# **Syllabus**

#### Course Information

Course Number: GEOL 651

Course Title: Paleoecological Community Analysis

Time: Tues/Thurs 2:20 PM - 3:35 PM

Location: Halbouty 174 Credit Hours: 3 CR

#### **Instructor Details**

Name: David Bapst Office: Halbouty 169

Email: dwbapst@tamu.edu

Office Hours:

• Tues/Thurs: 9:30-10:30 AM, 3:40-4:30 PM

Office Hours are held in-person in my office, as well as online – please send me an email or a message via the Canvas Learning Management System so I can send you a Zoom link. If these times do not work for you, then please contact me and we will work out alternative times for use to chat.

#### Course Description

Quantitative analysis of multivariate paleoecological community data; measurement of diversity; cluster analysis; gradient analysis by standard and canonical ordination techniques.

#### Course Prerequisites

A basic course in statistics or approval of instructor. (Graduate students are routinely approved.)

#### **Special Course Designation**

None.

## Course Learning Outcomes

Graduate students who complete this course should be able to:

- Calculate common ecological measurements in R.
- Apply multivariate statistical techniques to their own research work.
- Intuit potential caveats and artifacts in multivariate analyses, such as ordinations and cluster analyses.
- Interpret and critically evaluate another person's analysis of multivariate data sets of ecological or environmental variables
- Identify appropriate methods for visualizing and summarizing multivariate structure.
- Use classification analyses to discriminate and test groups within datasets.
- Troubleshoot error messages and other problems with their code.
- Teach themselves an unfamiliar statistical test to apply to their own data.
- Devise novel analytical approaches when necessary, using statistical theory, simulations, etc.

#### Textbook and/or Resource Materials

Students need access to their own computer, on which they should have the R interpreter (install from CRAN: https://cran.r-project.org/), the integrated development environment (IDE) Rstudio (install from the Rstudio website, https://www.rstudio.com/products/rstudio/download/#download), and a spreadsheet program (such as Microsoft Excel). Both R and RStudio are available for free, and LibreOffice Calc is a free spreadsheet program.

No textbooks are required, however you may find the following volumes useful in your studies, a:

- Borcard et al., 2011. Numerical Ecology with R. Springer. 306 pp.
- Crawley, M.J., 2013. The R Book. John Wiley & Sons, West Sussex, 1051 p.
- Hammer and Harper, 2006. Paleontological Data Analysis. Wiley-Blackwell. 351 p.
- Legendre and Legendre, 2012. Numerical Ecology, 3rd edition. Elsevier. 1006 pp. (There are many reprints of this volume older versions are also good!)
- Patzkowsky and Holland, 2012. Stratigraphic Paleobiology: Understanding the Distribution of Fossil Taxa in Time and Space. University of Chicago Press. 256 pp.
- Sneath and Sokal, 1973. Numerical Taxonomy: Principles and Practice of Numerical Classification. W H Freeman and Co. 588 pp.
- Sokal and Rohlf, xxxx. Biometry: The Principles and Practice of Statistics in Biological Research. (Newest version is 2011. 1994 edition is also good.)
- Zar, 2009. Biostatical Analyses, 5th edition. Pearson. 960 pp.

#### **Grading Policy**

Your final letter grade will be based on the final percentage grade for the course:

$\mathbf{A}$	90 - 100%
В	80 - 89%
$\mathbf{C}$	70 - 79%
D	60 - 69%
$\mathbf{F}$	Less than 60%

Your final percentage for the course will be based on:

Project Paper	40%
Preliminary Drafts & Data Set	15%
Project-Associated Papers	10%
In Class Presentations	10%
Homework Assignments	25%

Grades in this class will be based on a series of individual homework assignments, a final project with associated assignments, including in-class presentations and a final paper.

Term Project, Drafts and Final Project Paper This class requires a project-based term paper, with students proposing a project focused on research question of their own selection from within the earth and environmental sciences. Students are required to locate and obtain an appropriate dataset – perhaps from a publicly-available source, such as supplemental material for an article, or collected as part of their own research, or supplied by their advisor. Datasets must have a minimum of 10 samples and more than one variable measured for each sample, so that reasonable questions concerning multivariate

data structure can be addressed. Addressing these research questions will require applying various analyses from throughout the course, and possibly beyond the covered course material.

