern Island. Develop a possible pros and cons list for aquaculture or use the Aquaculture Pros and Cons handout provided.
2. Engage the class in a discussion about the case study. How and why did the two communities reach such different conclusions about the issue of shrimp farming?
3. Introduce the idea of a town meeting or debate in which various members of the community come together to reach a consensus on an issue or proposal which will affect their community. Explain that the class will conduct their own town meeting to decide whether to permit the establishment of an aquaculture venture in their own community.
4. Have the class set the parameters of the aquaculture site that is being proposed:
 - a. Will the company be culturing finfish, shellfish, or sea vegetables? Will it be a carnivorous or herbivorous species? What species?

- b. Will the site be warmwater, coldwater or marine? A river, estuary, shorefront, land-based, or deepwater?
 - c. Is the area already used by others? By whom?
5. In the aquaculture debate, groups of students will role play a position on aquaculture and defend it in a town meeting. Select about six roles from this list, or create roles appropriate to your community: commercial fisherperson, tourist bureau representative, homeowner, vacationer, local/state politician, small-scale aquaculture entrepreneur (local), large-scale aquaculture entrepreneur (international), scientist, or conservation group representative.

Before the debate, stress the professionalism and decorum which ought to take place in a town meeting. Establish a set of guidelines based on mutual respect so that the debate does not degenerate into a shouting match. You may need to stress that the point of a debate is to adopt the position of the group and defend that position. The position may or may not reflect the students' own opinions. Therefore, students ought not to feel personally attacked and have the advantage of learning how to argue positions other than their own. Students should gain an understanding of the complexity of community issues.

6. Break the class up into as many groups as there are roles. Assign (or let the groups choose) a different role for each cooperative learning group. You may want to provide a "blurb" describing each group's general position on aquaculture. However, be careful not to pigeonhole groups into black and white categories. There are advantages to letting the students struggle with defining the roles of these groups themselves, rather than providing them with a predetermined script. Encourage groups to approach this as a real-life scenario.

Give students time (20-30 minutes) to prepare their case. They can use the Two Florida Communities handout and the Aquaculture Pros and Cons as reference materials to help build their arguments. Case statements can include stipulations such as: "I support aquaculture in the community if x, y, and z are included."

7. Give each group three minutes to present their case. After all groups have spoken, any group may "counter" or challenge another group's argument. Be sure to give the challenger a time limit (one or two minutes) and give the challenged group an opportunity to respond. Limit challenges and responses to one per group.
8. After the debate is over, individuals will be asked to vote on whether or not they want to start an aquaculture venture in their community and what, if any, stipulations they'd enforce. Write the final decision on the board or overhead and, as a group, list the reasons and/or stipulations for the decision.

ASSESSMENT

Ask students to write an essay describing their personal opinion regarding the class vote and explain their reasoning.

EXTENSIONS

- Survey/Questionnaire: Ask students to create a survey/questionnaire to determine how members of the community would feel (or do feel) about having an aquaculture facility in their community. Have them survey family, friends, and members of the community and share their results with the class. Students may also choose to tape a personal interview with someone who has an interesting point of view.
- Marine Issues: Divide students into groups and have each group monitor one local marine issue or controversy involving fisheries and/or aquaculture.

CREDIT

Adapted with permission from “To Culture or Not to Culture: The Controversy Continues” in the *Maine Aquaculture Curriculum Guide* by the Maine Aquaculture Innovation Center, www.maineaquaculture.org.

TWO FLORIDA COMMUNITIES

Two island communities in Florida were approached by shrimp farming entrepreneurs. One community said yes while the other community said no. Why?

A few years ago both Gull Island and Tern Island were approached by separate companies wishing to establish shrimp farming operations on their islands. The majority of the year-round residents on Gull Island and Tern Island make their living as fishermen and wild shrimpers. While the residents of Tern Island fiercely rejected the proposal for shrimp farming ponds on their island near the coast, the residents of Gull Island grappled with the proposal for some time and eventually decided to accept it and try shrimp farming, hoping to supplement their traditional fishing income. What prompted these two similar communities to have such different responses to shrimp farming on their islands? Let's take a look at these two different approaches.

Tern Island

In 2003, a representative from Shrimp Servers Inc. submitted a proposal for a 10-year lease of 100 acres of coastal lands on Tern Island. The residents of Tern Island were first introduced to the proposal at a public hearing. No attempt was made to introduce the idea to Tern Island's residents prior to the hearing, and the people of Tern Island were not pleased about being left in the dark.

