

# Spatial Ecology and Modeling of Fish Populations - FAS 6416



## 1 Overview

Spatial approaches to fisheries management are increasingly of interest the conservation and management of fish populations; and spatial research on fish populations and fish ecology is becoming a cornerstone of fisheries research. This course explores in some depth spatial ecology concepts, spatial aspects of population dynamics models, examples of field data analyses, and computer simulation tools to understand mechanisms that determine fish population distributions and the importance of spatial dynamics for fisheries management and conservation.

The course is suitable for students who are interested in an interdisciplinary research field that draws as much from ecology as from fisheries management.

- 2 credits
- Spring Semester
- On-line (Weekly on-line discussion meeting Wednesday 8.00 pm-8.45 pm EST)
- Course website: <http://elearning.ufl.edu/>

**Course Prerequisites:** Graduate student status in Fisheries and Aquatic Sciences. Students should be interested in models. Experience in R is beneficial. Interested graduate students in Wildlife Ecology, SNRE, and Soil and Water Sciences are welcome are welcome.

**Instructor:** Dr. Juliane Struve, [jstruve@ufl.edu](mailto:jstruve@ufl.edu). SFRC Fisheries and Aquatic Sciences Rm. 34, Building 544. Telephone: 352-273-3632. Cell Phone: 352-213-5108

- Please use the Canvas message/Inbox feature for fastest response.
- Office hours: Tuesdays, 3-5pm or online by appointment

**Textbook(s) and/or readings:** The course does not have a designated text book. Reading materials will be assigned for every session and typical consist of 1-2 classic and recent papers. Readings from other texts will supplement the material presented in class. All readings will be made available to the students before class.

## 2 Learning Outcomes

At the end of this course, each student will be able to:

- Differentiate between different types of models that lead to spatial patterns in fish populations.
- Compare different types of models and how they operate at different spatial and temporal scales.
- Describe basic ideas behind ecological models used to describe the spatial dynamics of fish.
- Assess and explain the role of habitat and the environment in the development of spatial patterns and distributions.
- Analyze the implications for population management behind different types of spatial models.

## 3 Course Logistics

The course is taught at graduate level to students from different disciplines and backgrounds and student interaction is encouraged. All students are expected to be familiar with course content posted on the course website, to complete all practical exercises and homework assignments, and to contribute to class discussions

The models introduced will cover a range of topics from small-scale behavior-related search models to large scale dispersion models. Students will encounter these models mostly through the primary literature. Ecological concepts behind the models and their importance in fisheries management and conservation will be presented in lectures. Course topics include simple and more complex modeling approaches throughout the course. Practical exercises will accompany some of the topics. Each module will include an on-line discussion of a specific topic.

Lectures will be posted before the course meeting day and will remain accessible for at least two weeks. Students are responsible for viewing the lectures during this period, participating in online discussion sessions while they are active, and for acquiring assignments.

### Technology Requirements:

- A computer or mobile device with high-speed internet connection.
- Latest version of web browser. Canvas supports only the two most recent versions of any given browser. [What browser am I using?](#)
- Latest version of R <https://www.r-project.org/>
- Latest version of tinn-r <https://sourceforge.net/projects/tinn-r/>

## 3.1 Assignments & Deliverables

### Participation

Students are expected to participate actively and constructively in all elements of the course.

### On-line Discussions

Discussion topics related to primary literature will be set weekly. Participation in the discussions is required. Students are expected to provide original and relevant contributions to achieve full marks. If more than one discussion is missed, each additional discussion missed will lead to a 5 point reduction in the point total.

### Quizzes

Quizzes are intended to facilitate interaction with complex and challenging topics presented in the primary literature. Exams will contain a mixture of short essay questions and technical questions and may include content developed in literature discussions and student present

### Homework Assignments

These will consist of summary exercises, critical thinking questions or literature research tasks and will be given out weekly, with the due date typically being a week after the assignment was given. Homework assignments are expected to be completed individually by each students. Students are expected to provide original and relevant contributions to achieve full marks. Students Group exercises will be announced separately. Instructions will be posted online for each assignment. If more than one discussion is missed, each additional discussion missed will lead to a 5 point reduction in the point total.

