Course: Tópicos Especiais em Ecologia Animal: Global Environmental Change and Thermal Ecology (ECL1944)

Credits (Teor-Prat-Ext-Est): 002-000-000-000

Hours: 30 h

Duration: 23-fevereiro a 01-março, 10:00-12:00 and 14:00-18:00

Local: Sala de Seminários do Departamento de Zoologia

Instructors
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Course Learning Outcomes
At the end of the course, you should:

- Understand the major changes to Earth's ecosystems as a consequence of human activity.
- Explain how changes to the landscape by the loss of habitat and climate change results in a dramatic alteration in the thermal environment.
- Discuss how physiological processes are affected by temperature. In turn, variation in physiological performance influences life history traits, population dynamics and interspecific interactions.
- Evaluate the potential responses of organisms to global environmental change, determine the reliability of models used to forecast changes in distributions, and characterize extinction risk of species.
- Have the ability to use R and R-Studio to analyze biophysical and eco-physiological data. Note: the goal of the course is not to develop proficiency in species distributional models although we will review them.

Course Description
We are living in an unprecedented period in which global habitats are experiencing massive changes at an alarming rate. Turnover of forest, grassland, and wetland into human dominated landscapes reduces the availability of habitat to support species. Furthermore, the near unabated release of greenhouse gases is transforming Earth's climate; the world is getting warmer, and patterns of rainfall are shifting. The principles of thermal ecology, that is the relationship between temperature and biological processes at different levels of organization, provides a framework for understanding how organisms respond to fluctuating temperatures. This course focuses on the thermal challenges organisms face in a warmer world. Topics include (1) evidence of anthropogenic climate change, (2) quantifying the thermal environment, (3) how temperature influences physiological processes and in turn variation in life history traits, (4) population dynamics, (5) the role of phenotypic plasticity.

The class format includes lectures, discussions, and application of simulations and models to forecast species response to altered environments.

Course Resources
I encourage the use of computers during class. Cell phones are more intrusive. The software we will present in class is platform-independent, with the exception that we have not been able to get R or RStudio to work with Chromebook computers. It is possible, but one has to use Linux.

Relevant Websites if you do not already have R and R-Studio:

- R – https://cran.r-project.org
- RStudio – https://www.rstudio.com/products/rstudio/download/#download
- Michael Kearny's NicheMapR Website – https://mrke.github.io

Course Format
My goal for the course is to foster a dialog about the loss of biological diversity as a consequence of anthropogenetic activities, including climate warming and habitat degradation. The course will be focused on organismal biology and how species may cope or respond to rapid changes to their environment. I intend to research Tuesdays for a formal lecture and Thursdays for discussion of recent papers. Also note the lecture topics are not set in stone; we may change the topics based on the interests of individuals in the class and appearance of recent and cool studies.

Assigned Readings
Updated every class.

Assessment & Grades
Individual grades will be determined by the following components:

- 15% Class Participation (leading class discussion)
- 20% Assignments (Analyses and Simulations)
- 15% Short answer quizzes (3)
- 30% Critical evaluation of recent papers (3 two-page assessments)
- 20% Independent Project Presentation

Grading
Point Values for Assignments – Total Points 100

- Class Participation – 15
- Analyses and Simulations – 20
- Quizzes 35
- Critical Evaluation of Papers 30

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Suggested Schedule of Topics

Class	Date	Subject	Readings
1	23-Feb	Signature of global environmental change Climate change: temperature and drought (reorganization of ecosystems) Habitat alteration: habitat deterioration (grazing and agriculture)	
2	23-Feb	Introduction to thermal ecology Integrating biophysical models and life history	
3	23-Feb	Biophysical ecology: core principles, mass-water balance	
4	24-Feb	Quantifying the thermal environment: operative environmental temperatures What is an operative environmental temperature? Empirical approaches Analytical approaches	
5	24-Feb	Core thermal traits: are thermal traits conserved or evolutionarily labile? T_b, T_{pref}, $T_{voluntary\text{-}thermal\text{-}limits}$, CT_{max}, CT_{min}	
6	24-Feb	Thermoregulation, thermoconforming (when to regulate your body temperature?)	
7	27-Feb	Thermal sensitivity of physiology Performance, growth, and metabolism Estimating thermal performance curves	
8	27-Feb	Thermal ecology and allocation rules (life historical consequences of temperature)	
9	27-Feb	Thermal consequences of habitat selection Living on mountain tops	
10	28-Feb	Heat stress and heat hardening	

		Water stress Hydrothermoregulation	
11	28-Feb	The thermal ecology of interspecific interactions	
12	28-Feb	The thermal ecology of sex Temperature-dependent sex determination Mating systems	Dissanayake et al. 2021 Heredity
13	01-Mar	Predicting species reponses to climate change Species distributional models: correlative and mechanistic niche modeling Temperature, activity, and extinction	
14	01-Mar	Evolution of thermal traits: acclimation, plasticity, and selection	Svensson et al. PNAS 2020
15	01-Mar	Thermal ecology of invasive species? Extreme events	