Fishes

OEB 177

Instructor Info

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Office Hours TBD

MCZ Labs 105

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Course Info

Tues & Thurs, 1.5hrs

Wed, 2hrs

MCZ 101; Lab Space

Description

Fish make up the largest group of vertebrates on the planet, easily outnumbering mammals, marsupials, birds, and reptiles combined.. Not only are they abundant, but they've diversified into an extraordinary array of sizes, shapes, lifestyles, and habitats. You can find them in the coldest, deepest parts of the ocean, and in the hottest freshwater ponds in the desert. This course will explore fish diversity and their biology.

Overview

During the first half of this course, we will work up the fish phylogeny, examining both extinct and extant lineages. In the second half, we'll dive deep into the specific systems fish have developed that allow them to dominate the aquatic world. We'll spend the last few weeks looking at their behavior, ecology, and some of the conservation efforts currently underway to help protect our fish populations. Throughout the semester, labs will help students connect what they have read and heard with what they can see and feel, reinforcing the material.

Material

Required Texts

Helfman, G.S., Collette, B.B., Facey, D.E., & Bowen, B.W. *The Diversity of Fishes: Biology, Evolution, and Ecology*. 2nd Edition. Wiley-Blackwell. 2009. ("DOF")

Long, John. *The Rise of Fishes: 500 million Years of Evolution*. UNSW Press. 1995. ("ROF")

Recommended Text

Paxton, J.R. & Eschmeyer, W.N. *Encyclopedia of Fishes*. 2nd Edition. Harcourt Brace & Co. 1998.

Other

Any required journal articles and book chapters will be provided on Canvas.

Grading Scheme

15%	Review Paper
15%	Lab Worksheets
40%	Midterm Exams, 20% each
30%	Final Exam

Review Paper

Students will choose a scientific article concerning a topic or species that we covered in class. For this assignment, you will write a summary of the paper and a review: strengths of the paper, things they could improve, perhaps any holes that they did not address, etc. You will then give your review to two classmates to independently review, and you will incorporate their edits into your final draft. You will turn in an abstract of the original paper, the two peer-reviewed copies of your review, the names of people whose papers you reviewed, and your final draft. 15% of your grade will depend on how thoughtfully and thoroughly you reviewed your peers' papers.

Learning Objectives

- Become familiar with the evolutionary history and taxonomic diversity of fishes
- Improve your understanding of the basic physiological and behavioral adaptations that fishes use to carry out their life cycle
- Gain skills regarding the dissection, collection, and preservation of fish specimens through laboratory work
- Be able to identify fish down to the level of orders
- Learn to critically review a paper and summarize it, as well as review and provide helpful criticism to your peers' work

Schedule

MODULE 1: One Fish, Two Fish, Red Fish, Blue Fish

Week 1

•History of the Earth - Fish Remix	• ROF Introduction • Friedman, M. (2015). The early evolution of ray-finned fishes. *Paleontology*, 58(2): 213-228.
•Stem & Extant Agnathans & Gnathostomes	• DOF Ch. 11, pp. 169-179; Ch. 13, pp. 231-240 • ROF Ch. 1, Ch. 2, & Ch. 5 • Janvier, P. (2015). Facts and fancies about early fossil chordates and vertebrates. *Nature*, 520(7548):483-489. • Brazeau, M.D. & Friedman, M. (2015). The origin and early phylogenetic history of jawed vertebrates. *Nature*, 520(7548): 490-497.

Week 2

•Chondrichthyans I: Overview & Sharks	• DOF Ch. 11, pp. 197-200; Ch. 12, pp. 205-227 • ROF Ch. 4, pp. 66-81,& Ch. 3
•Chondrichthyans II: Batoids & Chimaeras	• DOF Chapter 12, pp. 227-229 • ROF Ch. 4, pp. 81-87

Week 3

•Stem & Extant Sarcopterygians	• DOF Ch. 11, pp. 179-185; Ch. 13, pp. 242-248 • ROF Ch. 8 & Ch. 9 • Friedman, M., Coates, M.I., & Anderson, P. (2007). First discovery of a primitive coelacanth fin fills a major gap in the evolution of lobed fins and limbs. *Evolution and Development*, 9(4):329-337.
•Actinopts I: Overview	• DOF Ch. 14 & Ch. 15 • ROF Ch. 6 & Ch. 7 • Friedman, M. (2015). The early evolution of ray-finned fishes. *Palaeontology*, 58(2): 213-228. • Betancur, R. *et al.*. (2017). Phylogenetic classification of bony fishes. *BMC Evolutionary Biology*, 17(162).

