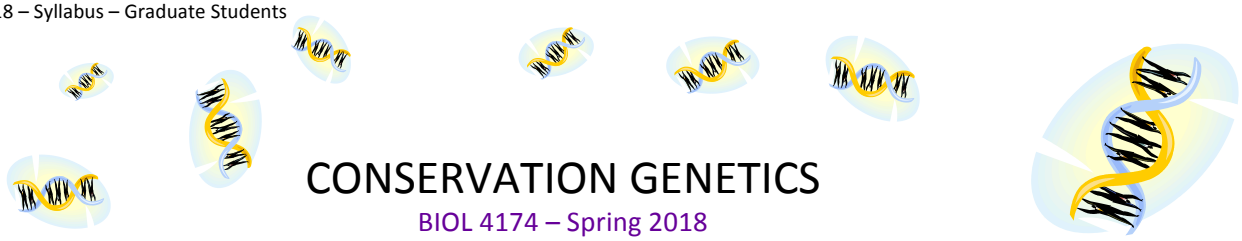

CONSERVATION GENETICS

BIOL 4174 – Spring 2018

Time & Place:	**Lecture:**	MO+WE	4:35pm - 5:50pm	SCEN 203
	Lab:	WE	9:40am - 12:40pm	SCEN 606

Instructors:	Dr. Marlis R. Douglas	SCEN 738	mrd1@uark.edu	575-4176
	Mr. Tyler K. Chafin	SCEN 705	tkchafin@uark.edu	575-7413

Office hours: By appointment

Course Goal:

Conservation genetics encompasses the field of ecological and evolutionary genetics/genomics as it applies to **conservation and management of biodiversity**. The course is intended for students working in the **broader areas of applied ecology, wildlife biology, fisheries, and conservation biology**. It provides a foundation to basic concepts and theories in population and evolutionary genetics/genomics and how these are translated in applied disciplines such as resource management, environmental sciences and sustainability.

The course will not teach students molecular genetic lab methods, but instead focus on what **type of data** are needed to **infer biodiversity patterns**, and how such data are **analyzed** and interpreted in an **applied context**.

Course Objectives:

1) Review aspects of population genetics/genomics, phylogenetics and evolution as they apply to conservation and management of biodiversity.
2) Obtain a basic understanding how molecular markers are applied to infer biodiversity patterns, their limitations and suitability for conservation research.
3) Understand analytical approaches to assess and describe biodiversity.
4) Evaluate the role of genetic information in conservation and management of threatened and endangered species and wildlife forensics.
5) Develop an ability to critically review the literature in conservation genetics/genomics and molecular ecology.

Prerequisites:

Biology core courses (evolution, ecology, genetics, cell biology), junior or senior standing. Students are expected to have a basic understanding of evolutionary concepts, ecological processes, genetic methods and statistical data analysis. Do not hesitate to seek clarification if you fail to grasp lecture materials. However, the responsibility for absorbing/ understanding the prerequisite materials for computer labs, discussions and assignment is yours.

Expectations:

Students are expected to **immerse** themselves into the field of conservation genetics and develop the ability to critically evaluate research and management within a conservation genetics framework. There is a substantial amount of reading required and there is a heavy emphasis on data analysis. Active participation in all phases of the course is essential.

How to get your questions answered

E-mail is the preferred method for communication, either for a direct answer to your question

or as a means to set up a meeting time with the instructors.

How to do well in Conservation Genetics:

- Attend class – exams and assignments emphasize lecture and reading materials.
- Read assigned materials – they supplement lectures and form the basis for discussions.
- Come prepared - an effective learning strategy is to review lecture notes.
- Keep your lecture notes neat and organized – legible notes are easier to study.
- Stay up with the material and deal with ambiguities by seeking assistance promptly.

Required Materials: as posted on Blackboard <https://learn.uark.edu>

- Handouts will be posted (at latest) by 9 am the day of class.
- Assigned readings will be available at least 1 week before class session.
- Students are responsible for downloading and printing materials prior to each session.
- Students must read assigned materials before coming to lectures or labs.

Required Text:

Allendorf FW, Luikart G. 2012. Conservation and the Genetics of Populations (2nd ed.). Wiley-Blackwell Ltd., Oxford, UK.

Recommended Texts:

Frankham R, Ballou JD, Ralls K, Eldridge M, Dudash MR, Fenster CB, Lacy RC, Sunnucks P. 2017. Genetic Management of Fragmented Animal and Plant Populations. Oxford University Press, Oxford, UK.

