Fish Population & Harvest Management Exercise

An overview for teachers

In this Exercise the students will be in charge of there own fishing fleet. The goal of this game is to educate students on how fragile a population of fish can be if harvested with little thought for long term use. Over fishing is a major problem in every ocean on earth. Students will be asked to manage catch quotas for an individual fishery. The following are instructions for the game. In an ideal situation some of the class will succeed while others struggle. This way follow up questions can be answered with examples from the exercise using the successful and unsuccessful data. This class exercise works well after a lecture on fishing regulations and management techniques. The next two pages illustrate some of the more common management techniques applied in fisheries management today.

General Fisheries Management, Concepts and Techniques

Input Controls:

Input controls are the oldest type of fishery management tool. Designed to limit either the number of people fishing or the efficiency of fishing, input controls are the type of measure adopted when a fishery is first managed. Input controls include restrictions on gear, vessels, area fished, time fished, or numbers of people fishing. They apply to both commercial and sport fisheries, and may be applied to an entire fishery or to segments of it. Input controls are considered to be an indirect means of limiting the exploitation of fish stocks, because they do not directly control the amount of catch.

Licenses:

Licenses may be used to certify fishermen or vessels to limit the number and types of vessels or fishermen that can participate in the fishery. License limitations are intended to limit fishing capacity and effort, but their effect on either is indirect. Limited licenses are used in federal fisheries such as the Hawaiian lobster and Pacific ground fish fisheries and in state fisheries such as the California sea urchin and Oregon pink shrimp fisheries. Licenses can also be linked to vessel and gear requirements. In some fisheries, limited licenses are tradable

Output controls:

Output controls are management techniques that directly limit catch, and hence a significant component of fishing mortality (which also includes mortality from bycatch, ghost fishing, and habitat degradation due to fishing). Output controls can be used to set catch limits for an entire fleet or fishery, such as a total allowable catch. They can also be used to set catch limits for specific vessels (e.g. trip limits, individual vessel quotas), owners, or operators (individual fishing quotas), so that the sum of the catch limits for individuals or vessels equals the TAC for the entire fishery.

Output controls rely on the ability to monitor total catch. This can be achieved by either (1) measuring total landed catch with reliable landings records, port-sampling data, and some estimates of discarded or unreported catch; or (2) measuring the actual total catch with at-sea observer coverage or verifiable logbook data.

Total allowable catch:

TAC is a management measure that limits the total output from a fishery by setting the maximum weight or number of fish that can be harvested. TAC-based management requires that landings be monitored and that fishing operations stop when the TAC for the fishery is met. A TAC is based on stock assessments and other indicators of biological productivity, usually derived from both fishery-dependent (catch) and fishery independent (biological survey) data. Data collected from fishermen, processors, or dockside sampling can be combined with at-sea observations and independent fishery survey cruises to provide information about the total biomass, age distribution, and number of fish harvested. Typically, the TAC is determined on an annual basis, and then partitioned across seasons. To the extent that a TAC is well estimated and enforced it can control total fishing mortality on a stock.

Trip limits and bag limits:

These measures can pace landings by limiting the amount of harvest of a species in a given trip. Trip limits are applied in commercial fisheries when there is interest in spacing out the landings over time, or a desire to specify maximum landings sizes, and they are usually accompanied by a limit on the frequency of landings.

Quotas:

Individual Fishing Quotas (IFQs) are a fishery management tool used in the Alaska halibut and sablefish, wreckfish, and surf clam / ocean quahog fisheries in the United States and other fisheries throughout the world. These allocate a certain portion of the TAC to individual vessels, fishermen, or other eligible recipients based on initial qualifying criteria. Individual vessel quotas (IVQs) are used in a number of fisheries worldwide, including some Canadian and Norwegian fisheries. IVQs are similar to IFQs, except that they divide the TAC among vessels registered in a fishery, rather than among individuals.

The Exercise

What you will need for a 20 student classroom:

1) 20 - 6 sided dice. One for each student
2) Each student will need to cut out 40 small fish out of paper.

