Course Information

Course Number: WFSC 448

Course Title: Fish Ecophysiology

Course Website: http://people.tamu.edu/~tdewitt/WFSC448/index.html

Time: Monday, Wednesday, Friday 11:30 am-12:20 pm

Location: WFES 411

Credit Hours: 3

Instructor Details

Instructor: Dr. Thomas DeWitt

Office: 214 WFES

Phone: --

E-Mail: tdewitt@tamu.edu

Office Hours: 1-2 pm, Fridays

Course Description

The course is centered on ecological domains and the demands they place on physiological performance. It explores several related themes: (1) physiological mechanisms and control in fishes, (2) interaction of physiological mechanisms with the environment, and (3) adaptive value of physiological traits. The latter are ultimately emphasized. Another emphasis is analysis of physiology and adaptation with models and ability to work with quantitative data. We therefore will be doing some process and functional modeling. Each week we will quickly refresh background from other courses and extend that knowledge to new domains.

Course Prerequisites

No firm prerequisites are enforced. However, this course is a component of an integrated suite of courses. It is useful before taking this 400 level class to have good background in general ecology and specific knowledge of aquatic ecosystems, fish anatomy and basic aspects of bodily function, including nutrition and disease. We recommend the following courses as good preparation for this course: RENR 215 (Ecology), WFSC 311 (Ichthyology), WFSC 404 (Aquatic Ecosystems), and WFSC 447 (Aquatic Animal Nutrition, Feeding and Disease Management). Knowledge of genetics, evolution, toxicology or developmental biology would be useful.

Course Learning Outcomes

The major learning outcome of this class is that student will be able to contextualize information on the physiological systems of fishes based on environmental states. For example, the respiratory apparatus of a given taxon may pose different constraints in one environment relative to another, and have still different consequences given alternative combinations of traits and environmental parameters. Students should therefore be able to predict and articulate such conflicts. Students will be able to demonstrate integrative thinking about adaptational biology, which means that they should be able to conceive of adaptive physiological solutions to complex problems like those mentioned just previously. Students will learn and exercise creativity in all assignments, drawing upon guidance and tips as instructed.

Textbook and/or Resource Materials

There is no required text. Readings will be assigned each week from openly accessible texts and primary scientific literature.

Grading Policy

Final grades will be determined by proportion of points scored (≥ 90 %, A; ≥ 80 %, B; ≥ 70 %, C; ≥ 60 %, D; < 60 %, F). Below are the points assigned to each graded component of the class:

Item Points

Take-home quizes 1-6 24

Exam 1 25

Exam 2 25

Individual scholarly project 25

Biotic index assignment 4

Data analysis assignment 4

Genetics assignment 6

Attendance 3

Participation (bonus) 2

The point total is 116. Recall, grades are determined by proportion of points scored using a standard grading scale. A curve may be applied to raise (never lower) grades to fit my perception of class talent. Quizzes are intended to ensure students are keeping up with the material and to flag to the instructor what material may remain unclear. They will be graded qualitatively (+, ~, -) which should equate to a preponderence of good and well articulated answers, a mix of correct and wrong or poorly articulated responses, and mostly poor answers. Exams will be multiple choice with the possibility of some short response or essay questions. The individual project is a literature research and oral presentation assignment. A rubric will be distributed for grading. These projects will consult 8-12 mostly excellent (primary literature) sources on a topic in fish ecophysiology of your choice that complements course material. Talks will be 10-12 minutes long. They will feature you presenting before the class using graphical media. You will write an abstract of your talk and provide the references used to inform it. Quantitative skills are important in science and employers typically cite poor quantitative skills in recent college graduates. Thus we will do 2-3 quantitative data analysis assignments related to fish ecophysiology and genetics.

*Graded Class Participation* – Participation is expected. It will be rewarded by up to 2 bonus points. (How many times have you missed a grade level by one or two points?). As a bonus, this is a freebie.

*Graded Attendance* – Attendance will be discounted by a quarter point for every unexcused absence after the first. Attendance will be taken by passing a sign-in sheet each day of lecture.

Late Work Policy

Late work is subject to refusal or penalty at the sole discretion of the instructor.

Course Schedule (tentative)

**Week**

1. Introduction

* Introduction to class structure, preliminary topics (adaptation; ecological tradeoffs; development, genetics, ecology and physical nature of the aquatic environment), probably an early start on form and movement.
* Reading: Introduction from Bennett chapter, [Adaptation and the evolution of physiological characters](https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.408.4496&rep=rep1&type=pdf).

2. Ecology of form and energetics related to swimming

* Review: external anatomy, types and function of locomotion
* Body shape, fins, hydrodynamics, locomotion, energetic of swimming, exercise and development
* Reading: Paul Webb on locomotory modes; Langerhans on swimming mode tradeoffs; Vogel on hydrodynamic drag, TBA on physiological transitions during sustained swimming.
* **Data analysis project:** using the sunfish data provided, calculate and graph correlations between habitat and body shape, and body shape and oxygen consumed during steady swimming. Interpret these results. Due on the first day of class next week.