Frankham R, Ballou JD, Briscoe DA. 2009. Introduction to Conservation Genetics (2nd ed.). Cambridge University Press, Cambridge, UK.

Frankham R, Ballou JD, Briscoe DA, McInnes KH. 2004. A Primer of Conservation Genetics. Cambridge University Press, Cambridge, UK.

Hedrick PW. 2009. Genetics of Populations (4th ed.). Jones & Bartlett Publishers, Sudbury, MA.

Course Structure:

1) **Lectures** will cover a brief review of population genetics, genomics and phylogenetic principles relevant to conservation, but focus on applications in biodiversity management and restoration.

2) **Discussions** of literature will help students synthesize concepts, and juxtapose theory with applied conservation issues. Case studies will be used to demonstrate how patterns of genetic variation within and among populations may help identify conservation needs and define management priorities.

3) **Computer labs** will provide an opportunity to learn analytical approaches in biological computing for various molecular data commonly used in conservation genetic, genomics and molecular ecology studies.

4) **Writing assignments** in form of a **Review Paper** (undergraduates) or **Research Proposal** (graduate students) will allow students to develop a deeper understanding of basic genetic concepts, genetic methods and analytical approaches as they apply to conservation.

Assignments, Testing and Grading:

Students will be evaluated based on 1 exam (15%), quizzes (12%), seminar presentation (10%), 14 computer labs (28%), 1, 1 term project (30%) and attendance/participation (5%).

Grade Scale: A = 91-100%; **B** = 81-90%; **C** = 71-80%, **D** = 61-70%, **F** <60%

Task / Deliverables	N	Points	Final Grade
Exam	1	150	15%
Quizzes	12	120	12%
Presentation	1	100	10%
Computer Labs	14	280	28%
Term Project	1	300	30%
Attendance + Participation		50	5%

1) **Exam** (150 pts): One take-home exam will test the ability of students to place conservation issues within a conceptual framework and relate genetic approaches to theoretical aspects. It will cover topics from Lectures 1-11. The exam must be turned in **by midnight on 02-Mar-18**.

2) **Quizzes** (120 pts): Most session will **start** with a short quiz, testing students' comprehension of the assigned readings and how concepts from early lectures apply to the case studies. Thorough reading of the assigned papers BEFORE each session is essential. There will be ~15 quizzes, but only 12 count towards the final grade; the lowest 3 scores will be dropped. There are no make-up quizzes; if you miss a class, your score will be 0.

3) **Presentation** (100 pts): Each student will synthesize via power-point presentation concepts and approaches relating to a key topic, and select 4-5 questions to be discussed in class, and moderate the in-class discussion. The **presentation** and selected discussion **questions** must be submitted **by midnight the day before the discussion**.

4) **Computer labs** (280 pts): 14 labs (20 pts each) will provide opportunities for hands-on learning of analytical tools; a quiz will test basic computing skills covered in Week 2. **Assignments** must be turned in **by midnight on the Monday following** each lab session.

5) **Term Project: Proposal** (300 points): students will write a Research Proposal. In consultation with Dr. Douglas, a subject that matches the student's background and interests will be selected. Sections of the proposal will be **turned in at specified deadlines**. Each student will give a short power-point presentation introducing their study system, central question, conceptual framework, goals of the research, and approaches.

   Goal of the **Proposal:** identify a relevant conservation issue, develop a conceptual framework, synthesize relevant background information, select appropriate molecular approaches, derive a workable study design and draft a realistic budget.

Classroom etiquette

Help maintain an atmosphere conducive to learning. Act responsibly and show respect towards others in your class. Stop talking when the general session (lectures, presentations or labs) begins, but do raise your hand if you would like to ask a question or contribute your thoughts and ideas. Mute cell phones and turn other distracting devices off at the beginning of each session. You will be asked to leave *immediately* if your behavior/actions impede the learning of other students.

Academic honesty, grading and absence policy:

Plagiarism involves theft of another's work and denial that it occurred. Examples are:

- submitting another's work as your own.
- little or disproportional contribution to collaborative projects.
- copying words or ideas from another without giving credit.
- failing to put excerpted materials within quotation marks.
- providing incorrect information about the source of a quotation or data.
- altering words, but copying sentence structure of a source without credit.
- copying the majority of your work (with or without credit).

All assignments will be submitted via *SafeAssign* on Blackboard, a program that checks for plagiarism. Visit < http://safeassign.com/ > for more data.