### Presentation assignment

Topics must be selected from a list by the first due date. Topic selection due date and presentation due date will be announced at the beginning of the course. Each student will be assigned a presentation, and all presentations will be viewable on the course website. Presentations should be 8-12 minutes long. Instructions will be given after the topics have been selected.

Presentations will be graded as follows:

- Content (15 pts)
- Organization (15 pts)
- Originality (15 pts)

## 3.2 Grades & Grading Scale

100 points Quizzes (10 points each)  
100 points Homework (10 points each)  
50 points for discussion (5 points each)  
150 points Presentation  
400 points total

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### Grading Scale (%)

A	93-100
A-	90-92
B+	87-89
B	82-86
B-	80-81
C+	77-79
C	73-76
C-	70-71
D+	67-69
D	63-66
D-	60-62
E	< 60

## 4 Course Content

**Learning Modules** (please note that the selection of literature is subject to change)

**1 Course Introduction, syllabus, course website, student introductions, brief excursion into some spatial ideas.**

**2 Mechanistic and functional tools for spatial dynamics: From sensory range models to the Ideal Free Distribution.**

Giske *et al.* (1998): Modeling spatial dynamics of fish. *Reviews in Fish Biology and Fisheries* 8, 57-91.

Warner *et al.* (1983): An experimental test on the effects of predation risk on habitat use in fish. *Ecology* 64, 1540-1548.

**3 Spatial dynamics in early life history models: Relationships between size, dispersion, habitat, and mortality in fish.**

Winemiller & Rose (1993): Why do so many fish produce so many tiny offspring? *AmNat* 1993 Oct; 142(4):585-603.

Lorenzen K. (1996): The relationship between body weight and natural mortality in juvenile and adult fish: a comparison of natural ecosystems and aquaculture. *Journal of Fish Biology* 1996;49:627-642.

**4 Habitat in density-independent population models - Estimating the population growth rate.**

Levin & Stunz (2005): Habitat triage for exploited fishes: Can we identify "Essential Fish Habitat?" *Estuarine, Coastal and Shelf Science* 64 (2005) 70-78.

Mangel *et al.* (2006): Using life history and persistence criteria to prioritize habitats for management and conservation. *Ecological Applications*, 16(2), 2006, pp. 797–806

**5 Habitat in density dependent population models – Estimating the carrying capacity.**

Myers *et al.* (2001) What is the carrying capacity for fish in the ocean? A meta-analysis of population dynamics of North Atlantic cod *Can. J. Fish. Aquat. Sci.* 58: 1464–1476 (2001)

**6 Fishing a heterogeneous population. Spatial variations in productivity and yield.**

Wilson, J.R. *et al.* (2012): Small-scale spatial variation in population dynamics and fishermen response in a coastal marine fishery. *PLOS on-line* Vol. 12(7).

Hamilton SL, Wilson JR, Ben-Horin T, Caselle JE. Utilizing Spatial Demographic and Life History Variation to Optimize Sustainable Yield of a Temperate Sex-Changing Fish. Sandin SA, ed. *PLoS ONE*. 2011;6(9)

**7 Mid-term course review and student presentations**

**8 Movement models: Random walk, diffusion and advection-diffusion models.**

Goethel, Daniel R. , Quinn II, Terrance J. and Cadrin, Steven X.(2011) 'Incorporating Spatial Structure in Stock Assessment: Movement Modeling in Marine Fish Population Dynamics', *Reviews in Fisheries Science*, 19: 2, 119–136

**9 Using location data to estimate movement.**

Patterson, T.A., Parton, A., Langrock, R., Blackwell, P.G., Thomas, L. & King, R. (2016) Statistical modelling of animal movement: a myopic review and a discussion of good practice. *arXiv*, arXiv, 1603.07511.

## **10 Modeling the benefits of Marine Protected Areas.**

Hilborn et al. (2004): When can marine reserves improve fisheries management? *Ocean & Coastal Management* 47 (2004) 197–205.

Rahlston, S. & O’Farral, M. (2007): Spatial variation in fishing mortality and its effect on yield. *Can. J. Fish. Aquat. Sci.* 65 588-599.

## **11 Habitat selection and distribution models: Resource selection models, IDFs, and the basin model.**

Shepherd, T. D. and Litvak, M.K. (2004): Density-dependent habitat selection and the ideal free distribution in marine spatial dynamics: considerations and cautions. *Fish and Fisheries*, 5, 141-152. 2.