During Week 3, students must submit a **Project Proposal**, where they briefly describe one or more potential research projects they might persue, and where they would get the data necessary, and the questions that would be addressed.

Drafts of the term paper are due at four points during the semester:

- 1. The first draft due, the **Introduction and Data Draft**, is expected to contain (at a minimum) the introduction, and a partial Methods section that describes the context and background of the data: where, when, and *how* was the data collected, and also describing any necessary treatments required to further analyze the data.
- 2. The second draft, the **Methods Draft** is expected to build off the former draft, but also describe the analytical approaches the student will apply in the Methods section.
- 3. The third draft due should be a relatively complete **Full Draft**, adding results, discussion and any necessary figures or tables. We will review this and give you feedback.
- 4. The fourth is the **Final Draft**, which will be the basis for your final grade for the term paper.

Each of the three interim drafts **should have** proper in-text citations and formatted references, include a file containing the current data set used for the project, regardless of whether it has been modified since the original data submission.

Project-Associated Papers Several times during the semester, you will be asked to locate peer-reviewed literature related to your research project, and give a very brief introduction of the work to the rest of the class. This will happen at least twice: first, during the first month of the course, you will be asked to locate a peer-reviewed papers (an experimental study, topical review, etc) that is relevant to your current research project ideas, perhaps pertaining to the prior work in this area and/or the importance of future work on this area. The intent is that such a paper might then be a worthwhile source to eventually cite in the introduction section of your final research paper at the end of this class. In the later third of this class, after you have begun to cement an idea of what analytical methods you want to use in your class project, I'll ask for a peer-reviewed study applies a similar methodological approach as what you are applying in your paper (and thus might again be a useful paper to publish in your final draft). Rather than submitting these papers via Canvas, I will ask you just to share a few sentences about this paper, as they may very well be useful to your fellow classmates as well.

**Expected Structure for the Term Paper** The length of your final paper will depends on how much you have to say to build an efficient, compelling investigation of your question. This final paper should be formatted like a scholarly manuscript, covering the methods, and results of their project. A complete paper draft will have the following required sections:

- Abstract (REQUIRED) A concise, one-paragraph summary of your study (e.g. questions, data, methods, results).
- Introduction (REQUIRED) Provide scientific context for your research question and background a reader would need to understand your study system and the importance of answering your research question. State your questions clearly and introduce how you will investigate them.
- Methods (REQUIRED) A complete description of the data and analyses you use, with justifications for why you chose those specific methods. Include references that support your decisions.
- Results (REQUIRED) A report of the results of your analyses, including reporting all necessary statistical values, and necessary supporting figures and tables. Interpretation of results should be minimized.
- **Discussion** (**REQUIRED**) An interpretation of your results in the context of the hypothesis you set out to test with reference to the published results of other workers. Address any analytical challenges,

alternative interpretations, related your findings to the work of others, implications of your results to the field, and suggestions for future work that could improve your ability to answer your research questions.

- Conclusions (OPTIONAL) A concise summary of the "take-home" results, interpretations, and implications of your research. Similar to the abstract, but does not restate the study's setup.
- References (REQUIRED) Choose a consistent journal format. If uncertain which to use, use Paleobiology style, as it the instructor's favorite.
- Data Appendix (REQUIRED) A file or table that contains all data you used for your paper. You must submit a data appendix with the draft of your Introduction and Methods draft, but you should update this appendix as you revise or add to your data over the course.

**Project Presentations** Early in the semester, students will take turns introducing the rest of the class to the data and questions they are planning on addressing in the term project. This presentation does not require slides or graphics (although you can use them if you want), and should be less than 5 minutes in duration.

Later, students will again present to the class their project, covering again the questions motivating the research, the nature of the dataset, and which methods they are planning to apply, or have already applied, to the dataset. Students should particularly focus on any difficulties they've encountered, or confusion they have about which methods to apply. Again, slides or graphics are not necessary, and the presentation should be kept brief, preferably under 5-8 minutes.

In the last week of the course, students will be asked to prepare a more detailed presentation as an endcap to the research project for the semester. Slides, figures and any other graphic aids are recommended. Students are expect to re-introduce the rest of the class to the motivation behind their analyses, the data they used, the methods they applied and why they chose those methods, and what the results can tell us about in the context of the system. (Depending on the class size, time constraints and public health emergencies, the instructor may poll the student on whether live presentations are preferred over recorded presentations.)

