This article reprinted from:
Beauchamp, C. 2005. Fishery simulation: Growth, harvest, and management of a hypothetical fish population. Pages 395-396, *in* Tested Studies for Laboratory Teaching, Volume 26 (M.A. O'Donnell, Editor). Proceedings of the 26th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 452 pages.

ISBN 1-890444-08-1

Fishery Simulation: Growth, Harvest and Management of a Hypothetical Fish Population

Christine Beauchamp
Biology Department, Dalhousie University
1355 Oxford Street, Halifax, Nova Scotia
Canada, B3H 4J1
christine.beauchamp@dal.ca

Christine Beauchamp received her MSc from Memorial University of Newfoundland and BEd from Dalhousie University. She is a senior instructor in the Biology Department at Dalhousie University where she teaches Introductory Ecology students, coordinates the department's teaching assistant program and serves as an academic advisor in the undergraduate Biology major program.

Introduction

(excerpted from the Fishery Simulation web site)

Commercially harvested fish stocks are valuable bioeconomic resources. Unfortunately, decades of overexploitation have left some fisheries – both the stocks and corresponding fishing-related industries – in a state of collapse. However, with foresight and effective long-term management, most fisheries can succeed. While a collapsed fishery can be assessed only in terms of losses, a fishery managed for sustainable harvest as well as industry profits has many associated benefits:

- a viable, "healthy", fish stock
- sustained catches
- sustained revenues
- employment opportunities, job stability
- support to local economies
- socioeconomic benefits
- high quality food for local and world markets

Instructional Objectives

The main objectives are to teach students about the logistic model of population growth, and at the same time raise their awareness of the dire consequences of overexploiting a renewable biological resource such as fish populations. These objectives are achieved by:

- applying the logistic growth model to an interesting and topical, though simulated, problem
- making the logistic model real by demonstrating that is has practical application
- exploring the measurable consequences of overexploiting a biological renewable resource as exemplified in the simulation.

If these objectives are achieved, students will appreciate that long-term over-fishing may wipe out a fish stock and result in a collapsed industry. Furthermore, the exercise will demonstrate that, over the long term, a controlled harvest system can sustain a fish stock and yield greater catches and revenue than an open access system.

Integrating the Fishery Simulation Exercise into Your Course

The exercise

The web address for the exercise is: ***webdev.ucis.dal.ca/biol2060/fishmodel/phpdemo.*** Students will find the exercise set out in a familiar question and answer format. Relevant background information including equations and definitions precede each set of questions. In addition, there is a linked glossary of terms and abbreviations in the site. In places throughout the web exercise students are asked to input values, and as a consequence, dynamic tables and charts are produced on the web page. These graphics can be copied and pasted into their written reports if the students wish to do so.

Part 1. Logistic Growth Model

This part is concerned with biology only – there is no harvesting (fishing). Here, students will see how a fish stock grows in the absence of fishing, according to the simple logistic equation.

Part 2. Harvest Model

Students work again with the biological model, but now with the catch or harvest term included. Fish stock size and steady state catch will be affected by the level of fishing effort. Steady state stock sizes and catch values can be compared over a range of effort values. A graph called a catch curve is generated, showing steady state catch values over an effort range.

Part 3. Bioeconomic Model

The number of boats in an open access fishery will depend on profits, which are affected by costs. Here the operating cost of a boat (one "unit" of effort) can be varied from a given "normal" value to see how boat number (effort), stock size, and catch change over time.

Follow-up suggestions

After completion of the Fishery Simulation exercises, there are a variety of follow-up activities to engage students in related issues. Here are some suggestions you might tackle with your class:

- Suggest alternatives to the MSY (maximum sustainable yield) strategy
- Research harvesting theories (*e.g.* fisheries, game, forestry)
- Develop growth projections and harvest limits for a local game species or commercial woodlot
- Select a biological renewable resource (BRR) and do one or more of these activities:
    - Case study
    - State of the resource
    - Exploitation history
- Discuss the potential impact of political and economic pressures on resource management
- Explore how BRR management has ecological, economic, political and cultural implications.

Acknowledgements

An early version of the growth and harvest exercise was developed by Rick McGarvey, a former graduate student in the Dalhousie Biology Department. The exercise has evolved over many years thanks to helpful suggestions from numerous students and teaching assistants. The website for the new online "Fishery Simulation" was developed with the programming assistance of Ye Liang.