

Draft syllabus**BIO 5180 – Field Investigations in Biological Sciences: Molecular Aquatic Ecology (3 cr.)**

This special section of BIO 5180 will function as a 3 week field and lab-intensive molecular ecology course. It will include 25 hours of lectures and 50 hours of field and lab activities.

The course runs from Tuesday, July 16, 2019 to Friday, August 2, 2019. It will meet daily, *all day*, except for July 24 and 31, August 1, and the weekends. Students can arrange supervised access to lab facilities by arrangement during the “off days” as needed for class assignments. For the most up to date information on the course, see <http://sun.science.wayne.edu/~jram/bio5180/>

COURSE OBJECTIVES:

- To learn molecular and bioinformatic techniques used in aquatic biology
- To develop an understanding of how genetic analysis techniques can be used to understand the taxonomy, evolution, and interactions of aquatic organisms
- To develop an understanding of DNA analysis in conservation and environmental protection
- To provide a field course applicable to the undergraduate Environmental Science and T-RUST graduate curriculum

PREREQUISITE: Intro Biology (or equivalent background in molecular biology and ecology).

LECTURE: Will usually be held at the Belle Isle Aquarium. Additional locations will be rooms 5364 Scott Hall (conference room), 5252/5257 Scott Hall (Physiology teaching lab and PCR core facility), and the computer room at 325 Mazurek at the Wayne State University School of Medicine.

FIELD AND LABORATORY LOCATIONS: Field locations are listed in the syllabus. Laboratory facilities for the course are in the basement of the Belle Isle Aquarium, the Ram Laboratory at 6112 and 6132 Scott Hall, the Department of Physiology teaching lab and PCR core facility, and the computer lab classroom at 325 Mazurek.

LECTURE TEXT:**Required:**

Molecular Ecology, Joanna R. Freeland (Author), Stephen D. Petersen (Author), Heather Kirk (Editor). 2nd ed., \$50.64 paperback & FREE Shipping from Amazon.com

Freshwater Ecology, 2nd Edition: Walter K. Dodds (Author), Matt R Whiles (Author) \$77.89 & FREE Shipping from Amazon.com (or available used, from \$33.03)

Recommended (we will provide copies on reserve; or electronically via WSU libraries):

Introduction to Conservation Genetics Richard Frankham (Author), et al. Free at WSU library online: <https://ebookcentral.proquest.com/lib/wayne/detail.action?docID=256698>

Molecular Markers, Natural History, and Evolution John C. Avise \$5.00 on e-Bay; \$75 new
An Introduction to Molecular Ecology, 3rd Ed., Rowe G, Sweet M, & Beebee T: Price: \$46.84
 WSU library: will purchase for the course.

Phylogenetic Trees Made Easy, Fifth Edition [Paperback], Barry G. Hall (Author), \$67.95 Amazon
Community Ecology [Paperback], Gary G. Mittelbach (Author), \$90.73 & FREE Shipping or
Community Ecology, by Peter Morin.

LABORATORY TEXT and notebook:

- *Field and Laboratory Techniques of Molecular Ecology and Bioinformatics*: Field and laboratory instructions by J. L. Ram and others (with the assistance of A.A. Vasquez)—in preparation. Printouts of first week will be available the first day of class and also online.
- A 3-ring binder

COURSE WEB SITE: canvas.wayne.edu; also <http://sun.science.wayne.edu/~jram/bio5180/>

INSTRUCTORS:

Dr. Jeffrey Ram, faculty, 6112 Scott Hall, 248 200-9431, jeffram@gmail.com. Office hours by appointment

Dr. Donna Kashian, faculty, Biological Sciences

Mike Sergeant, instructional assistant. Biological Sciences, sergeantmike67@gmail.com

Unless otherwise stated, lectures will be held in the mornings in the front conference room at the Belle Isle Aquarium. Field trips will be to various locations on Belle Isle and labs will be held in lab facilities at the Belle Isle Aquarium at end of morning and all afternoon (see separate field and lab schedule). **This draft schedule is subject to change dependent on guest lecturers and weather.**

