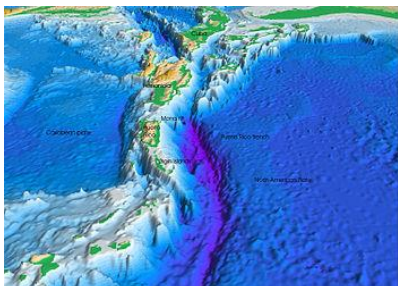


## MIDDLE and HIGH SCHOOL

### Next Gen Science Standards:

MS-LS2-5 } Possible alignment if students are required to make a judgement based on specific criteria.  
HS-LS2-6 }

[www.MaineAgintheClassroom.org](http://www.MaineAgintheClassroom.org)



### *Climate of Change Part IV: The Future of Aquaculture*

## **Aquaculture: Husbandry 101**

Developed by the Island Institute, Rockland, Maine

Revised and formatted by Maine Agriculture in the Classroom

### **Overview:**

Husbandry is the care, cultivation and breeding of animals and plants, which is usually one of the first things you think about when starting an aquaculture business. When paired with strong financial management and sales and marketing, husbandry is part of a successful aquaculture business. Simply put, as a farmer, your goal is to keep your animals (or plants) at optimum health that will lead to a profitable harvest.

This activity is a short 45-minute lesson focused on the different aspects of husbandry. Students will use the Aquaculture in Shared Waters: **Husbandry** fact sheet to help them understand the basics of aquaculture husbandry. Topics covered in the fact sheet include choosing a site and the correct gear for your crop, the harmful effects of biofouling, predators and pests, farm biosecurity and record keeping.

### **Essential Questions:**

- What are the basic components of aquaculture husbandry?
- How might husbandry practices (good or bad) influence an aquaculture operation?

### **Learning Objectives:**

Students will

- identify key aspects of the successful care, cultivation and breeding of plants and animals in an aquaculture setting.
- describe best practices for keeping aquacultured plants and animals healthy.

### **Materials:**

- *Aquaculture in Shared Waters: Husbandry* fact sheet
- Blue, pink and yellow sticky notes for students (1 color for each student)



## Background Information:

As community members begin to think about the future of the coast of Maine, many are turning to aquaculture. Some people are curious about starting a new business, others may know someone who is interested. Some just want to better understand what aquaculture looks like. To help answer these questions, the partners involved in the Aquaculture in Shared Waters project developed a fact sheet series that provides a jumping-off point for a more in-depth conversation about aquaculture. These *Aquaculture in Shared Waters Fact Sheets* can be found on the Island Institute aquaculture webpage:

<http://www.islandinstitute.org/resource/aquaculture-shared-waters-fact-sheets>

- **Introduction to Aquaculture** - what is needed to start a small operation in Maine
- **Know Your Water** - basic water quality monitoring techniques
- **Husbandry** - best practices for shellfish aquaculture
- **The Business of Aquaculture** - how to successfully develop and run a small aquaculture business
- **Kelp Production** - what is needed to start your own seaweed aquaculture operation

The Aquaculture in Shared Waters project is a National Sea Grant funded program to help prepare fishermen to start an aquaculture venture. Support from this project comes from partnerships between the following organizations: University of Maine School of Marine Sciences, Maine Sea Grant, University of Maine Cooperative Extension, Maine Aquaculture Association, Maine Aquaculture Innovation Center, Coastal Enterprises Inc., and the Island Institute.

## Procedure:

Before the start of the lesson, hand out the Aquaculture in Shared Waters: **Husbandry** fact sheet to each student

- Handout sticky notes to each student, making sure students have three different colored sticky notes.
  - Be sure to have extra sticky notes in case students need to make additional notes
- Students will then take time to read through the fact sheet and will work individually to answer the following and write their responses on their sticky notes:
  - This made me think of... (blue sticky)
  - I wonder... (pink sticky)
  - This information reminds me of the film... (yellow sticky)
- Once students have finished the activity, come back as a class and sort the colored sticky notes together on the board. In one column, put all the blue notes together, followed by the pink and yellow sticky notes. Are there similar questions and responses? Have students work together to create one question and/or response for each of the three colors.

*If students finish ahead of time, have them read through the additional Aquaculture in Shared Waters fact sheets and have students do a similar sticky note activity.*



# Aquaculture in Shared Waters Husbandry



Dana Morse<sub>1</sub>, Samuel Belknap<sub>2</sub>, and Rebecca Clark Uchenna<sub>3</sub>

When people think of sea farming, it's usually the husbandry part that they have in mind: tending the crop, working on the boat, etc. Husbandry is a rewarding part of the aquaculture process, and good husbandry is critical to success. Paired with strong financial management and sales and marketing, husbandry is where the rubber meets the road.

Your goal as the farmer is very simple, but difficult to do well: **Successful aquaculturists keep their animals and plants at optimum health.** Another way to think about this is to keep the crop at minimum stress: low stress equals faster growth, improved survival, and maximum quality. Good farmers know their crop, their site, and their gear.

Sources of stress vary by crop. For example, seaweeds have different requirements than oysters, mussels, or salmon. That said, some basic themes apply to all, and this sheet covers some of the common considerations.



