

**Welcome to Ichthyology!**  
**Ichthyology is the study of fishes, their biology and biodiversity**

**Ichthyology BIOL 632-01/632L-01; EVSS 724-01/724L-01,  
Fall Semester 2020**

**Mon and Wed 8:30 - 11:30 AM**  
**Online lectures/meetings with labs online or Grice Marine Lab rm 101**

**Instructor**

Dr. Antony (Tony) S. Harold, Professor, Grice Marine Laboratory, Department of Biology, College of Charleston, 205 Fort Johnson, Charleston, SC 29412. Office phone (843) 953-9180; cell phone (843) 460-2057; fax (843) 953-9199; email harolda@cofc.edu. Office location: GML Annex Rm 125. Office hours: GML 125 or on Zoom, by appointment. Mail box in Grice Marine Laboratory room 102.

Short Biography: I received my B.S., M.S. from the University of Toronto and PhD from Memorial University of Newfoundland, followed by postdoctoral research at the Smithsonian Institution (Washington, DC) and the California Academy of Sciences (San Francisco). I joined the College of Charleston in the mid 1990s where I have mainly taught Evolution, Zoogeography, Biology of Fishes and Ichthyology. The focus of my research is the evolution, ecology and biogeography of marine fishes.

**Course Description**

A study of the biology of fishes, emphasizing diversity and evolution, morphology, ecology, physiology, life history, behavior, systematics and biogeography. Laboratory work focuses on groups important in the local fauna.

Prerequisites: BIOL 600, 601, 610, and 611 or permission of the instructor.

## Student Learning Outcomes

Students are expected to show mastery in the broad area of ichthyology (fish biology), with special reference to evolutionary relationships, adaptive morphological attributes, biogeography, ecology, and physiology. Mastery is also required in laboratory and field based activities, with an emphasis on anatomy and identification of fish species.

Students should be able to:

1. Distinguish families and higher taxonomic groups of fishes with respect to their physical features.
2. Draw patterns of phylogenetic relationships among various groups of fishes and to understand the evolutionary significance of features mapped on these phylogenetic trees.
3. Identify selected fish specimens to the level of species using standardized laboratory methods, dichotomous keys and other descriptive literature.
4. Compare and contrast a variety of aquatic habitats with respect to kinds of fishes present, their physiological/ecological features, and biodiversity.
5. Describe the form and function of systems involved in food acquisition, locomotion and buoyancy control.

The degree to which students have learned this material will be evaluated by (a) a written mid-term test and a final examination, (b) two laboratory practical tests, and (c) their ability to critically evaluate published works in fish biology and write about their findings in a Critique paper that will be graded.

## Course Objectives

1. Define, describe, and explain the following concepts as they relate to fishes: speciation, phylogeny, life history, biogeography, ecology, osmoregulation, reproductive mode, and biodiversity. Provide specific examples of fish taxa for these processes and their effects on diversity.
2. Study live and preserved fish specimens (this and other laboratory/field activities are subject to the availability of in-person study after Sept 14,

2020) towards recognition of an array of species, with emphasis on those of the Charleston Harbor and immediate coastal region. Develop knowledge of the families and higher categories of fish classification.

3. Acquire a knowledge of the skeleton and other anatomical components and their functions. Apply information about these structures to an understanding of the functional morphology of fishes, with an emphasis on locomotion, buoyancy control, feeding, and osmoregulation.

### **Policies and Requirements**

1. Academic integrity: For information on the Honor Code, Academic Integrity and related issues refer to <http://deanofstudents.cofc.edu/honor-system/index.php>. Cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when suspected, are investigated. Each incident will be examined to determine the degree of deception involved.

2. Textbooks (both required):

Helfman, G.S., B.B. Collette, D.E. Facey, and B.W. Bowen. 2009. *The Diversity of Fishes*. 2<sup>nd</sup> edition. Wiley-Blackwell, Inc., 720 pages. ISBN 978-1-4051-2494-2

Kells, V., and K. Carpenter. 2011. *A Field Guide to Coastal Fishes: From Maine to Texas*. Johns Hopkins University Press.

3. Additional material:

Dissecting kit (optional due to uncertainty about whether we will have in-person labs), available from College Bookstore or by ordering on-line (e.g., \$16.99 from Amazon, [https://www.amazon.com/Advanced-Biology-Anatomy-Dissecting-Dissection/dp/B017XY1FQS?ref\\_=Oct\\_s9\\_apbd\\_orecs\\_hd\\_bw\\_b8M86qp&pf\\_rd\\_r=JW8MFY6AQKSMEDA2AK21&pf\\_rd\\_p=0487f864-fcd5-55da-859b-d9face3aecf0&pf\\_rd\\_s=merchandised-search-10&pf\\_rd\\_t=BROWSE&pf\\_rd\\_i=7656075011](https://www.amazon.com/Advanced-Biology-Anatomy-Dissecting-Dissection/dp/B017XY1FQS?ref_=Oct_s9_apbd_orecs_hd_bw_b8M86qp&pf_rd_r=JW8MFY6AQKSMEDA2AK21&pf_rd_p=0487f864-fcd5-55da-859b-d9face3aecf0&pf_rd_s=merchandised-search-10&pf_rd_t=BROWSE&pf_rd_i=7656075011)). Always have your instruments with you for in-person laboratories.