The proposed 100-acre lease area was near coastal mangrove forests, which were important breeding and feeding grounds for the fish and wild shrimp that the residents depended on for their income. The fishing community was concerned about not having access to the coast near those 100 acres but, more importantly, they worried about the effect the shrimp ponds would have on the nearby waters and mangrove forests. They feared contamination of the water from the shrimp food and waste, antibiotics used in the ponds, chemicals used in the shrimp foods, and diseases spread by the farmed shrimp. Another fear was that escaped shrimp could mix with wild shrimp and negatively affect the local native shrimp species. Many of these fears were valid, while others were not. Contamination problems have arisen in some shrimp pond operations due to poor management. Producers using better management practices and following U.S. regulations would have a very low risk of contamination.

The effect of aquaculture on the local economy was another issue for the residents of Tern Island. While Shrimp Servers Inc. promised economic gain, residents feared that the big corporation would bring workers from off-island. Residents researched the job total and determined that there would be a total of only three to five jobs available, which might not make up for the money lost from the 100 acres of land leased to Shrimp Servers Inc.

Another issue was tourism. Tourists and summer residents alike are attracted by the beauty of the island. In the summer, the size of the island swells from 1,200 to 6,000. Islanders feared the shrimp ponds would be an eyesore that would compromise the natural beauty of the island, deter tourists, and reduce the property value of their homes. Due to community opposition, Shrimp Servers Inc. withdrew its proposal.

Gull Island

Soon after the Tern Island aquaculture fiasco, Gull Island was approached with a different shrimp farming proposition. Initially, a representative of Shrimp Lovers Ltd. came to the island to speak with members of the Gull Island Fisherman's Coop. Members of the community were invited to several informative discussions to decide whether they were interested in exploring shrimp farming as an option. Although there was a great deal of negative aquaculture propaganda floating around the community, there was little in the way of concrete information. Keeping an open mind, the Gull Island Fisherman's Coop thoroughly researched shrimp farming, and visited other shrimp farms in Florida and Texas.

A number of the shrimp farms that Gull Island residents visited were well run operations employing former and current fishermen. The farms used better management practices including fully recirculating water systems and bacteria capable of digesting shrimp wastes rather than traditional water discharge shrimp culture systems. As a result the effluent did not flow into oceans or rivers and affect local fish populations. The farms avoided problems with contamination and disease by ensuring that the shrimp were not stressed by overcrowding, which minimized their use of antibiotics and other chemicals. They followed U.S. laws regarding antibiotic and chemical use, only using those that had been reviewed and approved by the Food and Drug Administration's Center for Veterinary Medicine. Shrimp farmers frequently commented that if the shrimp ponds were to contaminate the waters in any way, their stocks would be the first ones to suffer.

Although the Gull Island fishing community was sufficiently convinced about the merits of aquaculture to continue exploring shrimp farming as an option, there was still opposition from members of the community. Some residents remained concerned about the potential environmental problems associated with aquaculture. Other residents felt that the shrimp farms would bring competition and have a negative economic affect on the wild shrimpers. Still others were concerned with the aesthetic value of their coastline and the affect that shrimp farms could have on the property value of their homes. Much of this opposition came from summer residents and tourists.

Ultimately, there was greater support for shrimp farming than there was opposition to it. Shrimp Lovers Ltd. Offered to help set up any member of the community who wanted to get involved in shrimp farming, so a mutually beneficial partnership was established. Gull Island began shrimp farming very conservatively, with two ponds on 25 acres. They invested in a "zero-discharge" system that used settling ponds and employed bacteria to digest the shrimp wastes, and purposefully stocked shrimp in low densities to avoid problems associated with overcrowding. As a result of their caution, no antibiotics were necessary and the shrimp and the surrounding habitat were healthy.

Aquaculture: Pros and Cons

Arguments in favor of aquaculture:

1. Can create jobs in community
2. Can increase revenue on city, state and national level
3. Can reduce seafood trade deficit
4. Can help feed a growing U.S. and world population
5. Can encourage local investment
6. Can increase scientific knowledge and technology
7. Can place more emphasis on protecting coastal waters from pollution, especially in the case of mollusk and seaweed culture.
8. May reduce fishing pressure on certain wild stocks if that species can be produced through aquaculture rather than fished.

Arguments against aquaculture:

1. Can conflict with other users of water bodies such as lobstermen, fishermen or migrating fish
2. Can put excess pressure on wild stocks that are used to create high protein feed pellets
3. Can amplify and transfer disease and parasites to wild fish populations
4. Can pollute water systems with excess nutrients (fish feed & wastes), chemicals and antibiotics
5. Can compromise native gene pools if farmed fish and native species interbreed
6. Can threaten livelihood of fishermen
7. Can be an unpredictable enterprise for small local communities due to its susceptibility to severe weather, predators, disease, and global competition
8. Can compromise the aesthetic beauty of coastline