IB 171: Freshwater Ecology

Tues, Thurs 2-3:30, 3 units

130 Wheeler Hall

Lakes, rivers, wetlands, and estuaries are biologically rich, dynamic, and among the most vital and the most vulnerable of Earth's ecosystems. This course will introduce students to the natural history and evolutionary, and population, community, and landscape ecology of the world's freshwater and estuarine ecosystems. This course will cover broad principles of ecology, hydrology, biogeochemistry, and biotic and landscape dynamics, but will illustrate these with detailed examination of the biota and environments of freshwater and estuarine environments. Below, the various taxa we will consider are linked to "big ecology" concepts that they can illustrate (*in italics*). The features and processes that influence resilience of freshwater ecosystems to climate, harvesting, land use, and biotic change will be emphasized. The course will have 3 h of lecture per week, two exams, a synthesis paper, a short oral presentation, and an optional field trip.

Jan 19 Overview, logistics

Jan 21 Why natural history is critical for conserving freshwater biota and habitats (*upscaling from traits of organisms to population, community, and ecosystem dynamics*)

Jan 26 Natural history of freshwater biota: bacteria and cyanobacteria (*Microbial genomics down drainage networks*)

Jan 28 Geomorphic and hydrologic contexts

Feb 2 Freshwater environments: springs, streams, rivers, wetlands, lakes, reservoirs and estuaries, and seasonality (*Landscape controls on environmental regimes*)

Feb 4 Natural history of freshwater biota: Attached algae, phytoplankton, and macrophytes (*Alternative "stable" states*)

Feb 9 Natural history of freshwater biota: Riparian vegetation and fungi (*Ecological stoichiometry, nutritional ecology*)

Feb 11 Natural history of freshwater biota: Invertebrates *(Life history bottlenecks*)

Feb 16 Natural history of freshwater biota: Vertebrates (*How smart are fish*?)

Feb 18 Controls over distributions and abundances of organisms: tracking versus enduring spatial variation in risk, stress, and opportunities among habitat patchs (*Ideal Free Distributions vs Landscapes of Food and Fear*)

Feb 23 Size structured population and species interactions in freshwaters (*Ontogenetic niches*)

Feb 25 Seasonal assembly of food webs in fresh waters: (*Disturbance, stress, phenology and succession*)

Mar 1 Species impacts on ecosystems (*Top down and bottom up food web controls*)

Mar 3 Species abundances, performances and interaction strengths down drainage networks (*trait, context, and system dependence along environmental gradients*)

Mar 8 Species impacts on ecosystems (*non-trophic, 'ecological engineering'*) **Midterm Takehome Exam I due**.

Mar 10 Oligotrophication and eutrophication of freshwaters (*Energy sources, trophic transfer efficiency and the distribution of trophic level biomass*)

Mar 15 Cross-ecosystem linkages: benthic-pelagic in lakes, rivers, and watersheds

Mar 17 Cross-ecosystem linkages: rivers, estuaries and coastal oceans

Mar 21-25 (Spring break)

Mar 29 Invasions in fresh waters (*can traits predict invaders, or invasibility*?)

Mar 31 Disease ecology in fresh waters

Apr 5 Global change: impacts of warming, land use, and altered precipitation regimes on freshwaters

Apr 7 Restoration and resilience in fresh waters and watersheds. **Synthesis paper due**

Apr 12 Student presentations on responses and fates of freshwater biota and habitats under global change

Apr 14 Student presentations on responses and fates of freshwater biota and habitats under global change

Apr 19 Student presentations on responses and fates of freshwater biota and habitats under global change

Apr 21 Student presentations on responses and fates of freshwater biota and habitats under global change

April 26 Synthesis and discussion

April 28 Review for final exam

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Requirements for class:

Short answer essays in advance of each class--Students should submit an answer, written in complete sentences but no more than 0.5 pages single spaced, to a question posed for the class. These answers should be submitted by students to a folder on bCourses 171 site by the evening before the relevant lecture (more details forthcoming when I can figure out bCourse posting mysteries.) **20 points**.

Midterm Exam, Take home—starts **February 23, due March 8.** Research the life cycle, phenology, diet, habitat requirements, ecology, biogeography, evolutionary history, and ecological 'roles' of a focal freshwater organism of your choice. Information from each student's research will be compiled into a common class database, including a taxon-specific phenology circle (life history events arranged around 365 'degrees'). **20 points.**

Synthesis paper, due **April 5**. Students will write a paper (8-10 pages single spaced, including figures and references) that projects the future of a specific (real) freshwater or estuarine population or ecosystem of their choice over the next 5, 10, and 50 years, under justified (from the literature or first hand knowledge) assumptions about future climate change, land and water use, and biotic change. **20 points.**

Students will report their findings from synthesis papers in 10-minute individual oral presentations that, like papers, are grounded in scientific knowledge of the ecophysiology, phenology and ecology of key taxa or functional groups of organisms, as well as species interactions, environmental structure and dynamics, and feedbacks between organisms and environments. **20 points.**

Final Exam (short answer essays). **20 points.**