4. Laboratory activities (adapted to online presentations including photos and videos of various fishes until in-person classroom work resumes):

A. Handling and manipulation of fish specimens and some dissection. See Appendix on Lab Safety.

B. Osteological study of dried skeletal preparations and cleared and stained fish specimens.

C. Identification:

Learning to use dichotomous keys and to record specimen attributes commonly used in ichthyology. Identification of a set of "unknown" fish specimens (or photographic images of specimens in the event we remain on-line).

D. Studying the fishes in the Grice Marine Laboratory study collection, especially those on a list of taxa, to be distributed in class. The emphasis will be on representatives of families occurring in the southeastern United States. Specimens will also be obtained in the field for study in the laboratory.

E. Exercises in systematic study of fishes, such as phylogenetic and morphometric analysis.

F. A number of field activities will provide experience with collecting techniques and examples of fish assemblages from the area around Charleston. These trips will include beach seining, collecting in the salt marsh, and trawling from a vessel operated by the South Carolina Department of Natural Resources.

5. Tests/exams: There will be two exams on lecture material: a mid-term test and a final examination. Both will consist of questions of various types, with an emphasis on objective questions (multiple choice, true/false), but there will also be some requiring written or analytical answers.

6. Critique paper:

We will read a series of published papers from the journal *Copeia* on various aspects of fish biology. You will write a critique/review paper of one of these published papers (your choice). You should obtain the article you will critique and all others to be discussed directly from the on-line holdings of the journal *Copeia* through the College's library web resources: instructions and a list of articles from which you will make your choice will be distribute to the class early in the semester.

## 7. Summary of graded work:

### *Lecture*

A. Final examination	20%
B. Critique paper	15%
C. Mid-term test	15%

### *Laboratory*

D. Mid-term lab test	15%
E. Identification of unknowns	10%
F. Final laboratory practical	15%

### *General*

G. Laboratory exercises, Discussion Board and other participation	10%
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## 8. Grading scale:

100-90 = A 89-85 = B+ 84-80 = B 79-75 = C+  
74-70 = C 69-60 = D 59-00 = F

9. Disabilities accommodation: If there is a student in the class who has a documented disability and has been approved to receive accommodations through the Center for Disability Services/SNAP, please discuss this with the instructor during office hours.

## 10. On-line Course Environment

The lectures are going to be posted on OAKS sequentially as VoiceThread (over PowerPoint files) and will be available throughout the semester once they have been posted. We will also have a weekly class meeting on Zoom during which I will highlight lecture/lab material and discuss any questions/comments you may have. We also make use of the OAKS Discussion Board for questions/comments: your activity on the Discussion Board and other means of participation will account for a portion of your grade (see Part 7G, "Summary of Graded Work", above). There will be a Discussion Board function available in most of the course modules on OAKS.

I will also use email for some of the question/answer through the semester.

There is also a Comment function on Zoom which I hope you will use while we have our online class meetings. During Zoom sessions I prefer that any questions or comments you have are posted that way rather than making an audio/video statement. Those questions and the ensuing discussion will be a great contribution to understanding the course material.

Most of the lecture material will be VoiceThread (over PowerPoint pdfs) so you will be able to work through it at your own pace, however I suggest you try to do each lecture according to the posted class schedule. The exact date/time of each Zoom class meeting will be sent out to the class by email several days in advance but those sessions will always take place during one of our scheduled slots (Mon/Wed 8:30 - 11:30 AM).

### COURSE SCHEDULE (LECTURE AND LAB)

**Required readings**<sup>1</sup> are chapters or page ranges in the course text by Helfman et al. (2009) [abbreviated HCFB]. Other readings, to be provided, are Cailliet et al. (1996) [CLE], and Moyle, P.B. and J.J. Cech, Jr. (1996) [MC].

Date	Topic	Readings <sup>1</sup>
August		
Wed 26	Introduction: The diversity of fishes	HCFB 1, 2
Mon 31	Basic morphology: external and other features; morphological character lab exercise	HCFB 1, 2
September		
Wed 02	Systematics and fish taxonomy; dichotomous keys and other tools used in identification	HCFB 2
Mon 07	Fish diversity 1: Agnatha, Gnathostomata and Chondrichthyes	HCFB 11, 12, 13
Wed 09	Fish diversity 1: Agnatha, Gnathostomata and Chondrichthyes, continued	HCFB 11, 12, 13
Mon 14	Fish diversity 2: Osteichthyes; Sarcopterygii vs. Actinopterygii; Living Sarcopterygii	HCFB 13
Wed 16	Osteology - study of the skeleton; clearing and staining technique. <b>SIGN UP FOR CRITIQUE ARTICLE BY TODAY</b>	HCFB 3; CLE 3, pp. 38-40
Mon 21	Fish diversity 2: Osteichthyes; Sarcopterygii vs. Actinopterygii; Living Sarcopterygii	
Wed 23	Introduction to estuarine fish ecology	MC 31
Mon 28	Fish diversity 3: basal Actinopterygii; Polypteriformes through Clupeomorpha	HCFB 14
Wed 30	Fish diversity 3: basal Actinopterygii; Polypteriformes through Clupeomorpha	HCFB 14
October		