LECTURE TOPICS**	Date & time	Presenter or host/organizer
Week 1		
1. Organization & Introduction. Molecular methods & ecology	Tuesday, July 16, 8:30 am – 9:20 am	Ram
2. Freshwater Biota: Ecological relationships	Tuesday, July 16, 9:30 am – 10:30 am	Donna Kashian
3. Methods of collecting and preserving organisms (scrapers, nets, dredges, etc.)	Tuesday, July 16, 10:30 am – 11:00 am	Ram
4. Bioinformatics: Sequence databases & analysis, primer design & restriction sites	Wed., July 17, 8:30 am – 9:20 am	Ram
5. Freshwater biota: benthic organisms	Wed., July 17, 9:30 am – 10:20 am	Mike Sergeant; flex
6. GUEST CURATOR: Organisms of the Belle Isle Aquarium	Wed., July 17, 10:30 am–11:20 am	Paul Shuert (Belle Isle Aquarium curator), flex.
7. GUEST LECTURE: High Throughput Sequencing. Nanopore methods & data.	Thursday, July 18, 8:30 am – 9:40 am	Stokes Baker, Univ. of Detroit Mercy.
8. GUEST LECTURE: Using molecular data to study communities	Thursday, July 18, 9:50 am–10:50 am	Abigail Cahill, Albion College
9. Zooplankton	Friday, July 19, 8:30 am – 9:20 am	Vasquez
10. Brainstorm student projects; discuss problem set 1	Friday, July 19, 9:30 am – 11:00 am	Ram, Sergeant, Kashian
Week 2		
11. Bioinformatics : Sequence comparisons, MEGA, trees. Introduction to problem set 2.	Monday, July 22, 8:30 am – 9:20 am	Ram
12. Students (3 groups) present project proposals	Monday, July 22, 9:30 am – 11:00 am	Kashian, Ram, Sergeant
13. DNA sequencing; class sequencing data from previous lab expts.	Tuesday, July 23, 8:30 am – 9:00 am	Ram, flex
14. GUEST LECTURE: Biostatistics and community analysis (biodiversity and other)	Tuesday, July 23, 9:00 am – 10:20 am On Wayne State campus	Abigail Cahill
15. Students (3 groups) present project proposals	Tuesday, July 23, 10:30 am – 12 noon On Wayne State campus	Kashian, Ram, Sergeant
No lecture on Wednesday, July 24	No lecture on Wednesday, July 24	Lab & classroom open
16. High throughput sequencing and metagenomics: concepts and methods.	Thursday, July 25, 8:30 am – 9:20 am	Ram or guest lecturer
17. GUEST LECTURE: Fish diversity	Thursday, July 25, 9:30 am–10:20 am	Aquarium staff, TBD, flex
18. GUEST LECTURE: Environmental DNA	Thursday, July 25, 10:30 am – 11:20 am	Andrew Mahon, CMU; set
20. GUEST LECTURE: Molecular aquatic ecology applied in the marine environment: Marine reef cryptofauna	Friday, July 26, 9:00 am – 9:50 am	Catherine Harris, Aquarium staff
Week 3		
22. Conservation genetics	Monday, July 29, 8:30 am – 9:20 am	Ram or Danielson-Francois
23. GUEST LECTURE. Genetic assays for ecological issues	Monday, July 29, 9:30 am – 10:20 am	TBD; flex
24. Transcriptomes: functional genomics	Tuesday, July 30, 9:30 am – 10:20 am	Ram; flex
No lecture on Wednesday, July 31 or Thursday, August 1		Lab & classroom open
25. Student project reports	Friday, August 2, 9:00 am – 12 noon	Ram, Vasquez, Sergeant, et al.

**** The instructor reserves the right to make changes to the above schedule and topics****

MOLECULAR ECOLOGY LABORATORY AND FIELD EXERCISES & HOMEWORK ASSIGNMENTS

All field trips will be to various locations on Belle Isle, except as otherwise noted. Field trips will generally last about 2 hours. A 45 min break for lunch, etc. will be in the final schedule. The biological, molecular, and bioinformatics laboratory sessions will be scheduled for 3 hours on field trip days and for 5 hours when no field trip is scheduled the same day.

Bioinformatics will be done partly as supervised laboratory activities and partly as homework.

On Student Project days, a teaching assistant or course director will be present in the lab all day, to provide assistance, consultation, or advice as needed.

Homework assignments are due a day or two after being assigned (as detailed in the schedule; no rest for the weary!) or at the next meeting of the class, i.e., the day after a “no class day” or after the weekend if assigned on Friday. A list of homework assignments and points is given after the schedule.

Students will generally work in the field and laboratory in teams of 3 students. Written assignments (lab reports, problem sets) should be each student’s own work and will be individually graded. Oral student project proposals and the final student project oral reports will be assigned a student group grade (same for all students in the group).

METHODS MANUAL: A manual of field methods and laboratory experiments is in preparation, for use in this course. The following outline lists the laboratory activities planned for the course.