For all the above presentations, students in the audience will actively participate by posing questions (for the live presentations), as well as providing written feedback about each other's presentations, which will be passed in an anonymized form to the presenter. Giving peer feedback, particularly on the final presentation, is a component of the Project Presentation grade.

#### Late Work Policy

Late work is discouraged, but will be accepted with a penalty relative to how late the submission is, depending on the assignment and reason given for the late submission. Work submitted late due to an excused absence is not considered late work, and is exempt from the late work policy.

#### Course Schedule

			Lecture Topic	Assignments
Week 1	Tu	Jan 16	SNOW DAY	
	$\operatorname{Th}$	Jan 17	Course Introductions, Research	
			Questions & Multivariate Data	
			Set Structure	
Week 2	Tu	Jan 23	Programming with R in	Install R before Class!
			RStudio	
	$\operatorname{Th}$	Jan 25	Loading Data Sets &	Research Questions
			Manipulating Tables in R	
Week 3	Tu	Jan 30	Data Transformations &	Proposal
			Cleaning Data in R	

			Lecture Topic	Assignments
	Th	Feb 1	Typical Univariate Statistics: Parametric & Non-Parametric Tests	Loading Data
Week 4	Tu	Feb 6	Measuring Correlations & Fitting a Regression	Correlations & Regressions
	$\operatorname{Th}$	Feb 8	Multiple & Logistic Regression in R	Introduction and Data Draft
Week 5	Tu	Feb 13	Model Selection & Step-Wise Methods with Akaike Information Criterion	$Univariate\ HW$
	Th	Feb 15	Yardsticks for Ecology: Diversity, Evenness & Richness	
Week 6	Tu	Feb 20	Community Ecology Metrics in R; Rarefaction and Collector's Curves	Regression & Model Selection HW Due
	$\operatorname{Th}$	Feb 22	Dissimilarity Metrics & Their Uses (ANOSIM, PERMANOVA)	$Dissimilarity\ HW$
Week 7	Tu	Feb 27	Cluster Analyses: Visualizing Dissimilarity	
	$\operatorname{Th}$	Feb 29	Cluster Analyses in R	
Week 8	Tu	Mar 5	Understanding Principal Component Analysis (PCA) for Metric Data	Cluster Analysis HW
	Th	Mar 7	Performing and Interpreting a PCA	Methods Draft
Spring Break	$\mathrm{Tu}$	Mar 12	Spring Break	
	$\operatorname{Th}$	Mar 14	Spring Break	
Week 9	$\mathrm{Tu}$	Mar 19	PCO/MDS & NMDS in R	
	Th	Mar 21	Do an Ordination with your Data in Class	
Week 10	Tu	Mar 26	Detrended Correspondence Analysis (DCA) for Community Ecology in R	PCO ℰ PCO HW
	Th	Mar 28	Direct Gradient Analysis in R (CCA, RDA)	
Week 11	Tu	Apr 2	Term Project Progress Presentations	
	Th	Apr 4	Classification with Ordinations (LDA, CVA, DFA)	DCA & CCA HW
Week 12	Tu	Apr 9	More Classification with Ordinations	Full Draft
	$\operatorname{Th}$	Apr 11	CART: Classification & Regression Tree Analysis	
Week 13	Tu	$\mathrm{Apr}\ 16$	CART & Random Forest in R	$DFA\ HW$
	$\operatorname{Th}$	Apr 18	Troubleshooting Day	$CART\ HW$
Week 14	Tu	Apr $23$	Final Presentations	
	$\operatorname{Th}$	Apr 25	Final Presentations	