Malicious plagiarism (turning in someone else's completed work as your own or turning in work done for a previous course) will be punished under sanctions outlined by the university <http://provost.uark.edu/ >.

Plagiarism stemming from potential misunderstanding (i.e., poor paraphrasing; lack of citations; missing quotations; etc.) will require students to correct/ resubmit the assignment for credit. Recurring issues will elicit university sanctions (above).

Questions about how to cite, paraphrase, or use quotation marks correctly should be directed to the GTA or (b) an on-line writing lab < http://owl.english.purdue.edu >.

Absence policy

If illness, a family emergency, or a University-sponsored event necessitates a class absence, then written verification (i.e., doctor's excuse, newspaper obituary, or letter from a coach) must be provided **in advance**, when circumstances allow.

Special needs

If you have special needs for lectures, assignments or exams, please contact Dr. Douglas after the first day of class. Do not hesitate to talk with her at any time during the semester if indeed something should develop. We will try to be as accommodating as possible.

Inclement Weather

The inclement weather policy for this class follows University policy, and students should make every reasonable effort to attend class. However, if travel to class might involve significant health and/ or property risk due to severe weather, then students are encouraged to stay home. If it is questionable whether class will meet, then every effort will be made to announce cancellations via e-mail.

Emergencies / RazAlert

For safety reasons, we will designate a person to leave their cell phone on (and monitor it) to alert the class of an emergency notifications (RazAlert). Please learn how to follow the emergency procedures on the provost's website: < emergency.uark.edu >

Conservation Genetics – Part 1: Basic Concepts

Part 1 introduces basic concepts in conservation genetics. Lectures will cover a brief review of population genetics principles relevant to conservation. Pattern and process of genetic diversity in large and small populations are examined in an evolutionary context. Methods to identify and describe genetic diversity are introduced. These approaches are then discussed in an applied management context. Part 1 will be concluded with a take-home exam; students will be tested about their knowledge of key concepts and their understanding of genetic approaches to address conservation issues.

Week	Day	Date	Lectures (DISC 404)
1	WE	17-Jan	Lec-1: Course Logistics / Introduction - What is Conservation Genetics?
2	MO	22-Jan	Lec-2: Biodiversity Loss + Genetic Diversity
2	WE	24-Jan	Lec-3: Genetic Variation: Methods
3	MO	29-Jan	Lec-4: Genetic Variation: Approaches
3	WE	31-Jan	Lec-5: Genetic Diversity in Large Populations: Mutation + Selection
4	MO	05-Feb	Lec-6: Genetic diversity in Small Populations: Genetic Drift + Migration
4	WE	07-Feb	Lec-7: Genetic Management
5	MO	12-Feb	Lec-8: Genetic Structure + Dispersal
5	WE	14-Feb	Lec-9: Conservation Units: ESU and MU
6	MO	19-Feb	Lec-10: Species Concepts
6	WE	21-Feb	Lec-11: Metagenomics + Species Composition
7	**FR**	**02-Mar**	**Exam Due (midnight)**

Conservation Genetics - Part 2: Applications & Case Studies

6) **Part 2** highlights application of genetic approaches in biodiversity conservation through discussion of real-world problems. Review papers and case studies will be selected from the primary literature to demonstrate how conservation needs and management priorities can be clearly defined through an analysis of genetic variation within and among populations.

Thorough reading of the assigned papers BEFORE each session is essential for understanding of the topic and substantial contributions to the discussions. To encourage students to indeed read the papers, each session will start with a **quiz** about the papers to be discussed during that session (Topic 1-12).

For Topic 1-6, a graduate student will present the concepts and approaches, and will also moderate the discussion. For Topic 7-12, Dr. Douglas will summarize concepts and approaches, and undergraduates will present selected case studies related to the topic. Topics will be assigned based on students' interest and knowledge.

