Course outline for Biology 623: Physiological Ecology of Overwintering. Fall Semester 1998. Lectures Mondays and Wednesdays, 10:30-11:30 in Room 252 AHRB. Laboratory on Thursdays, 14:00-17:00 in Room 252 AHRB and as announced.

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We will explore the biologically relevant environmental changes that accompany winter, and compare alternative strategies that organisms use to cope with winter including: migration, acclimatization, hibernation, supercooling, freezing avoidance, freeze tolerance, freeze resistance, and arctic endurance. We will examine first-hand and learn techniques of investigating the physical changes in the winter environment and directly investigate the physiology and ecology of freezing tolerance in wood frogs and insects, freezing resistance and antifreeze in Antarctic fish, hibernation in ground squirrels, acclimatization in small birds and mammals, and supercooling in insects and arctic ground squirrels.

There is one assigned text: "Life in the Cold, an Introduction to Winter Ecology" 3rd Edition by Peter J. Marchand. New England Press: Hanover, NH (1996), available at the UAF bookstore, and but one recommended one "Winter an Ecological Handbook" by James C. Halfpenny and Roy Douglas Ozanne, Johnson Books: Boulder, CO (1989). These books are used by winter ecology courses at other universities and I will draw from them for lecture material. Other readings will be assigned and will be available in the Bio-Sciences Library. These are best read before class.

Each student will prepare a paper and present a seminar; teams of students will conduct original research. There will be a final take-home exam. Papers can be on a subject of your choice or on a subject drawn from a list that I will provide. They are to be 10 pages or more in length (12 point font; double-spaced, 1” borders). Another student in the class must review them before being turned in. They are due 2 November 1998. I will provide critical commentary on each paper, and revisions will be accepted. Seminars (40 minutes long) are to be based on the primary literature and on a subject different from that of the paper. A one-page subject summary is to be provided to other class members on the class day before your talk. Your talk will be videotaped and the tape made available for your screening. Lab/discussion periods will be used for lecture and discussion, for practical demonstrations, and for original data collection. The final will be short answer and comprehensive. Grades will be based on the paper (35%), seminar (30%), final (20%) and lab and class participation (15%).

Topics to be discussed include the following:

Alternative winter strategies of migration, acclimatization, and hibernation
Freeze tolerance, freeze resistance, and supercooling
Overwintering strategies of insects
Freeze damage and desiccation.
Cryoprotection.
Ice nucleation and ice nucleation proteins.
Antifreeze or thermal hysteresis proteins.
Proximate cues for seasonality: photoperiodism, biological rhythms, latitudinal clines.
Heat transfer: conduction, convection, insulation, radiation, evaporation, albedo.
The winter physical environment: prenival, nival, postnival.
Snow ecology:
Temperature and life: metabolism, Q10, endothermy, ectothermy.
Lipids and overwintering
Acclimatization and thermogenesis.
Hibernation and torpor in mammals and birds.
Winter forage and caching.

We also plan to have a series of guest lecturers who have expertise in local systems and animals. These will come at irregular times and will inevitably throw off our schedule.

Systems, case histories to be discussed.

Fish, arctic grayling
Aquatic insects, nymphs
Terrestrial insects, yellow-jacket queens and green stink bugs
Northern amphibians, wood frogs
Small mammals, red-backed voles, tree squirrels, flying squirrels, arctic ground squirrels
Large mammals, caribou, muskoxen, moose.
Birds, chickadees, ravens
Cold resistance of plants and trees, spruce,

Laboratory exercises.

walk in woods
locating insect hibernacula, collecting insects
microhabitat changes with onset of winter
measuring temperature
calibration of thermometers
datalogging of temperatures
small mammal trapping
telemetry
winter home range of tree squirrels and flying squirrels
measuring freezing and thawing
thermal hysteresis and antifreeze
measuring solute concentrations
measuring supercooling points
glucose and other cryoprotectants
snow depth and density, supra-, intra- and sub-nival space
measuring insect supercooling and freeze tolerance
measuring wood frog supercooling and freeze tolerance

Potential Paper and Seminar Subjects.

These are present here just to get your imagination going. You may choose from this list or come up with something of your own. I encourage you to choose a topic that is unrelated to your own research interest. All topics must be cleared with me before you begin. Remember, the topic of your paper and talk cannot be the same!

latitudinal clines in life history strategies
NST and brown fat metabolism
mammalian migration (whales, bats, caribou)
avian migration
proximal signals for avian migration
ecological aspects of snow
photoperiodism in insects
freeze damage in animal tissue
mechanisms of cryoprotectants
ravens in winter
vitrification
overwintering stresses in trees
overwintering of microorganisms
latitudinal clines in body size
daily torpor in ...
freeze tolerance in ...
physics of ice crystallization
cold hardiness in plants
animal antifreeze
cold hardiness in passerines
sleep in animals and winter
photoperiodism in humans
seasonal affective disorder in humans
Useful sources for the natural history of overwintering.

Name:

Status/Major/Research Interests:

Courses taken in physiology and ecology:

Reason for taking this course/ what would you like to get out of/ideas for lectures