ADDITIONAL REFERENCE MATERIAL FOR FIELD AND LABORATORY ACTIVITIES OF THIS COURSE CAN BE FOUND IN:

Limnological Analyses, by R.G. Wetzel and G.E. Likens, 3rd ed., 2000, Springer Verlag, and

BIOTA IDENTIFICATION KEYS: *Guide To The Study Of Freshwater Biology*, by J.G & P.R.

Needham, 1962, Holden-Day

Schedule: (note on each scheduled day, a 30-45-min break in the scheduled time will be included for lunch: arrangements will be made for lunch on Belle Isle)**

Draft schedule, subject to change dependent on available personnel and weather.

DATE	ACTIVITY
Tuesday, July 16 11:00 am – 5 pm	Field Trip: Sea wall critters, plankton, whole water. Lab: DNAzol Direct extraction, DNA amplification (PCR); bioethics training Homework: Lab report 1 (preliminary about PCR). Literature reviews.
Wednesday, July 17 12:00 noon – 5 pm	Field Trip: benthic organisms from Blue Heron Lagoon; view other sites Lab: plankton eDNA benthic organism extraction (lysis & proteinase K, spin column method); zooplankton & benthic organism taxonomy; PCR products from Tuesday sent for sequencing; benthic organism DNAzol Direct extractions. Bioinformatics: Primer design and restriction analysis Homework: Problem set 1 assigned. Lab report 1 due. Assign lab report 2(full PCR lab report)
Thursday, July 18 11:00 am ASUs 12 noon – 5 pm Nanopore lab	Visual and Microscopic Inspection of Belle isle ASUs, and potential extractions. Nanopore experimental technique laboratory. Homework: Summary of Guest Lecturer lecture (optional).
Friday, July 19 11:00 am – 5 pm	Field Trip: Rouge River watershed & other Areas of Concern. Upon return to lab, PCR of benthic and/or ASU samples. Homework: Lab report 2 due. Problem set 1 (codons, mutations, primer design & restriction sites).

<p>Monday, July 22 12 noon – 5 pm</p>	<p>Field Trip: Fishing (for those w/license) in Detroit River Lab: Fish preservation, sorting, and identification; zooplankton, and/or benthic organisms PCR (universal and species-specific PCR). Fish DNA extractions. Note: On Monday, July 20, student groups will present their Student Project proposals. The suggested focus of the Student Projects is Belle Isle organisms or Aquarium fish (both eDNA related and genotyping projects are suggested); Students can begin field trips for sample collection the same day, if the project is approved. Lab: PCR of fish DNA: sample preparation for sequencing; send benthic and plankton PCR products for sequencing. Gel electrophoresis of mussel and fish PCR products. Start of Student Projects, as applicable. Homework: Literature reviews related to student projects. Assign problem set 2, on sequence comparisons, trees, and phylogenetics (MEGA was taught in the AM lecture).</p>
<p>Tuesday, July 23 11:30 am – 5 pm On WSU campus.</p>	<p>12 noon. Lunch. 1:00 pm Field Trip: Sequencing labs on the WSU campus. 2:00 pm Statistics: practical experience with various software (see lecture schedule). 3:30 pm Lab: RamLab, and as needed Belle Isle Aquarium Lab will be open for Student Projects. Very likely will be sending PCR products from student projects and fish for sequencing. Homework: Revision of Lab report 2 due.</p>
<p>Wednesday, July 24 No formal lecture or lab.</p>	<p>No formal lab or lecture. Lab will be open and supervised as needed for Student Projects</p>
<p>Thursday, July 25 12 noon –5 pm</p>	<p>Field Trip: Forensics field trip to fish market and restaurant (lunch) Lab: Continue sequence analysis of data received from fish, benthic, and mussel plankton PCR sequencing submissions. Bioinformatics: phylogenetic analysis (MEGA software). BLAST, MEGA, CLUSTALW, etc. Discuss the phylogenetics problem set (due on this day). Start forensic PCR analysis of commercial fish samples; continuation of previous fish and benthic organisms DNA analysis; PCR products from plankton eDNA. Send fish PCR products for sequencing Homework: Lab report 2 revision due. Lab report 3 (benthic and mussels plankton PCR; this will describe the PCR results; bioinformatics of the same experiment (after data received). Literature reviews related to projects due. Summary of the invited speaker lecture (optional, for credit).</p>
<p>Friday, July 26 9:30 am – 12 noon, bioinformatics; 1 – 4 pm for student projects and discussions</p>	<p>TBD, Possibly <i>Morning</i> on WSU campus: Bioinformatics lab: High throughput sequence data analysis (continued) <i>Afternoon</i> Field Trip: As needed for Student Projects Send forensic PCR products for sequencing. Lab: As needed for Student Projects Homework: Lab report 4 due (this is the fish & mussels PCR lab, now including bioinformatics of the sequences received). Problems: Bioinformatics related to high throughput sequencing (using provided data sets) assigned.</p>