Week	Day	Date	Seminar Presentations & Discussions (DISC 404)	Assigned to
7	MO	26-Feb	Project Presentations	Graduate Students
7	WE	28-Feb	Topic 1: DNA Taxonomy & DNA Barcoding	*Cleary*
8	MO	05-Mar	Topic 2: Hybridization + Introgression	*Hilario-Perez*
8	WE	07-Mar	Topic 3: Population Fragmentation	*Zbinden*
9	MO	12-Mar	Topic 4: Translocations + Assisted Migration	*Murchison*
9	*WE*	*14-Mar*	*No class*	
10			*Spring Break*	
11	MO	26-Mar	Topic 5: Landscape Genetics	*McDill*
11	WE	28-Mar	Topic 6: Climate Change	*Hasik*
12	MO	02-Apr	Topic 7: eDNA (environmental DNA)	TBD
12	WE	04-Apr	Topic 8: Invasive Species	TBD
13	MO	09-Apr	Topic 9: aDNA (ancient DNA)	TBD
13	*WE*	*11-Apr*	*No class*	
14	MO	16-Apr	Topic 10: Individual Identification	TBD
14	WE	18-Apr	Topic 11: Parentage and Kinship Analysis	TBD
15	MO	23-Apr	Topic 12: Forensics and Poaching	TBD
15	WE	25-Apr	Paper Presentation	Undergraduates
16	MO	30-Apr	Paper Presentation	Undergraduates
16	WE	02-May	Course Wrap-up	
		09-May	*Finals Week – 7:45PM-9:45PM*	

Conservation Genetics – Part 3: Analytical Approaches

Part 3 explores in 14 hands-on computer lab sessions analytical approaches employed for different types of molecular data. Statistical methods that specifically identify genetic diversity, describe how it is partitioned, and relate observed diversity patterns to underlying processes will be emphasized. Familiarity with basic statistical approaches and basic computer skills are required.

Labs 12-14 are mandatory for graduate students, and are not required for undergraduates.

Week	Date	Lab	Computer Lab (SCEN 606)
1	17-Jan		**No Lab**
2	24-Jan	Lab 1	**Introduction to Biological Computing**
3	31-Feb	Lab 2	**Sequence Data 1:** Introduction to Sequence Data & Editing
4	07-Feb	Lab 3	**Sequence Data 2:** Sequence Alignment, BLAST
5	14-Feb	Lab 4	**Sequence Data 3:** Phylogeography & Haplotype Networks
6	21-Feb	Lab 5	**Sequence Data 4:** Tree building 1: Maximum Parsimony
7	28-Feb	Lab 6	**Sequence Data 5:** Tree building 2: Maximum Likelihood
8	07-Mar	Lab 7	**Sequence Data 6:** Tree building 3: Bayesian Methods
9	14-Mar	Lab 8	**Sequence Data 7:** Coalescent Theory and the 'Molecular Clock'
10			*Spring Break*
11	28-Mar	Lab 9	**Microsatellite Data 1:** Genetic Diversity Measures
12	04-Apr	Lab 10	**Microsatellite Data 2:** Population Structure & Admixture
13	11-Apr	Lab 11	**Microsatellite Data 3:** Inference of Recent Migration
14	18-Apr	Lab 12	**Genomic Data 1:** Introduction to NGS and Cloud Computing
15	25-Apr	Lab 13	**Genomic Data 2:** Introduction to RADseq with pyRAD
16	02-May	Lab 14	**Genomic Data 3:** Detecting Introgression
			Finals Week

Conservation Genetics – Part 4: Research Proposal

Part 4: Writing a research proposal will enable students explore a topic related to their research within a conceptual framework, choose appropriate molecular methods to derive genetic data, and select analytical approaches for to address the key questions and test hypotheses. The **intricacies of** conservation genetics studies are best learned by planning/designing an actual project; this will be practiced by writing a research proposal. Students will work independently throughout the semester, but will meet occasionally in-class or individually with the instructor so as to define major components of the proposal and report on progress towards its completion. A proper foundation of primary literature that underpins the proposal will be stressed.

A subject that matches the student's background and interests will be selected in consultation with Dr. Douglas. A topic that **relates to your graduate research is appropriate**, but an **existing proposal cannot** be re-written to fulfill this assignment.

Grading: Students will be evaluated on their ability to identify a relevant conservation genetic issue, place it within a conceptual framework, develop a study design, select/synthesize background information, outline molecular and analytical approaches to address the study questions, and derive expected outcomes. Drafts of various components of proposal will be turned in at specified deadlines; requested changes must be incorporated into a final version.

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Week	Day	Date	Research Proposal (due by midnight)
2	FR	26-Jan	Identify Research Topic / RFP
3	FR	02-Feb	Outline
5	FR	16-Feb	Introduction + Objectives
7	MO	26 Feb	Presentations 1
7	WE	28-Feb	Presentations 2
11	FR	30-Mar	Background
13	FR	13-Apr	Approach + Timeline
15	FR	27-Apr	Budget, Budget Justification, Facilities, Data Management
16	FR	4-May	**Final Version with Revisions**