A clean cage and appropriate stocking density for the site will contribute to success for this oyster farmer.

**Photo: Dana Morse**

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## Dealing with Predators and Pests

Common *predators* of shellfish include crabs, starfish, lobsters, snails and diving ducks. Pests can include things that are not necessarily lethal to the crop, but which can still cause a problem, such as mud blister worms in oysters, or snail eggs on seaweed. Ideal predator deterrence is efficient, cost-effective, and has minimal environmental disturbance. Knowing predator life cycles and behavior is critical to good deterrence. Some of the common methods for avoiding predators and pests include:

- **Physical barriers:** cages, nets or other containment systems that separate your crop from the problem.
- **Avoidance by location and siting:** siting a farm that has minimal occurrences of a specific predator or pest. For example: maybe a site has a barnacle set at one depth, but not another; or a place where the salinities are a bit low for crabs to thrive, but good for oysters; or a place where the flow is high enough to keep the fouling down on a line of kelp. Again, this is a place where knowing the crop and knowing the site is critical.
- **Manual control:** sometimes a hands-on management approach is necessary. You may have to periodically handle your gear and crop to get rid of a predator or pest. Examples might include tumbling oysters to reduce a barnacle set, or removing green crabs that have managed to get under a net on a clam farm. Manual control is expensive, but if your predator/pest control can be combined with another activity (such as regular tumbling of oysters), then you can minimize this cost. Farmers should also be aware that manual treatments may have damaging effects early or late in the season, contributing to winter mortality. Small tests are advised before large changes are made.



Green crabs have overtaken this cage of small scallops. **Photo: Terry Gray**

## Biosecurity

Biosecurity refers to procedures that may be taken to protect humans or animals against disease or harmful biological agents. No farmer wants to introduce a disease, predator, or unwanted organism to the farm, and since sea farms are connected by water, problems on one farm can spread to others. To limit biosecurity risks, farmers should pay particular attention to the movement of animals/plants from one site to another, and the movement of people and equipment on and off the farm—including visitors. A written plan is strongly encouraged to establish procedures that can limit risk. Specific activities can include health screening for any seed crop that you plan to plant on the farm, ensuring that equipment (boats, machinery, and even things like boots and foul weather gear) is clean before being allowed on the farm, and establishing preventive disinfection if warranted. Not all diseases can be avoided, but the cost of good prevention is well worth the costs when weighed against potentially heavy losses.

## Recordkeeping

Recordkeeping is essential for farming success. Notes on tides, temperatures, farm production, densities, predators, timing and treatments for biofouling and algal blooms and other details can help to avoid repeat mistakes, can help farmers to focus correctly on new development efforts and can help you qualify for such things as crop insurance. Your memory can change, so write it down! The more you can observe and record, the better your ability to analyze your farm and business will be. Waterproof notebooks are an inexpensive, easy-to-use and valuable resource for any sea farmer.

## \* Environmental Stewardship

While anti-fouling paints are in common use with marine vessels, aquaculture producers are encouraged to limit use of any anti-fouling substances on equipment used to grow the crop. Chemicals which have good anti-fouling properties - such as copper - can reside in shellfish tissue over the long term, and pose a human health risk. Similarly, growers can take precautions to limit other environmental interactions, for example: using clean-burning outboards or newer engines rather than older models, and using food-grade hydraulic fluid as an alternate to traditional petroleum-based products.



## Resources



### Information on growing Oysters, Mussels, Razor Clams, Scallops and Kelp

- <http://www.seagrant.umaine.edu/resources-for-shellfish-growers/species/mussel>
- <http://www.seagrant.umaine.edu/resources-for-shellfish-growers/species/american-oyster>
- <http://www.seagrant.umaine.edu/resources-for-shellfish-growers/species/razor-clam>
- <http://www.seagrant.umaine.edu/resources-for-shellfish-growers/species/scallop>

### Aquaculture in Shared Waters fact sheet series:

- <http://www.seagrant.umaine.edu/Resources-and-news>

### Kelp Farming Manual:

- [http://www.oceanapproved.com/s/OceanApproved\\_KelpManualLowRez-9pqe.pdf](http://www.oceanapproved.com/s/OceanApproved_KelpManualLowRez-9pqe.pdf)

### Advice to new (and experienced) producers, from the East Coast Shellfish Growers Association:

- <http://www.ecsga.org/Pages/Resources/RookieMistakes.html>

### Publications from the Northeast Regional Aquaculture Center (NRAC):

- A nice brochure on dealing specifically with shellfish predators, from WHOI Sea Grant: <http://web.whoi.edu/seagrant/whoi-h-05-004-walton-w-c-predators-of-co/>
- A great resource for growers is the list of publications from NRAC. There are several guides and a large number of fact sheets on everything from growing oysters and mussels, to business operations and biosecurity, all available for download. NRAC publications can be seen and downloaded from: <https://agresearch.umd.edu/nrac/publications-0>

The goal of these fact sheets is to inform readers about the possibilities of integrating aquaculture with current fishing and seafood businesses, and to diversify incomes along Maine's working waterfront.

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