Mon 05	Fish diversity 4: Euteleostei; Ostariophysii through Myctophiformes	HCFB 14
Wed 07	Harbor trawling cruise (Tony Harold and Pete Meier)	
Mon 12	Study of fish specimens collected during harbor trawling trip. Dissection of structures associated with reproduction and feeding/digestion; plus musculature	HCFB 4, 9, 10
Wed 14	Mid-term test on lecture material	
Mon 19	Phylogenetic systematics lecture and lab	HCFB 2; CLE 9
Wed 21	Mid-term lab test (covering Required Fish Species No. 1 through 59, Myctophidae)	
Mon 26	Fish diversity 5: Acanthomorpha; Paracanthopterygii to Percomorpha	HCFB 14, 15
Wed 28	Field activity: Beach seining	
November		
Mon 02	Fish ecology and assemblages	HCFB 19, 20; CLE 13; MC 27
Wed 04	Fish Diversity 6: Perciformes continued, Tetraodontiformes, Pleuronectiformes	HCFB 15
Mon 09	Form and function of feeding; <b>CRITIQUE PAPERS DUE</b>	HCFB 8
Wed 11	Form and function of buoyancy control and locomotion	HCFB 4, 5, 8
Mon 16	Form and function of buoyancy control and locomotion	HCFB 4, 5, 8
Wed 18	Study of internal anatomy of cleared and stained fish specimens prepared by students; <b>IDENTIFICATIONS OF UNKNOWNNS DUE</b>	HCFB 16
Mon 23	<b>FINAL LAB PRACTICAL</b>	HCFB 16
Wed 25	Thanksgiving Break	
Mon 30	Classes resume, all online; Geographic patterns and processes - biogeography of fishes	HCFB 9, 10
December		
Wed 02	Geographic patterns and processes - biogeography of fishes	
Wed 09	<b>FINAL EXAMINATION: 1:00 - 3:00 PM</b>	

## Appendix: Laboratory Safety Protocol

During this class you are expected to handle fish specimens that are preserved in aqueous solutions of 50% isopropyl alcohol or 70% ethyl alcohol. Both chemicals can be potentially hazardous, and the following safety precautions must be observed by all students participating in BIOL 632/EVSS 724 in order to insure your safety. Students dismissed from a teaching lab due to violations of the following safety procedures will not be allowed to re-enter the laboratory until authorized to do so by the instructor. Any course work missed because of a violation of these guidelines cannot be made up at another time (or by an extension of the lab period) and will be treated as an unexcused absence.

1. You are responsible for knowing the biological, chemical, electrical, ergonomic, mechanical, and physical hazards associated with the equipment and materials that are being utilized in the laboratory. Listen to all instructions and ask questions about that which you do not understand. MSDS safety sheets for 50% isopropyl alcohol and 70% ethyl alcohol are available in GML 101 and 201.
2. Know the location of safety equipment: telephones, emergency shower, eyewash, fire extinguisher, fire alarm pull.
3. Know the appropriate emergency response procedures. If there is an injury or emergency, call 953-5611.
4. Do not work alone in the laboratory if you are working with hazardous materials or equipment.
5. Do not engage in horseplay, pranks or other acts of mischief while in lab.
6. Drinking, eating, and application of cosmetics is forbidden in GML 101 and 201 when alcohol containers are open or preserved fish specimens are present. Smoking is forbidden in all College buildings.
7. Closed toe shoes are required in GML 101 and GML 201. The heel and top of foot must be covered. High heeled shoes, sandals, and perforated shoes are not permitted. This is to protect your feet from glass if a specimen jar is accidentally dropped.
8. Appropriate protective gloves will be available to students in GML 101 and 201 in order to handle fish that are preserved in alcohol solutions if needed. Alcohol

solutions can cause upon direct contact minor skin irritations. If skin irritations are detected, please wash exposed surface with mild soap and plenty of water.

9. Protective eyewear will be available to students in GML 101 and 201 in order to protect their eyes if needed while removing and returning fish specimens to their containers, since alcohol solutions could be accidentally splashed if fish are handled incorrectly. Alcohol solutions can cause severe eye irritation and discomfort if in direct contact, and reversible and/or irreversible corneal damage may occur. If alcohol is splashed on eyes, immediately flush eyes with plenty of water for 15 minutes.

10. Treat sharps and broken glassware containers carefully. Broken glass should be disposed of in properly marked safety containers. All sharps (needles, razor blades, etc.) used for any purpose must be disposed of in specially labeled SHARPS containers.

11. Use good personal hygiene. Keep your hands and face clean. Wash hands thoroughly with soap and water after handling any chemical or biological agent.

12. Clean up the work area on completion of an operation or an experiment. Before leaving the laboratory, you are responsible for making sure your lab area is clean and organized.