#### Optional Course Information Items: Student Resources

- Are You Having an Emergency? A variety of student resources focused on health and safety are available to you as a student at Texas A&M. Student Life provides a number of services, such as free legal services to students on non-university matters, emergency food resources, off campus student services, support for pregnant and parenting students, access to short-term relief pantries and support for former foster and adopted domestic students. Student Counseling and Mental Health, part of University Health Services (UHS) can provide short-term counseling services and help coordinate long-term help at off-campus providers.
- Prolonged Absences Student Assistance Services (SAS) can serve as a liaison for students in critical and/or life-altering situations where students are unable to communicate with their instructors. Student Absence Notifications are intended to serve as a central point of contact for students who need to notify their instructors when an absence is due to an emergency and requires missing class for an extended period of time (more than three class days). See more here. In addition to SAS, students should use the Title IX office as the first point of contact for any incident involving domestic abuse, sexual harassment, or students dealing with issues related to their sexuality, reproductive health or sexual health. Absences related to such issues should be coordinated through the Title IX office. Finally, if absences are related to long-term health issues or disabilities that are registered through Disability Resources, absences or the inability to participate in class should be discussed with the Disability Resources office. Title IX and Disability Resources have the ability to notify your instructors and provide rationale for excused absences when the situation warrants it.
- Tell Somebody! In many of these emergent situations, whether these are cases require prolonged absences or not, it is important to inform the university about situations involving many of the above scenarios, including mental health issues that might fall under SAS/UHS, and can be reported to the university via the Tell Somebody webform.
- Writing Support The University Writing Center (UWC) has trained peer consultants available to work with you on any kind of writing or speaking project, including research papers, lab reports, application essays, or creative writing, and at any stage of your process, whether you're deciding on a topic or reviewing your final draft. You can also get help with public speaking, presentations, and group projects. We can work with you in person at our Evans or BLCC locations or via Zoom or email. To schedule an appointment or to view our handouts, videos, or interactive learning modules, visit writingcenter.tamu.edu. If you have questions, need help making an appointment, or encounter difficulty accessing our services, call 979-458-1455 or email us.
- Technology Support For issues with University technological infrastructure, like the campus wifi or using the Canvas Learning Management System, you should contact TAMU IT Help Desk Central via email, virtual chat, phone, etc.
- Other Commonly Needed Student Resources Additional commonly utilized student services related to Admissions, the Registrar, Financial Aid, Student Business Services, Veteran Services and many others can be contacted via the Aggie One Stop service. Individual services you may need access to may include Scholarships and Financial Aid, Student Billing Services, Employment, Academic Success, Involvement and Engagement, Leadership and Service, Student Housing, and Graduate Student Health Insurance. Links to an even broader list of student resources, many of which are university-wide, can be found on the ECCB program's Student Resources page.

## 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 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 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).

"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).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

#### 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).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

### 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.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit 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):

- 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.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students wishing to discuss concerns related to mental and/or physical health in a confidential setting are encouraged to make an appointment with University Health Services or download the TELUS Health Student Support app for 24/7 access to professional counseling in multiple languages. Walk-in services for urgent, non-emergency needs are available during normal business hours at University Health Services locations; call 979.458.4584 for details.

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.

#### Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through University Health Services. Students needing a listening ear can call the Texas A&M Helpline (979.845.2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends for mental health peer support while classes are in session. The TELUS Health Student Support app provides access to professional counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or 988 lifeline.org.

Students needing a listening ear can contact University Health Services (979.458.4584) or call the Texas A&M Helpline (979.845.2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends while classes are in session. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

### Campus Specific Policies

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Disability Resources office. Title IX and Disability Resources have the ability to notify your instructors and provide rationale for excused absences when the situation warrants it.

- Tell Somebody! In many of these emergent situations, whether these are cases require prolonged absences or not, it is important to inform the university about situations involving many of the above scenarios, including mental health issues that might fall under SAS/UHS, and can be reported to the university via the Tell Somebody webform.
- Writing Support The University Writing Center (UWC) has trained peer consultants available to work with you on any kind of writing or speaking project, including research papers, lab reports, application essays, or creative writing, and at any stage of your process, whether you're deciding on a topic or reviewing your final draft. You can also get help with public speaking, presentations, and group projects. We can work with you in person at our Evans or BLCC locations or via Zoom or email. To schedule an appointment or to view our handouts, videos, or interactive learning modules, visit writingcenter.tamu.edu. If you have questions, need help making an appointment, or encounter difficulty accessing our services, call 979-458-1455 or email us.
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## Campus Policies

### Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items may do so by going to howdy.tamu.edu and clicking on the "Directory Hold Information" link in the Student Records channel on the MyRecord tab. The complete FERPA Notice to Students and the student records policy is available on the Office of the Registrar webpage.

Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in officially recognized activities and sports, medical residence location and medical residence specialization.