Molecular Ecology Syllabus

Monday, July 29 11 am – 5 pm; 1 pm Discussion	Field Trip: Invasive species on Belle Isle OR Beach microbiology Lab: Complete benthic & zooplankton samples analysis (will have sequences by this time). plus: As needed for Student Projects Homework: Conservation genetics problems assigned, discussion.
Tuesday, July 30 To be determined	Field Trip: As needed for student projects. Lab: Discuss results of benthic & zooplankton experiments (no formal lab report for this). As needed for Student Projects. Homework: Conservation genetics problems due. Last day to submit guest lecture and literature summaries. Optional speaker summary due.
Wed., July 31 & Thursday August 1	No scheduled field or lab. Use for completing student project in lab and for preparation of final report (lab will be available but no formal lessons scheduled)
Friday, August 2.12 noon- 2:00 pm	Lab Notebooks due. Speaker summary & student project reports due (see lecture schedule). Course picnic and farewell event.

**** The instructor reserves the right to make changes to the above schedule and topics****

HOMEWORK:

Homework assignments will consist of field trip and laboratory reports, problem sets, and written summaries & analysis of readings from original scientific literature, and student project proposals and final report.

GRADING:

A total of 1000 points are available to be earned. Course grades are determined from total point accumulation at the end of the course, with final letter grades based generally on a straight scale, modified as appropriate depending on the level of achievement of the highest scoring students. Point scores for individual assignments are recorded for individual graded items during the course. An unofficial letter grade equivalent of the points will be provided with the return of each assignment for approximate evaluation; however, the final grade will be determined from the total points score. Additional points, up to a limit of 150 points, will be obtainable by extra credit opportunities announced during the course.

This list shows the maximum points value for each activity.

Lab Notebook	60 points
Lab Reports (report 1, 40 pts; report 2, 80 pts; report 3; 40 pts; report 4, 80 pts)	240 points
Lab exam	50 points
Student Project	
Written proposal, 100 pts; oral presentation of proposal, 50 pts	150 points
Final project report, oral presentation	200 points
Homework problem sets (60 points for each problem set)	180 points
Primer design & restriction analysis	
Phylogenetics	
Conservation genetics	
An optional metagenomics problem set may also be provided, for 60 points	
Scientific literature and guest seminar reviews: 20 points each up to a maximum of 200 points. The total shown here is based on 6 such reviews:	120 points
Total maximum points available:	1000 points

Extra credit opportunities (additional activities, problem sets, literature reviews, or a lab quiz) may be announced during the course, at the discretion of the instructors.

ATTENDANCE: Prompt attendance is required at ALL laboratory sessions. Students must contact Dr. Ram or Mike Sergeant in advance if they will be missing a laboratory. Vehicles for field trips will LEAVE no more than 5 min after the start of class for field trip days. Students will meet at the vehicles (unless otherwise announced)

LAB NOTEBOOK

A 3-ring binder notebook will be maintained containing handouts, lab notes, raw data and graphs etc., species lists, exercise or demonstration descriptions and results, etc. It will be submitted on the last day of lab and graded subjectively for completeness, coherence, and neatness.

LAB EXAM

A written Lab Exam will be given, consisting of explanations of analytic procedures and principles, identifications of equipment and function, and identifications of biota

ADD/DROP POLICY:

Consult the instructor if you wish to add or drop the course after it has started.

ACADEMIC INTEGRITY POLICY:

A student found cheating (for example, committing plagiarism in a lab report; using another student's work for problem sets) will receive a zero for that assignment with no opportunity to drop or replace that score (i.e., no extra credit assignment can add that proportion of the total score back into the total). A second episode of cheating will result in a grade of E for the course and possible university disciplinary action.

STUDENTS WITH DISABILITIES:

If you have a physical or mental impairment that may interfere with your ability to successfully complete the requirements for this course, please discuss with the teachers of the course. Alternatively, or If you are not satisfied with the response or accommodation of the instructors, you can contact Educational Accessibility Services (583 Student Center Building; 577-1851) to discuss appropriate accommodations on a confidential basis.

ACADEMIC DISPUTES, including issues not specifically resolved or covered by this syllabus, will be resolved by following the guidelines for University Student Due Process.