Lindberg et al. (2006): Density-dependent habitat selection and performance by a large mobile reef fish. *Ecological Applications* 16(2).

Haugen, T. O., I. J. Winfield, L. A. Vøllestad, J. M. Fletcher, J. B. James, and N. C. Stenseth. 2006. The ideal free pike: 50 years of fitness-maximizing dispersal in Windermere. *Proceedings of the Royal Society B* 273:2917–2924.

## **12 Metapopulation dynamics in fish populations (subject to confirmation).**

Hanski, I (1998): Metapopulation dynamics. *Nature* |vol 396 | 5 November.

Defeo O and Cansado S (2015) The relevance of the metapopulation concept to fisheries: a review. *Marine Stewardship Council Science Series* 3: 1 – 80.

# **5 Policies and Requirements**

This syllabus represents current plans and objectives for this course. As the semester progresses, changes may need to be made to accommodate timing, logistics, or to enhance learning. Such changes, communicated clearly, are not unusual and should be expected.

## **5.1 Late Submissions & Make-up Requests**

It is the responsibility of the student to access on-line lectures, readings, quizzes, and exams and to maintain satisfactory progress in the course.

Students must request permission to make-up an assignment prior to missing it. If prior permission is not granted the student will receive 0 points for the assignment. Late assignments will not be accepted without prior consent of the instructor, and will only be accepted up to a maximum of one week after the due date. Extenuating circumstances or situations that fall within university policies will be addressed on an individual basis. Computer or other hardware failures, except failure of the UF e-Learning system, will not excuse students for missing assignments. Any late submissions due to technical issues MUST be accompanied by the ticket number received from the Helpdesk when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request consideration.

For computer, software compatibility, or access problems call the HELP DESK phone number—352-392-HELP = 352- 392-4357 (option 2).

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

## 5.2 Semester Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning.

**At approximately the mid-point of the semester**, the School of Forest Resources & Conservation will request anonymous feedback on student satisfaction on various aspects of this course. These surveys will be sent out through Canvas and are not required, but encouraged. This is not the UF Faculty Evaluation!

**At the end of the semester**, students are expected to provide UF with feedback on the quality of instruction in this course using a standard set of university and college criteria (UF Faculty Evaluations). These evaluations are conducted online at <https://evaluations.ufl.edu>. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results>.

## 5.3 Netiquette: Communication Courtesy

All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. Failure to do so may result in loss of participation points and/or referral to the Dean of Students' Office. <http://teach.ufl.edu/docs/NetiquetteGuideforOnlineCourses.pdf>

## 5.4 Academic Honesty Policy

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."*

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct or appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated.

Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see:

<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

## 5.5 University Policy on Accommodating Students with Disabilities:

Students requesting accommodation for disabilities must first register with the Dean of Students Office (<http://www.dso.ufl.edu/drc/>). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

## 5.6 Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

# 6 Getting Help

For issues with technical difficulties for e-learning in Canvas, please post your question to the Technical Help Discussion in your course, or contact the UF Help Desk at:

- [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu) | (352) 392-HELP - select option 2 | <http://elearning.ufl.edu>
- Library Help Desk support <http://cms.uflib.ufl.edu/ask>
- SFRC Academic Hub <https://ufl.instructure.com/courses/303721>

## 6.1 Student Life, Wellness, and Counseling Help

- Counseling and Wellness resources <http://www.counseling.ufl.edu/cwc/>
- U Matter, We Care <http://www.umatter.ufl.edu/>
- Career Resource Center <http://www.crc.ufl.edu/>
- Other resources are available at <http://www.distance.ufl.edu/getting-help> for online students.

## 6.2 Student Complaint Process

The School of Forest Resources & Conservation cares about your experience and we will make every effort to address course concerns. We request that all of our online students complete a course satisfaction survey each semester, which is a time for you to voice your thoughts on how your course is being delivered.

If you have a more urgent concern, your first point of contact should be the SFRC Academic Coordinator or the Graduate/Undergraduate Coordinator for the program offering the course. You may also submit a complaint directly to UF administration:

- Students in online courses: <http://www.distance.ufl.edu/student-complaint-process>
- Students in face-to-face courses:  
[https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)