- This scenario represents an open access fishery with no regulations.
- Each student or pair will start with 30 fish pieces on their desk which will represent the ocean. And each will have one six sided die.
- One fishing season consist of between 1 and 6 fishing trips or roles of the die. One round represents one year. The game works best with 10 years
- The student will take the same number of fish out of the ocean as the die shows after each roll.
- At the end of each year each student will need to have caught/harvested at least 5 fish this represents the operational costs for the fishing fleet. Anything over 5 fish is profit. If a student does not catch 5 fish in a single year the game is over for them. Because they are out of business as a commercial harvester. Fish caught in previous years can't be rolled over to the following year.
- At the end of each year the total number of fish remaining uncaught in the ocean is added up. For every 2 fish left 1 more is added due to natural reproduction. Or this equation can be used which corresponds to the worksheets given {Remaining Ocean Fish ÷ 2 = Natural Reproduction}
- Here are a few examples:

30 fish to start game	30
-12 fish harvested	-13
18 remaining ocean fish	17 ÷ 2 = 8.5
+ 9 natural reproduction	+8or9
27 start of next year	26or27

- There is no starting over! The student with the highest profit and largest sustainable fish population after 10 years wins.

Advanced Scenarios:

Here are a few extras to make the exercise more challenging.

- Try running the above scenario with a <u>quota limiting</u> the total catch per year try 7, 9, or 12. Then see what the success rate is for the class. Another example set the quota for 11 and try to see how long it takes to deplete the fish population.
- Try running the scenario with a <u>time limitation</u> for the fishing season. Every student will have to start and end the seasons at the same time. There will be no quota limitations just the teacher telling the students to start and stop fishing for each season. Allow the students to role between 1 and 3 times. Note students will have to role and record their catch very fast in order to be successful. List some rules that needs to take place before the next die is rolled. This will drive some students out of business due to lack of catch while others should see their ocean stocks do well.
- Since the exercise is dealing with the ocean and wild fish stocks adding real life factors in the scenario helps students get a sense of the different challenges there can be to manage fish stocks.

  Examples:

  Hurricane hits coast {+ 2 operational costs for a year}
  Gas prices go up {+ 1 to operational cost forever}
  Bad reproductive year {– 2 to reproduction for a year}
  Foreign fishing fleet {-4 to total stock for X amount of years}
  Improved technology {+ 2 to total catch each year}

  These situations can be tried on the entire class or just a few students.

Fish Population Classroom Exercise
Student Instructions

BEFORE STARTING

1) Cut out 50 fish between 2 and 4 inches the size does not matter.
2) Obtain worksheets pages
   1) Total Trawl Catch Worksheet
   2) Cost & Profit Worksheet
   3) Remaining Ocean Population Worksheet
3) One 6 sided die

GAME PLAY

1) Put name on top of all 3 worksheets
2) Spread fish out on desktop or floor
3) Go Fishing. Roll the die between 1 and 6 times. After each role take the number on the die and add it to column {1a} in the appropriate numbered trip box. The number of trips you take per year is up to you keeping in mind that you need to pay your operating costs and leave fish in the ocean for reproduction.
4) Once you have completed all your fishing trips you have completed one season. Add up the catch from trips that year and put that total in Total Catch YTD column {1b}. YTD = Year To Date
5) Take the Total Catch YTD number {1b} and subtract it from the Start of Year Fish Population number {1c}. Example:

   Total Catch YTD = 14
   Start of year Population = 30

   30 – 14 = 16 Remaining Ocean Fish
7) Moving to page 2 Cost and Profit Worksheet. Transfer the Total Catch YTD {1b} from page one to Total Catch YTD {2a} page two.
8) Subtract the Operational Cost {2b} from your Total Catch YTD {2a} to get Profit{2c}

   Example:

   Total Catch YTD = 14
   Operational Cost = 5

   14 – 5 = 9 Profit
9) Place the number from the Remaining ocean fish column {1d} from page one to the Remaining fish {3a} column on page three in the following years row.

10) Take the Previous Years Remaining Fish {3a} number from page three and divide it by 2 to get the Natural Reproduction {3b} numbers for that year.

Example:

Previous Year Remaining Fish 16 ÷ 2 = Natural Reproduction

11) Finally take your Remaining Ocean Fish {1d} from page one and add it to the Natural Reproduction {3b} number and you have the Start of Year Fish Population {1c} for pages one and three.

Example:

Remaining Ocean Fish 16
Natural reproduction 8

16 + 8 = 24 Start of year Population

12) Continue this process for ten years. Remember if you can't pay your operating costs you have to start over and try a different strategy.