3. Ecophysiological and kinematic aspects of feeding in fishes

* Review: external morphology of trophic apparatus, relation of swimming morphology to feeding mode
* Phenotypic plasticity of jaws, tradeoffs of (or lack thereof) feeding with other functions, gut length tradeoffs, kinematics of feeding
* Reading: Winemiller or Keenleyside on trophic morphology; Meyer or DeWitt on trophic plasticity; Wainwright/Westneat on feeding kinematics.

4. Environmental biology of respiration

* Review gills, air-breathing, oxygen physiology
* Oxygen stress in natural environments, phenotypic plasticity of gills, aquatic surface respiration and other behaviors, physiology of aestivation
* External reading: Chapman on diversification and evolution of gill plasticity in African cichlids; Tobler on sulfide environments and tradeoffs of respiratory and cave adaptations. TBA on mummichog aestivation.

5. Toxicology

* Review: detoxification mechanisms in fishes
* Ecophysiology of chemically stressful environments; liver function; physiology of stress; lateral impacts of toxicology on other ecophysiological domains
* External reading: Gerlai reading on liver function and toxicology models in fishes; TBA on endocrine disruption in fishes; Rosenthal on pollution effects on sensory systems;

6. Ecology of water balance

* Review/discuss: Anatomical and physiological osmoregulatory mechanisms, ionic regulation, stress responses and effects, freezing resistance, acid-base balance, heat shock
* Reading: Classic Kinne (1940) on osmoregulatory accommodation; salmonid papers on anadromy adaptations.

7. Growth

* Review/discuss: Factors affecting growth, growth regulation, growth rate measurements and models, otolith analysis
* Reading: Arendt & Wilson on optimistic growth of sunfish with an ontogenetic refuge from ecological competition; Conover on latitudinal countergradient variation of growth rate.
* Friday: **Exam I**

8. Reproduction I

* Review/discuss: Reproductive physiology (emphasis on endocrinology), breeding behavior, development, physiological adaptations, bioenergetics, mating systems, alternative reproductive strategies, sex change, single sex species
* Reading: Gross/McMillan on alternative mating strategies; Terry on hormonal/pheromonal communication during courtship and copulation/mating; Gabor or Cummings on Amazon mollies.

9. Reproduction II

* **Modeling** TBA

10. Sensory Perception I

* Review/discuss: chemoreception
* Chemoreception, olfaction, taste, ecological implications of chemoreception in aquatic environments
* Reading: Wisenden/Smith on Schreckstoff;

11. Sensory Perception II

* Review/discuss: Vibration & pressure waves; electroreception
* Reading: Wilcox on predator detection system for prey pressure waves; Atema on shark or catfish electromagnetic prey detection; TBA on schooling coordination via pressure waves; TBA on human sonic disturbance of fish migrations.

12. Sensory Perception III

* Review/discuss: Vision anatomy, cell biology, and neurophysiology
* Reading: Rush on UV sensors and sensory perception; learning ingrainment of visual predator models by Magurran.

13. Behavior and Communication I

* Discuss: ecology and physiology of migratory behavior, shoaling, feeding, aggression and territoriality, communication
* Reading: TBA on color mood and communication in sunfish melanophore controls; St. Mary or similar on visual transduction to endocrine response causing sex change in hermaphrodite wrasses
* Wednesday:
* Friday: No class (Thanksgiving holiday)

14. Behavior and Communication II, first 6 student presentations on Thursday

* Reading: TBA on communication by drumming in fishes; summative discussions of ecophysiological adaptive tradeoffs
* Friday: **Exam 2**

15. TBA

*Dates for exams and assignments will only be changed with written notification to all students in the course (notice via email or learning management system is acceptable).*

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](https://student-rules.tamu.edu/rule07/) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student’s grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](https://student-rules.tamu.edu/rule07/) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor” ([Student Rule 7, Section 7.4.1](https://student-rules.tamu.edu/rule07)).

“The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence” ([Student Rule 7, Section 7.4.2](https://student-rules.tamu.edu/rule07)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](https://student-rules.tamu.edu/rule24/).)

Academic Integrity Statement and Policy

“An Aggie does not lie, cheat or steal, or tolerate those who do.”

“Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one’s work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case” ([Section 20.1.2.3, Student Rule 20](https://aggiehonor.tamu.edu/Rules-and-Procedures/Rules/Honor-System-Rules)).

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

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*Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit* [*disability.tamu.edu*](https://disability.tamu.edu/)*.*

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](https://rules-saps.tamu.edu/PDFs/08.01.01.M1.pdf)):

* The incident is reasonably believed to be discrimination or harassment.
* The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University’s goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

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*Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with* [*Counseling and Psychological Services*](https://caps.tamu.edu/) *(CAPS).*

*Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University’s* [*Title IX webpage*](https://titleix.tamu.edu/)*.*

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student’s academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus

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*Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at* [*suicidepreventionlifeline.org*](https://suicidepreventionlifeline.org/)*.*

College and Department Policies

College and departmental units may establish their own policies and minimum syllabus requirements. As long as these policies and requirements do not contradict the university level requirements, colleges and departments can add them in this section. Please remove this section if not needed.

COVID

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.

Specific up-to-date guidance on COVID policies at TAMU may be found here:

<https://covid.tamu.edu/messages/fall-2022-covid-guidelines.html>