FISH 555 Spring 2023
Ray Hilborn

Age structured models in fisheries stock assessment

Instructor:
Ray Hilborn hilbornr@gmail.com
Office: 352b Fishery Sciences
Office Hours: by appointment

Guest Instructors: Drs. Allan Hicks and Ian Stewart, International Pacific Halibut Commission.

Credits 4 Graded or Credit/No Credit

Course web site:

Meeting times: March 20-25 all day in Seattle. During the regular academic quarter we will meet Thursdays 2:00-3:50 for lab section and lectures. All sessions will be available on-line. Total contact hours 60.

Final Exam None

1. Course Objectives and Background

Age-structured models form the basis of most stock assessments for commercially important species in U.S. as well as in Canada, Europe, Australia and New Zealand. Parameter estimation, analysis of uncertainty and evaluation of alternative harvest strategies for age-structured models constitutes the core of most fisheries population dynamics and has become a highly specialized field. The purpose of this course is to provide students with an intensive course in these models so they are prepared to participate in stock assessments as conducted by National Marine Fisheries Service and other agencies.

We will concentrate on statistical catch-at-age models, and treat in detail (1) selectivity patterns for surveys and fisheries, (2) appropriate likelihoods for indices of abundance and proportion-at-age data, (3) estimation of year-class strengths and stock-recruitment relationships, (4) technical aspects of assuring convergence when fitting data, (5) evaluation of uncertainty using Markov-Chain Monte-Carlo (MCMC), and (6) evaluation of alternative harvest policies.

The course is designed for students already familiar with the basics of age-structured models, maximum likelihood and Bayesian analysis. The intended audience for the course are students in the College of the Environment, but given the lack of similar courses

nationwide, the course is structured to allow students from other institutions to participate. Specifically, to make the course available to students from outside UW, it will be offered as a 1-week intensive session during the week of 20-24 March 2023. Subsequent lectures and homework will be offered remotely, with one 2-hour sessions each week in person for Seattle residents and remotely for others. each week. Students will be expected to spend about 4 hours each week with homework problems and analysis of data sets.

Students from UW will register for this course as a normal graduate student, students from outside UW can register as non-matriculated students.

Students not resident in Seattle should attend the 1 week initial session in person, and then subsequent lectures and lab sessions online, both real time and recorded, and must also complete the homeworks. Assistance with the homeworks will be available on-line.

2. Learning Goals

Upon successful completion of the course, you will have the following skills

2.1 Knowledge

- How to use the computer program Stock Synthesis 3 (SS3) to assess the history of abundance and fishing mortality of the stock
- Be able to calculate standard reference points such as B_{MSY}, and F_{MSY} for a fish population for which there are data on growth, maturity, mortality and vulnerability

2.2 Comprehension

- Understand the assumptions of the models you use

2.3 Application

- Perform a stock assessment with SS3 that can be used to provide management advice

2.4 Analysis

- Conduct sensitivity tests of your assessment to alternative assumptions or data
- Evaluate the consequences of alternative harvest strategies

2.5 Synthesis

- Understand how the data you input into your model provides the information on stock abundance, level of depletion and status relative to reference points

2.6 Evaluation

- Understand other age-structured stock assessments and identify key assumptions.
- Be qualified to review stock assessments

3. Course Policies

Academic Integrity: Trust between student and instructor is of paramount importance in academic settings. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-121) and your personal

contract as a student. I expect that you will know and follow the university's policies on cheating and plagiarism. Please review the College of the Environment website on academic integrity so that you are clear on what constitutes academic misconduct. Any suspected cases of academic misconduct will be handled per University of Washington regulations. For more information, see the College of the Environment Academic Misconduct Policy and the University of Washington Community Standards and Student Conduct website. Be advised that as an instructor at the UW, I have the responsibility to notify University Conduct committees about any suspected student misconduct.

Religious Accommodations: Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request Form (https://registrar.washington.edu/students/religious-accommodations-request/).

Disability Accommodations: It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is the policy and practice to create inclusive and accessible learning environments consistent with federal and state law. Full participation in this course requires: 1) the ability to attend the one week intensive session in person and the subsequent lectures and laboratories either in person or online. If you anticipate or experience barriers to your learning or full participation in this course based on a physical, learning, or mental health disability, please immediately contact the instructor to discuss possible accommodation(s). A more complete description of the disability policy of the College of the Environment can be found here. If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 (V), 206-543-8925 (TDD), uwdss@uw.edu.

4. Course Requirements and Grading

This course will be offered as a graded course for matriculated UW students and credit-no credit for non-matriculated students. The grade will be based 50% on a completed SS3 stock assessment and 50% on four homeworks. Each homework will require specific analysis to be done, either with a data set provided by the instructor or from the data set the student has chosen as their own example.

5. Method of instruction

The intensive one week will consist of a mix of lectures and labs. All participants must have a laptop computer capable of running the SS3 software and come prepared with a data set they wish to use as their major project. There will be 10 follow up lectures and laboratory sessions. The laboratory sessions will be used to learn more about the software

and prepare students for the homework problems. These lectures and laboratory sessions will be available over the internet.

The course will begin with input files that are already prepared. A major part of the course will be students inputting their own data in SS3 and doing analysis of their own stock.

6. Course Schedule

Time	Topic
Monday March 20 am	Overview of statistical catch-at-age models Historical integrated models, variation among countries and regions
Monday March 20 am	Types of data, and input for assessment models
Monday March 2 pm	Introduction to SS3 and initial model runs using a prepared input file, start building input file of new stock
Monday March 20 evening	Open laboratory
Tuesday March 21 am	Priors: recruitment, selectivity and q
Tuesday March 21 am	Recruitment assumptions
Tuesday March 21 pm	Get input file of new stock running
Tuesday March 21 evening	Open Laboratory
Wednesday March 22 am	Selectivity
Wednesday March 22 am	Data weighting
Wednesday March 22 pm	MPD and diagnostics of new stock
Wednesday March 22 evening	Open laboratory
Thursday March 23 am	Model Selection and Diagnostics, simplification of model structure so parameters are estimable
Thursday March 23 am	Using Length Data
Thursday March 23 pm	MCMC of new stock, start input file for their own stock
Thursday March 23 evening	Open Laboratory
Friday March 24 am	Projections
Friday March 24 am	Overview of alternative software
Friday March 24 pm	Students present their own stock issues
Friday March 24 evening	Conclusion
Lecture 1	Spatially structured models
Lecture 2	Using size composition and estimating growth
Lecture 3	Incorporating tag-recapture data
Lecture 4	What is informative in stock assessment data
Lecture 5	What determines sustainable yield, B_{MSY} and F_{MSY}

Lecture 6	Example: Bering Sea Pollock
Lecture 7	Example: Canary Rockfish
Lecture 8	The CASAL package an alternative to SS3
Lecture 9	Example: Pacific Halibut
Lecture 10	Example: Orange Roughy
Homework 1	Calculating basic reference points: yield-per-recruit, spawning biomass-per-recruit, and MSY
Homework 2	The impact of exploitation history on understanding stock status
Homework 3	How recruitment assumptions impact estimates of optimal exploitation rate and stock status
Homework 4	Projections under uncertainty