Week 4

•Actinopts II: Basal Actinopts & Teleostei	• DOF Ch. 11, pp. 185-197; Ch. 13, pp. 248-259, Ch. 14, pp. 261-266 • Patterson, C. (1982). Morphology and Interrelationships of Primitive Actinopterygian Fishes. *American Zoology*, 22: 241-259. • Lauder, G.V. & Liem, K. (1983). The evolution and interrelationships of the actinopterygian fishes. *Bulletin of the MCZ*, 150: 95-197.
•Actinopts III: Otocephalan Fishes	• DOF Ch. 14, pp. 267-275

Week 5

•Actinopts IV: Freshwater Fishes	• DOF Ch. 16, pp. 339-354; Ch. 18, pp. 410-414, 417-421 • Kocher, T.D. (2004). Adaptive evolution and explosive speciation: The cichlid fish model. *Nature Reviews Genetics*, 5(4): 288-298.
•Actinopts V: Deep Sea Fishes	• DOF Ch. 18, pp. 393-401 • Davis, M.P., Sparks, J.S., & Smith, W. L. (2016). Repeated and widespread evolution of bioluminescence in marine fishes. *PLOS One*.

Week 6

•Actinopts VI: Coral Reef Fishes	• Bellwood, D.R. & Wainwright, P.C. (2002). The History and Biogeography of Fishes on Coral Reefs. *Coral Reef Fishes: Dynamics and Diversity in a Complex Ecosystem*, 5-32.
•Actinopts VII: Pelagic Fishes	• DOF Ch. 18, pp. 401-405

MODULE 2: What Makes a Fish

Week 7

•Respiration	• DOF Ch. 5 • Hughes, G. M. (1960). A comparative study of gill ventilation in marine teleosts. *Journal of Experimental Biology*, 37:28-45.
•Cardiovascular Systems	• DOF Ch. 4, pp. 45-48 • Johansen, K., Lenfant, C., & Hanson, D. (1968). Cardiovascular dynamics in the Lungfishes. *Zeitschrift für vergleichende Physiologie* , 59(2): 157-186.

Week 8

•Homeostasis	• DOF Ch. 4, pp. 52; Ch. 7, pp. 101-105.
•Feeding Mechanisms	• DOF Ch. 4, pp. 41-42; Ch. 8, pp. 119-126 • Westneat, M.W. (2004). Evolution of levers and linkages in the feeding mechanisms of fishes. *Integrative & Comparative Biology*, 44: 378-389.

Week 9

•Sensory Systems	• DOF Ch. 6 • Moller, P. (1980). Electroreception. *Oceanus*, 23:44-54.
•Buoyancy	• DOF Ch. 4, pp. 50-52 & Ch. 5, pp. 68-70

Week 10

•Locomotion I - Lift Based Propulsion	• DOF Ch. 4, pg 41; Ch. 8, pp. 111-119 • Webb, P.W. (1984). Form and function in fish swimming. *Scientific American*, 251(1): 72-83. • Shadwick, R.E. (2005). How tunas and lamnid sharks swim: An evolutionary convergence. *American Scientist*, 93: 524-531.
•Locomotion II - Drag Based Propulsion	• Lauder, G.V. & Jayne, B.C. (1996). Pectoral fin locomotion in fishes: Testing drag-based models using three-dimensional kinematics. *Integrative & Comparative Biology*, 36(6): 567-581.

Week 11

•Communication	• DOF Ch. 22, pp. 477-485
•Reproduction	• DOF Ch. 21

MODULE 3: There Goes the Neighborhood

Week 12

•Symbiotic Relationships	• DOF Ch. 22, 492-497 • Preston, J.L. (1978). Communication systems and social interactions in a goby-shrimp symbiosis. *Animal Behavior*, 26(3): 791-802. • Bshary, R. & Schäffer, D. (2002). Choosy reef fish select cleaner fish that provide high-quality service. *Animal Behaviour*, 63(3), 557-564.
•Behavior	• DOF Ch. 23 • Gross, M.R., Coleman, R.M., & McDowall, R.M. (1988). Aquatic productivity and the evolution of diadromous fish migration. *Science*, 239(4845):1291-1293.

Week 13

•Ecology	• DOF Ch. 25 • Madigan, D.J., Boustany, A., & Collette, B.B. (2017). East not least for Pacific bluefin tuna. *Science*.
•Conservation Efforts	• DOF Ch. 26